

BROUGHTY FERRY FLOOD PROTECTION SCHEME



Flood Protection Scheme, Section 2, Fisher Street, Broughty Ferry

REPORT TO INFORM APPROPRIATE ASSESSMENT

Stannergate-Broughty Ferry Castle
February 2018

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References

- ANNEX A. BTO WeBS Core High Tide WeBS Data, Monifieth
- ANNEX B. BTO WeBS Core High Tide WeBS Data, Stannergate
- ANNEX C. BTO WeBS Low Tide Data, 2012/13
- ANNEX D. Email Report, Dr Ping Dong, January 2018

APPENDED DRAWINGS

516/L01	Works Areas Relative to MHWS and Construction Traffic Access
516/S1/01	Section 1- Plan Proposal Outline
516/S1/02	Section 1- Profiles 20 to 636.22m ~
516/S1/03	Section 1- Outline Construction Sequence
516/S2/01	Section 2- Plan Proposal Outline
516/S2/02	Section 2- Profiles 1-4
516/S2/03	Section 2- Outline Construction Sequence
516/S3/01	Section 3- Plan Proposal Outline
516/S3/02	Section 3- Profiles 15 to 180m
516/S3/03	Section 3- Outline Construction Sequence
516/S4/01	Section 4- Sections For Edge Protection
516/S4/02	Section 4- Profiles 1 to 7
516/S4/03	Section 4- Outline Construction Sequence

1 BACKGROUND

Dundee City Council (DCC) have a statutory duty under the Flood Risk Management (Scotland) Act 2009 with discretionary powers for non-agricultural land under the Flood Prevention Scotland Act 1961. DCC have therefore commissioned pre-construction assessments of the implications of climate change and the threat to local interests. The 2013 Dundee Coastal Study Stage 2 evaluated 12 management units, of which **two** are the subject of this report, see **Figure 1.1**.

- Management Unit 10: Grassy Beach (MU10)
- Management Unit 11: Broughty Ferry (MU11)

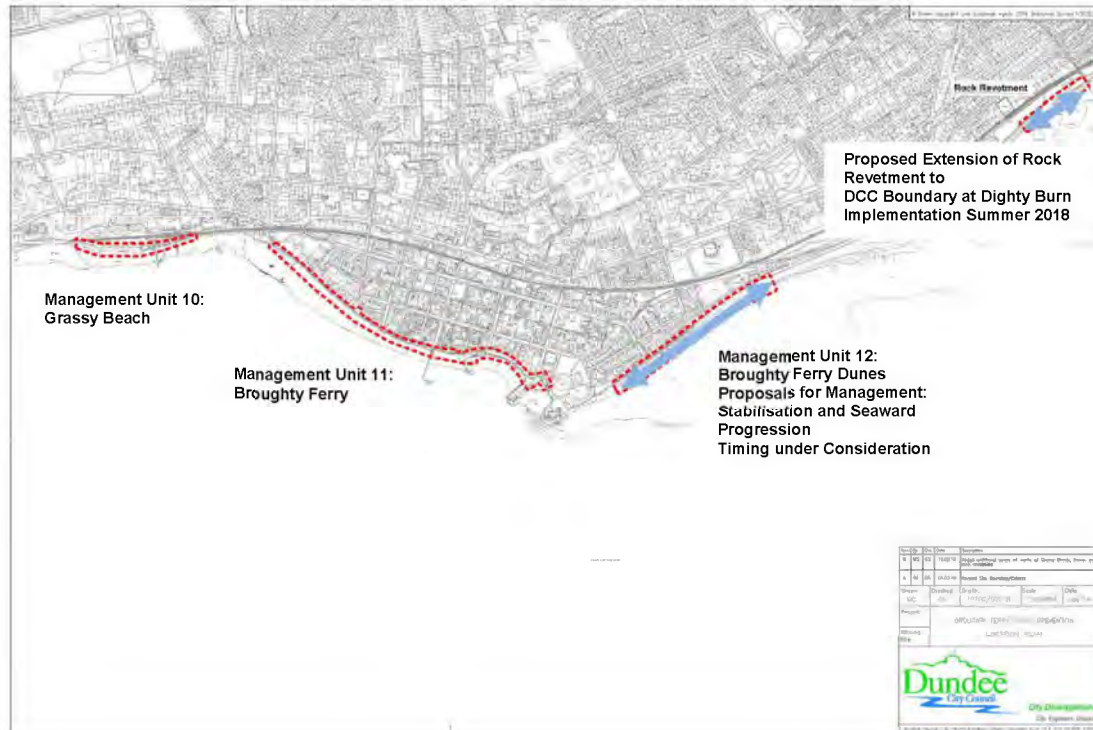


Figure 1.1. Location and extent of proposed Flood Protection Works

Broadly, proposals for Grassy Beach (MU10) are required to protect the public footpath and, in the Broughty Ferry section (MU11), to protect property, the latter requiring construction of a new seawall and walkway with set back flood wall. It was clear to DCC that these proposals would require construction activity below mean high water springs (MHWS) and within the boundary of a European designated site, the Firth of Tay and Eden Estuary SAC. In 2016 after reviewing the Mott MacDonald high level scoping report, and after reviewing the ECOS/MacLeod Consulting HRA Scoping Report in December 2017, Scottish Natural Heritage (SNH) confirmed that proposals will fall within the requirements of the Habitat Regulations and that full assessment would be required to address potentially adverse impacts, see link for details for the HRA process:-

<http://www.snh.gov.uk/planning-and-development/environmental-assessment/habitat-regulations-appraisal/>

The HRA process should firstly establish whether or not the proposal is directly connected with or necessary for site management for nature conservation. If the outcome of the first stage is *no* then a second stage must determine whether or not the proposal is likely to have a significant effect on the site, specifically for any of the qualifying features of the European Site(s). Where such effects *are* identified then a third stage, an appropriate assessment (AA) of the likely significant effects on site integrity, must be undertaken by the Competent Authority, in consultation with Scottish Natural Heritage (SNH). The AA is informed by a Report to Inform Appropriate Assessment (RIAA) and in order to allow permission for development to be granted, the RIAA and therefore AA must conclude, after taking into account mitigation of any adverse effects, there would be no adverse effect on the qualifying features and that the Conservation Objectives of the Site(s) will continue to be met during and after construction.

The aim of this report is to provide the RIAA required by the competent authority to enable an appropriate assessment. References are made to various sections of the Firth of Tay, as defined below.

- Inner Tay - Confluence of the Earn and Tay to Tay Rail Bridge
- Middle Tay – Tay Rail Bridge to Broughty Castle
- Outer Tay – Broughty Castle eastwards

Principal authors are Alasdair MacLeod (Macleod Consulting) and David Bell (ECOS Countryside Services LLP) who respectively have specialist knowledge of local coastal engineering and ecology. Alasdair Macleod through delivery of many projects in the area, including the footprinting for the V&A@Dundee, flood protection works, engineering works at Discovery Quay and wastewater management schemes. David Bell has been involved in WeBS bird counts on the Tay since 1976 and currently counts three key WeBS sectors on the Firth of Tay, namely, Inner Tay, Invergowrie and Broughty Ferry – Barry Buddon (Monifieth). Previously he has covered Tay Bridge-Broughty Ferry (Stannergate), Eden estuary low and core WeBS counts (for six years), St Andrews Bay and is still involved in the WEBS low tide counts on the Eden. Since establishing ECOS in 1987 he has undertaken professional contracts on the Tay which have included a Tay Estuary data collation and review on contract to SNH, estuary wide bird surveys to inform the delineation of the original SPA boundaries, several years of through the tide inter-tidal waterfowl counts on the Inner Tay, one year's open water waterfowl survey on the Inner Tay as well as many smaller EIA contracts targeting specific locations e.g. V&A footprint, Dundee Airport emergency slipway, sand dredging licences.

2 PROJECT OVERVIEW

2.1 Need for the project

The project will see the implementation of measures identified within the 2013 Dundee Coastal Study Stage 2 report which reduce the risk of flood damage to residential and commercial property and infrastructure within the lower lying areas of Broughty Ferry.

2.2 The project

Coastal flood protection works have been reviewed and completed design solutions are now available for four sections within MU10 and MU11, see **Figures 2.1-2.4**.



Figure 2.1. Section 1. Locations of proposed works at Broughty Ferry

2.2.1 Outline proposals Sections 1 and 2

Figure 2.2 outlines the proposal for a new gravity sea wall for Douglas Terrace / James Place and Fisher Street which will require a land claim extending 5-8m beyond the existing road edge to create a new walkway in front of a new set back flood protection wall which is to be constructed close to the road edge. Current design for the new river wall indicates that rock armour toe protection will be adequate but further assessment may require installation of sheet piling to protect against scour. For detail within Section 1 refer to appended Macleod Consulting Drawings **516/S1/01, S1/02 and S1/03** and for Section 2 refer to Drawings **516/S2/01, S2/02 and S3/03**.

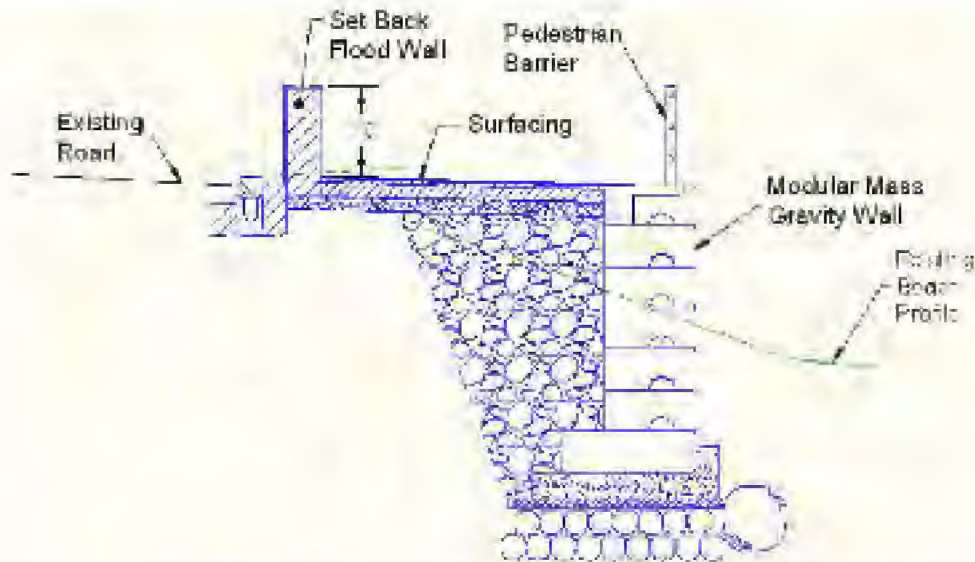


Figure 2.2. Broughty Ferry (MU11), Section 1 Douglas Terrace/James Place and Fisher Street

2.2.2 Outline proposals for Section 3, Beach Crescent

Proposals for Beach Crescent will reconfigure the existing roadway to provide perpendicular parking, a new 1.0m high set back flood wall and 4.0 to 5.0m wide walkway. Access to the beach will be enabled along its entire length by a concrete, stepped slab, the toe of which may have to be piled to prevent undercutting. For detail within Section 3 refer to appended Macleod Consulting Drawings 516/S3/01, S3/02 and S3/03.

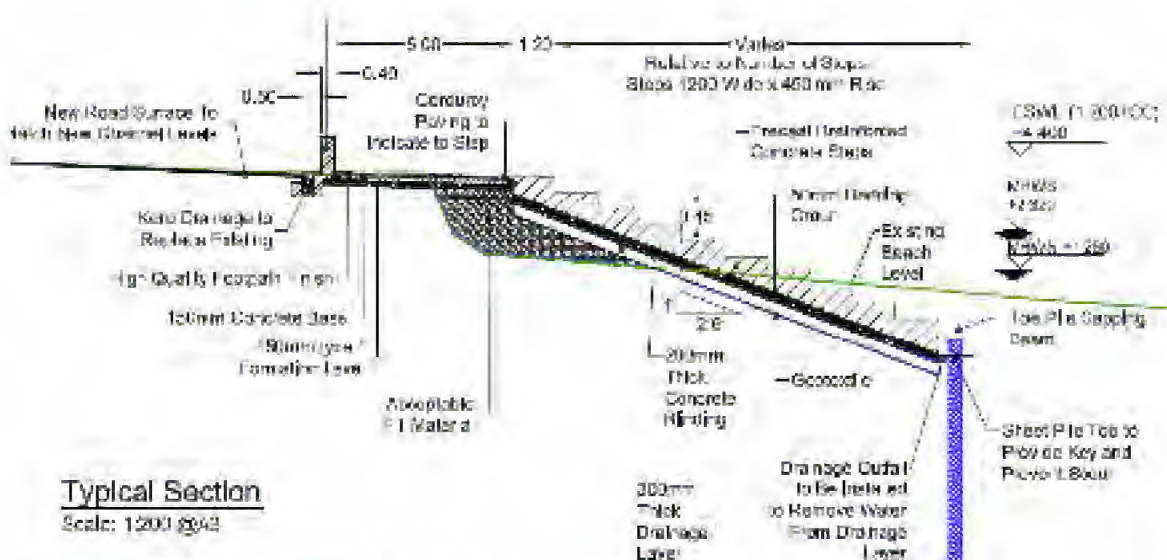


Figure 2.3. Broughty Ferry (MU11), Section 3, Beach Crescent

2.2.3 Outline proposals for Section 4, Grassy Beach

All works along Grassy Beach will be above the MHWS and will have **no** direct impact on European Sites. Works will deliver a gravity wall as close as possible to the existing verge with top-soil reinstatement and reseeded. For detail within Section 4 refer to appended Macleod Consulting Drawings 516/S4/01, S4/02 and S4/03.

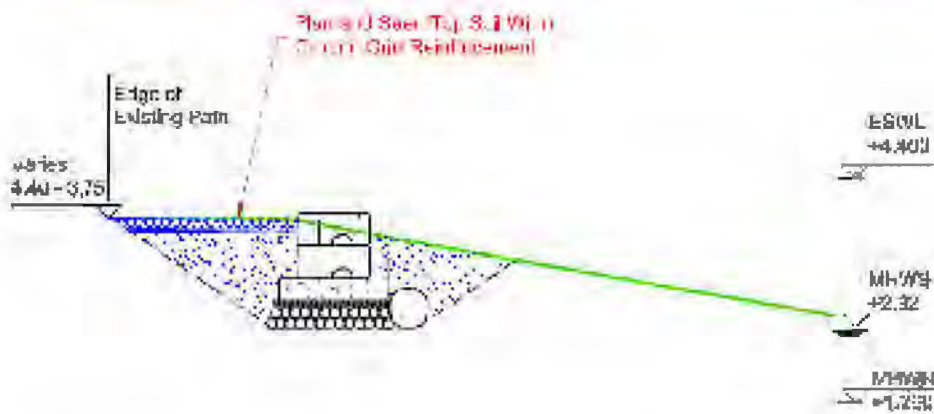


Figure 2.4. Broughty Ferry (MU11), Section 4, Grassy Beach

2.2.4 Anticipated construction methods

DCC have, as part of the development of the proposals, consulted with contractors experienced in the implementation of marine edge protection works. The input obtained has influenced the selection of the final proposals. Likely construction methods for each section have been developed for each of the proposed sections, refer appended Macleod Consulting drawings **516/S1/03**, **516/S2/03**, **516/S3/03** and **516/S4/03**.

These construction methods are constrained by ensuring that access is maintained to adjacent residential and commercial properties and to the tidally influenced Tay. It is therefore anticipated that construction will take place entirely from land at a number of locations of limited length with work progressing towards each other and that within each working area piling or other means of ground support will be required to retain existing soils whilst foundations are placed and sections of the pre cast (PC) gravity wall are built and backfilled.

Construction access to each work section is anticipated to be via the existing public roads. In order to limit traffic movements suitable excavated material would as far as practicable be stored locally including the foreshore and returned as backfill behind or in front of the completed wall as backfill. Where required the management of water levels within excavations will be managed by a combination of tidal working and groundwater pumping with any discharge fully in accordance with SEPA requirements.

Considering that some temporary disturbance of the existing foreshore beyond the footprint of the permanent works is therefore likely, a minimum allowance of 5.0m has been made generally but over the length of foreshore where the Scottish Water sewer is present this may be increased to 25m for better access along the foreshore which may or may not be required.

Any sheet piling that may be required where “box” type ground support cannot be used will be undertaken in the dry when tide level has fallen. Locations where this MAY be required are at the Scottish Water infrastructure buried in the foreshore at Douglas Terrace / James Place or to form a scour toe / restraint to the proposed stepped concrete slab at Beach Crescent. In both locations it is anticipated that the piling required will be of limited depth and can be installed using recognised protocols and techniques for operation in a sensitive urban environment.

In any event the DCC contract documentation will require the appointed contractor to develop a Construction Environmental Management Plan (CEMP) agreed with and approved by the relevant competent authority and incorporating any mitigation measures identified within this RIAA.

2.2.5 Summary of predicted works footprint

Works are likely to result in permanent habitat loss on completion and temporary habitat disturbance during construction. The extent of habitat areas potentially indirectly affected by hydrodynamic effects of the proposals is discussed further separately.

Section 1: Douglas Terrace / James Place

- Along Douglas Terrace and James Place the vertical face of the river wall is close to the toe of the existing inclined dressed masonry slope. There is therefore very little habitat directly and permanently lost within the 755m² that is between MHWS and the vertical face of the new wall.
- The worst case temporary loss assumes that construction plant MAY track along the beach seaward of the existing Scottish Water storm culvert up to 25m from the face of the new wall.

Section 2: Fisher Street

- At Fisher Street only half of the wall length is to be constructed below MHWS with the remainder in the amenity grassed areas above MHWS with very limited permanent loss of foreshore.
- The Scottish Water storm culvert turns inland before Fisher Street. Construction disturbance is therefore anticipated to extend no more than 10m from MHWS.

Section 3: Beach Crescent

- The Beach Crescent section will have a larger permanent land take with areas of beach replaced by stepped concrete PC units extending to approximately 2,520m².
- Additional temporary foreshore disturbance beyond the permanent works is anticipated to be no more than 5m over the 220m long frontage (1,100m²).

Section 4: Grassy Beach

- At Grassy Beach all permanent and temporary works will be undertaken **above** the MHWS.

A summary of the worst case scenarios for permanent and temporary habitat loss is presented below, see **Table 2.1**.

Table 2.1. Habitat impact summary, based on worst case scenario

Section	Habitat Impacted	* Permanent loss below MHWS Worst case scenario	*Temporary loss below MHWS Worst case scenario	Total area impacted below MHWS Worst case scenario	Estimated duration of temporary loss
Section 1 Douglas Ter.	Un-vegetated, mobile shingle sands and gravels	755m ²	14,760 m ²	15,515 m ²	Estimated 12 months
Section 2 Fisher Street	Un-vegetated, mobile shingle sands and gravels	100 m ²	685 m ²	785 m ²	Estimated 12 months
Section 3 Beach Cresc.	Un-vegetated, mobile shingle sands and gravels	2,520 m ²	1,100 m ²	3,620 m ²	Estimated 12 months
Section 4 Grassy Beach	Amenity grassland	None	None	None	Not applicable
TOTAL		3.38 ha	16.54ha	19.92ha	

* Based on Drawing Nos 516/L01; 516/S1/01; 516/S2/01; 516/S3/01; 516/S4/01
Firth of Tay SPA site area = 6918ha
Firth of Tay and Eden Estuary SAC site area = 15414ha
Outer Firth of Forth and St Andrews Bay Complex pSPA site area = 272,068ha

The total permanent loss is approximately 3.38ha, with a further 16.54ha temporarily impacted. The duration of the temporary habitat impact is very short term due to the mobility of the shingle habitat that will be impacted, and that the beach will be quickly restored to a new beach equilibrium.

2.2.6 Timing and duration of works

Current programming for MU10 and MU11 is still tentative but does predict a start date late in 2018, lasting two years, suggesting a completion date in late 2020. DCC advise that the winter months, when peak numbers of qualifying bird features are present, would be the most unattractive period for undertaking works below MHWS. Priority will therefore be given to working below MHWS during the spring and summer months when bird disturbance is less important. In any case DCC advise the following likely sequence of works:

- Within the two-year construction period, all sections could be under construction at the same time.
- The modular pre cast concrete (PC) gravity river wall within Section 1: Douglas Terrace and Section 2: Fisher Street is likely to be constructed in 15-20m lengths with two or three locations within each section being worked on at the same time. Overall the priority will be given to completing the wall as quickly as possible in as favourable tidal and weather conditions as possible, i.e. spring/summer/early autumn.
- Once the gap at the back of wall is filled then works to the rear of the wall can progress flexibly in terms of timing.
- At Beach Crescent the front toe would be constructed over the whole frontage before returning to work up the beach with bed preparation and placement of pre-cast units. The Broughty Ferry beach section is likely to take the longest to construct and would be difficult to interrupt once started and thus may require longer than the spring and summer months to complete.
- No in-water piling at any work face in any section.

3 CONSULTATION

SNH were consulted throughout the early design process, offering advice to Mott MacDonald (MM) whilst completing their Dundee Coastal Study, Stage 2, Habitat Regulations Appraisal – Stage 1 report to DCC.

This Stage 2 report considered **12 options** and their likely potential effects on Natura 2000 sites. SNH in response to MM in February 2012 advised that an “appropriate assessment” would be required under the Habitat Regulations for works that would have “a likely significant effect”. Where adverse effects were identified then detail mitigation should be delivered to avoid these effects.

Following completion of the Dundee Coastal Study Stage 2 Report in 2013 outline proposals have been further developed and continue to be refined in light of information obtained in the course of public engagement early to mid-June 2016 including:

- Delivery of letters to properties directly adjacent to the shoreline;
 - Two public exhibitions (June and December 2016);
 - Public meeting outlining the need and aims of the project;
- Note: The latter anticipated to have over 300 people in attendance.

In November 2017 SNH agreed to review a draft HRA scoping report for MU10 and 11, the Broughty Ferry options, but excluding emerging proposals for beach recharge within MU12 on the dunes to the east of Broughty Castle. SNH responded with detailed comment advising that an appropriate assessment was required due to permanent habitat loss and the appropriate assessment should consider the potential indirect and direct impacts of the proposal against the conservation objectives for each site. SNH advised that the RIAA should seek to quantify the impacts in addition to that already included in the Scoping Report. **Table 3.1** below summarises the SNH advice and subsequent actions which DCC have undertaken to consider the effects of proposals as set out in this report.

Table 3.1. Summary of SNH advice, 4th December 2017

European site	Feature highlighted by SNH as likely to be adversely impacted	SNH advice 4 th December 2017	Issues requiring consideration	DCC Response to SNH Advice
Firth of Tay and Eden Estuary SAC	Estuaries; Inter-tidal mudflats and sandflats, sub-tidal sandbanks	There will be temporary disturbance and a permanent loss of estuaries and inter-tidal mudflat and sandflat habitat for which the site is designated	<ol style="list-style-type: none"> 1. Quantification of direct losses 2. Indirect local changes to coastal hydrodynamics, sediment transport and sediment distribution. 3. Indirect impacts of these local changes on inter-tidal mudflats and sandflats and sub-tidal sandbanks. 4. Assessment of the above as a likely significant potential effect in terms of habitat extent, habitat quality/composition and functionality 	Review by Professor Ping Dong, University of Liverpool
	Harbour seal	Providing there is no “in-water” works producing	None, unless construction methods change to include	None required, as no “in-water”

European site	Feature highlighted by SNH as likely to be adversely impacted	SNH advice 4 th December 2017	Issues requiring consideration	DCC Response to SNH Advice
		noise then SNH agree that the proposal is unlikely to have a significant environmental effect	"in-water" construction activity	construction activity is proposed
Firth of Tay and Eden Estuary SPA	Ornithological qualifying features	Assessment must be widened to include the Broughty Ferry to Buddon Ness WeBS Core Count data and the potential for SPA birds to be disturbed	Use of the works areas by SPA birds to assess direct and indirect impact significance and duration Assess potential disturbance impacts in terms of source duration and bird receptors	ECOS assessment as presented in Section 7.0 of the following report
Outer Firth of Forth and St Andrews Bay complex proposed SPA (pSPA)	Ornithological qualifying features	This pSPA is further away from the proposed development and, providing it can be proved that there is no adverse impact on the integrity of the Firth of Tay and Eden Estuary SPA, then it should be able to come to the same conclusion for the pSPA	Species and numbers of birds using the area in relation to directly and indirectly impacted habitats	ECOS assessment as presented in Section 7.0 of the following report
Moray Firth SAC	All qualifying features	SNH agree that the proposal is unlikely to have a significant environmental effect	None, unless construction methods change to include "in-water" construction activity.	None required as no "in-water" construction activity is proposed
Isle of May SAC	All qualifying features	SNH agree that the proposal is unlikely to have a significant environmental effect	None, unless construction methods change to include "in-water" construction activity	None required as no "in-water" construction activity is proposed

4 BASELINE DATA

4.1 Nature conservation sites

Details of the seven relevant European nature conservation designations potentially impacted by the scheme are provided in the following sub-sections and tables.

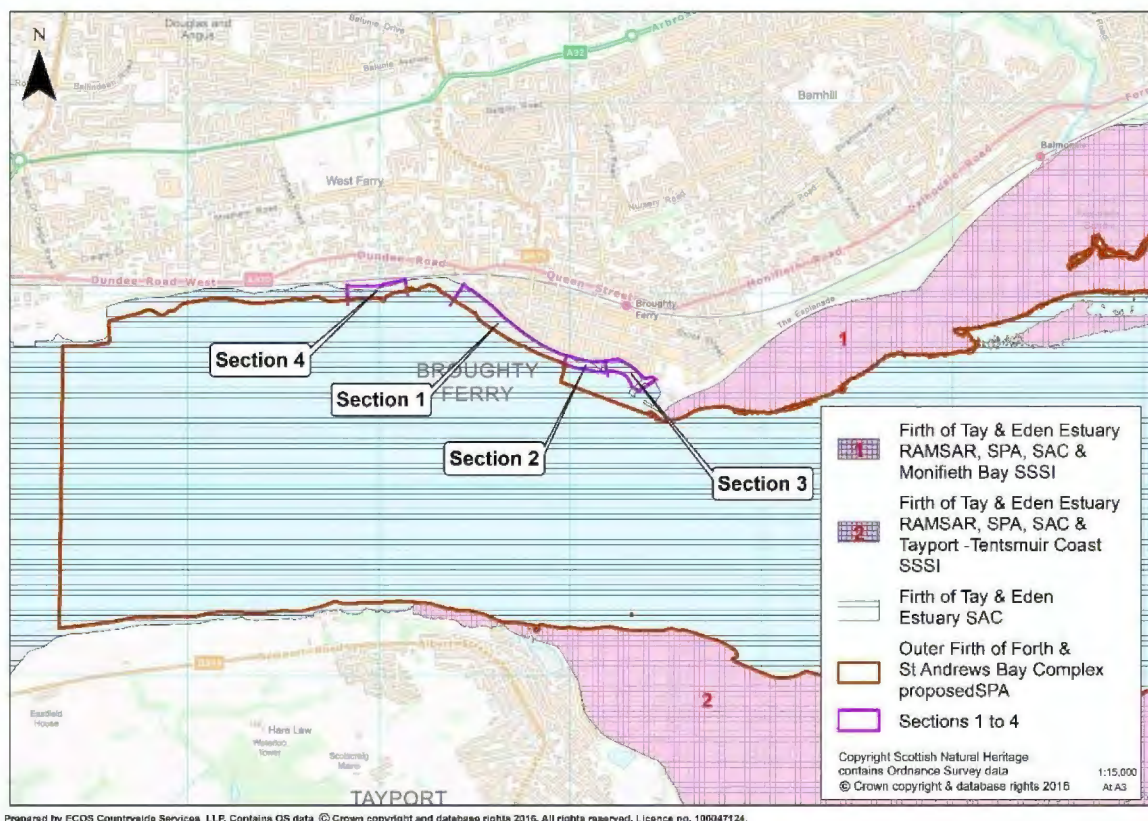


Figure 4.1. Location and extent of European sites in relation to works in MU10 and MU11

4.1.1 Name of Natura Sites potentially affected by proposals

- Firth of Tay and Eden Estuary Special Area of Conservation (SAC)¹
- River Tay SAC¹
- Moray Firth SAC¹
- Isle of May SAC¹
- Firth of Tay and Eden Estuary Special Protection Area (SPA)²
- Firth of Tay and Eden Estuary Ramsar Site³
- Outer Firth of Forth and St Andrews Bay Complex pSPA²

¹ EC Habitats Directive (92/43/EEC)

² EC Directive on the Conservation of Wild Birds (2009/147/EC)

³ Ramsar Convention Internationally Important Wetlands, Iran 1971

4.1.2 Natura Site qualifying interest(s) summary

(a) Firth of Tay and Eden Estuary SAC

There are three habitat features and one species covered by this designation, see Table 4.1.

Table 4.1. Qualifying SAC features

Scientific name	Common name
Estuaries	Estuaries
Mudflats and sandflats not covered by seawater at low tide	Intertidal mudflats and sandflats
Sandflats which are slightly covered by sea water all the time	Sub-tidal sandbanks
<i>Phoca vitulina</i>	Harbour seal

(b) River Tay SAC

One qualifying habitat and five qualifying species.

- Clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels
- Atlantic salmon (*Salmo salar*)
- Brook lamprey (*Lampetra planeri*)
- River lamprey (*Lampetra fluviatilis*)
- Sea lamprey (*Petromyzon marinus*)
- Otter (*Lutra lutra*)

(c) Moray Firth SAC

One habitat qualifying feature and one qualifying species.

- Sub-tidal sandbanks
- Bottle-nose dolphin (*Tursiops truncatus*)

(d) Isle of May SAC

One qualifying habitat and one qualifying species

- Reefs
- Grey Seal (*Halichoerus grypus*)

(e) Firth of Tay and Eden Estuary SPA

Six species qualifying as important in their own right with a further 14 species contributing to the overall waterfowl assemblage qualifying criterion, see **Table 4.2**.

Table 4.2. Qualifying SPA features

Article	Qualifying species															
Article 4.1	Marsh harrier, Little tern, Bar-tailed godwit															
Article 4.2	Redshank, pink-footed goose and greylag goose															
Article 4.2	<p>Waterfowl assemblage The waterfowl assemblage regularly supports 20,000+ wintering waterfowl.</p> <p>Named species which make up an important component of the waterfowl assemblage:</p> <table border="0"> <tr> <td>Shelduck</td> <td>Velvet scoter</td> <td>Cormorant</td> </tr> <tr> <td>Common scoter</td> <td>Eider</td> <td>Long-tailed duck</td> </tr> <tr> <td>Goosander</td> <td>Oystercatcher</td> <td>Goldeneye</td> </tr> <tr> <td>Grey plover</td> <td>Dunlin</td> <td>Red-breasted merganser</td> </tr> <tr> <td>Black-tailed godwit</td> <td></td> <td>Sanderling</td> </tr> </table>	Shelduck	Velvet scoter	Cormorant	Common scoter	Eider	Long-tailed duck	Goosander	Oystercatcher	Goldeneye	Grey plover	Dunlin	Red-breasted merganser	Black-tailed godwit		Sanderling
Shelduck	Velvet scoter	Cormorant														
Common scoter	Eider	Long-tailed duck														
Goosander	Oystercatcher	Goldeneye														
Grey plover	Dunlin	Red-breasted merganser														
Black-tailed godwit		Sanderling														

(f) Firth of Tay and Eden Estuary Ramsar

Under two Ramsar qualifying criteria there are four species, and the overall un-named assemblage, see **Table 4.3**. The four individually qualifying species are common to both SPA and Ramsar.

Table 4.3. Qualifying Ramsar features

Criterion	Description
3a	Regularly supports in winter over 20,000 waterfowl with a 1990/91-94/95 winter peak mean of 48,000 waterfowl, comprising 28,000 wildfowl and 20,000 waders.
3c	Regularly supports internationally important wintering populations of pink-footed goose <i>Anser brachyrhynchus</i> , greylag goose <i>A. anser</i> , bar-tailed godwit <i>Limosa lapponica</i> and redshank <i>Tringa totanus</i> .

(g) Outer Firth of Forth and St Andrews Bay Complex

This new proposed SPA lists 23 species of seabird, nine breeding and 14 non-breeding, see **Table 4.4**.

Table 4.4. Qualifying pSPA features

	Qualifying species
Breeding	Arctic tern; common tern; gannet; guillemot; herring gull; kittiwake; Manx shearwater; puffin; shag
Non-breeding	Black-headed gull, common gull; common scoter; eider; goldeneye; guillemot; herring gull; kittiwake; little gull; long-tailed duck; razorbill; red-breasted merganser; red-throated diver; shag

4.1.3 Conservation objectives for qualifying interests and their Site Condition

The conservation objectives of both SPA and SAC are the same, each differing in qualifying habitat and/or species. Qualifying features of each site is assessed for its condition against fixed criteria. Site condition monitoring (SCM) is the duty of SNH and the summaries below include the latest statement of condition. Whilst SAC habitats remain in a favourable maintained condition, a total of seven qualifying SPA/SAC species features are in an unfavourable condition, with a further two in favourable declining condition.

(i) Firth of Tay and Eden Estuary SAC – Habitats and Species

To avoid deterioration of the qualifying habitats (listed below) thus ensuring the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying features; and
To ensure for the qualifying habitats that the following are maintained in the long term:

- **Extent of the habitat on site**
- **Distribution of the habitat within site**
- **Structure and function of the habitat**
- **Processes supporting the habitat**
- **Distribution of typical species of the habitat**
- **Viability of typical species as components of the habitat**
- **No significant disturbance of typical species of the habitat**

Qualifying Habitats & Condition

- Estuaries - not assessed
- Intertidal mudflats and sandflats - favourable maintained, 31/12/2002
- Subtidal sandbanks – favourable maintained, 04/07/2002

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and

To ensure for the qualifying species that the following are maintained in the long term:

- **Population of the species as a viable component of the site**
- **Distribution of the species within site**
- **Distribution and extent of habitats supporting the species**
- **Structure, function and supporting processes of habitats supporting the species**
- **No significant disturbance of the species**

Qualifying Species & Condition

- Common seal – Unfavourable declining, 22/08/2013

(ii) River Tay SAC – Habitats and Species

To avoid deterioration of the qualifying habitats (listed below) thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and

To ensure for the qualifying habitats that the following are maintained in the long term:

- **Extent of the habitat on site**
- **Distribution of the habitat within site**
- **Structure and function of the habitat**
- **Processes supporting the habitat**
- **Distribution of typical species of the habitat**
- **Viability of typical species as components of the habitat**
- **No significant disturbance of typical species of the habitat**

Qualifying Habitats & Condition

- Clearwater lakes - favourable maintained, 12/08/2009

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and

To ensure for the qualifying species that the following are maintained in the long term:

- **Population of the species as a viable component of the site**
- **Distribution of the species within site**
- **Distribution and extent of habitats supporting the species**
- **Structure, function and supporting processes of habitats supporting the species**
- **No significant disturbance of the species**

Qualifying Species & Condition

- Atlantic salmon – Favourable maintained 19/09/2011
- Brook lamprey – Favourable maintained 30/11/2007
- River lamprey – favourable maintained 30/11/2007
- Sea lamprey – Favourable maintained 30/11/2007
- Otter – favourable maintained 03/09/2012

(iii) Isle of May SAC – Habitats and Species

To avoid deterioration of the qualifying habitats (listed below) thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and

To ensure for the qualifying habitats that the following are maintained in the long term:

- **Extent of the habitat on site**
- **Distribution of the habitat within site**
- **Structure and function of the habitat**
- **Processes supporting the habitat**
- **Distribution of typical species of the habitat**
- **Viability of typical species as components of the habitat**
- **No significant disturbance of typical species of the habitat**

Qualifying Habitats & Condition

- Reefs – Favourable maintained 24/11/2014

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and

To ensure for the qualifying species that the following are maintained in the long term:

- **Population of the species as a viable component of the site**
- **Distribution of the species within site**
- **Distribution and extent of habitats supporting the species**
- **Structure, function and supporting processes of habitats supporting the species**
- **No significant disturbance of the species**

Qualifying Species & Condition

- Grey seal – Favourable maintained 05/09/2007

(iv) Moray Firth SAC – Habitats and Species

To avoid deterioration of the qualifying habitats (listed below) thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and

To ensure for the qualifying habitats that the following are maintained in the long term:

- **Extent of the habitat on site**
- **Distribution of the habitat within site**
- **Structure and function of the habitat**
- **Processes supporting the habitat**
- **Distribution of typical species of the habitat**
- **Viability of typical species as components of the habitat**
- **No significant disturbance of typical species of the habitat**

Qualifying Habitats & Condition

- Subtidal sandbanks – favourable maintained, 12/08/2004

To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features; and

To ensure for the qualifying species that the following are maintained in the long term:

- **Population of the species as a viable component of the site**
- **Distribution of the species within site**
- **Distribution and extent of habitats supporting the species**
- **Structure, function and supporting processes of habitats supporting the species**
- **No significant disturbance of the species**

Qualifying Species & Condition

- Bottle-nose dolphin – Favourable recovered 21/09/2010

(v) Firth of Tay and Eden Estuary SPA

<p>To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and To ensure for the qualifying species that the following are maintained in the long term:</p> <ul style="list-style-type: none"> • Population of the species as a viable component of the site • Distribution of the species within site • Distribution and extent of habitats supporting the species • Structure, function and supporting processes of habitats supporting the species • No significant disturbance of the species
<p>Qualifying species & condition</p> <ul style="list-style-type: none"> • Bar-tailed godwit (<i>Limosa lapponica</i>) - favourable maintained, 28/02/2001 • Black-tailed godwit (<i>Limosa limosa islandica</i>)* - favourable maintained, 01/06/2011 • Common scoter (<i>Melanitta nigra</i>)* - unfavourable, no change, 21/03/2008 • Cormorant (<i>Phalacrocorax carbo</i>)* - favourable maintained, 28/02/2001 • Dunlin (<i>Calidris alpina alpina</i>)* - unfavourable, no change, 28/02/2001 • Eider (<i>Somateria mollissima</i>)* - unfavourable no change, 28/02/2001 • Goldeneye (<i>Bucephala clangula</i>)* - favourable maintained, 31/03/2008 • Goosander (<i>Mergus merganser</i>)* - favourable maintained, 28/02/2001 • Grey plover (<i>Pluvialis squatarola</i>)* - favourable maintained, 31/03/2008 • Greylag goose (<i>Anser anser</i>) – favourable declining, 31/03/2008 • Little tern (<i>Sterna albifrons</i>) - unfavourable, no change, 28.02/2001 • Long-tailed duck (<i>Clangula hyemalis</i>)* - unfavourable declining, 31/03/2008 • Marsh harrier (<i>Circus aeruginosus</i>) - favourable maintained, 01/09/2009 • Oystercatcher (<i>Haematopus ostralegus</i>) - favourable recovered, 31/03/2008 • Pink-footed goose (<i>Anser brachyrhynchus</i>) - favourable recovered, 28/10/2015 • Red-breasted merganser (<i>Mergus serrator</i>)* - unfavourable, no change, 28/02/2001 • Redshank (<i>Tringa totanus</i>) - favourable maintained, 28/02/2001 • Sanderling (<i>Calidris alba</i>)* - favourable recovered, 31/03/2008 • Shelduck (<i>Tadorna tadorna</i>) – favourable maintained, 31/03/2008 • Velvet scoter (<i>Melanitta fusca</i>)* - favourable. Maintained, 01/06/2011 • Waterfowl assemblage - favourable maintained, 01/06/2011 <p>* Indicates waterfowl assemblage only</p>

(vi) Firth of Tay and Eden Estuary Ramsar Site

The Ramsar site was most recently designated on 02/02/2000 and has a boundary that is contiguous with the SPA and SAC. The qualifying species listed below in **Table 4.5** are also qualifying species for the SPA, however assessments are 16 years out of date and do not reflect current status or condition. Redshank and bar-tailed godwit had declined dramatically from peaks in the 1990s. Elkins (2014) suggested a drop, of almost two thirds, in birds counted at high tide, in both species since 1996/97 and this observation is equally applicable to the SPA.

Table 4.5. Ramsar qualifying species list and condition

Feature	Condition	Assessment Date
Pink-footed goose (<i>Anser brachyrhynchus</i>), non-breeding	Favourable recovered	31/03/2008
Greylag goose (<i>Anser anser</i>), non-breeding	Favourable declining	31/03/2008
Bar-tailed godwit (<i>Limosa lapponica</i>), non-breeding	Favourable maintained	28/02/2001
Redshank (<i>Tringa totanus</i>), non-breeding	Favourable maintained	28/02/2001
Waterfowl assemblage, non-breeding	Favourable maintained	28/02/2001

4.2 Ecology and nature conservation

4.2.1 Site characterisation

The Firth of Tay and Eden Estuary SPA and SAC are contiguous in terms of bird and seal usage and have a total area of 6,918ha and 15,441ha respectively. These areas are relatively small in comparison to the Firth of Forth and St Andrews Bay Complex pSPA, which may cover 272,068ha if/when declared. The Middle Tay is highly

urbanised on the north shore and there are no natural habitat transitions due to land claim, port and harbour facilities and hard engineered coastal protection. The absence of significant semi-natural habitat above MHWS, and a very narrow inter-tidal habitat, limits potential bird interest and for this reason the Middle Tay was not included in the SPA, although it lies within the pSPA consultation boundary.

SAC qualifying harbour seal interest makes use of sub-tidal habitat for feeding and inter-tidal sandbanks between the bridges and off Broughty Ferry-Monifieth for hauling out to pup and moult and for these reasons the SAC does cover the Middle Tay.

Immediately to the west of Broughty Ferry is the Port of Dundee, operated by Forth Ports plc, reached by the main channel that follows the southern shoreline. The Port is kept open by dredging with arisings dumped offshore at a licensed site. In the east of Broughty Ferry there is a pier for mooring the local lifeboat and a small harbour. Water sports are popular with very active yacht and sailing clubs, jet-ski club and open water swimming club. Sea angling is a common sight at the harbour and occasionally off Grassy Beach. Further public interest includes the footpath from Stannergate to Douglas Terrace which continues by various types of path and the foreshore to Barry Buddon Firing Ranges. It is a route that is also popular with cycling commuters and recreational cyclists and more recently commercial dog walkers.

4.2.2 Geology, Geomorphology and hydrology

The estuary lies over Precambrian metamorphic and igneous rock and has formed in a downfaulted graben. Today's estuary overlies two former estuaries in-filled 8,500-5,500 years ago with material accumulation of 10-15m. Flandrian gravels are exposed in the area of proposed works. (Armstrong 1985; Buller et. al. 1971).

The Tay has an average flow rate of 198m³ s⁻¹ from its combined River Earn catchment of nearly 6,000km² (Bell 1996). Al-Mansi (1990) confirmed movements of sand into the estuary along the Monifieth beach towards Broughty Ferry, progressing as far as the Kingoodie mudflats. Recent studies (Duck 2010) proved provenance of sands as 3% River Earn, 17% River Tay, 29% Angus coast and 51% Fife coast. Buller (1975) showed that a mass of suspended material migrated up and down the estuary with the tides and was augmented by inner Tay mudflats of the north shore, with maxima on ebb phase neap and flood phase spring tides. (Dobereiner & McManus (1983).

4.2.3 Hydrodynamic processes

Duck (2010) appraised the hydrodynamic and sediment transport characteristics of the River Tay for the V&A@Dundee project. Sediments receive significant contributions from the Inner Tay mudflats, especially in combination with particular winds. Wind speed and direction are key factors, with strong SE winds and low tides combining to create wave induced erosion of the surface of the mudflats. The Tay is therefore a highly dynamic system with significant weather and flow (waves and currents) induced sediment transport. Dr Ping Dong, Professor of Coastal Engineering University of Liverpool (formerly at University of Dundee till April 2017), was therefore commissioned by DCC to review, as requested by SNH, the potential effects of the flood protection proposals on coastal hydrodynamics, sediment transport and sediment distribution which could affect the lower intertidal and subtidal regions of the SAC and SPA and associated features.

Professor Dong has extensively assessed coastal processes on the Firth of Tay and in undertaking the assessment of the potential hydrodynamic effects arising from the proposed changes to the shoreline boundary conditions at Douglas Terrace-Fisher Street and Beach Crescent, including temporary construction impacts, was able to draw on all of the available literature in relation to coastal processes in the vicinity of the works. A copy of the assessment undertaken by Professor Dong is included within **Annex D**, with a summary noted below.

(a) Douglas Terrace-Fisher Street, Sections 1 and 2

Changing the shoreline will not result in any net loss of beach material but modelling (Mott Macdonald 2017) has indicated that under **extreme** water and wave conditions local lowering of the beach profile will be induced within 10-20m of the wall and a slight berm formed close to MLWS. Foreshore trial holes undertaken by DCC show no appreciable variation in particle size or distribution with depth or distance from the existing river edge, see images below.



The modelling of the potential beach scour has shown the profile change affected by the scour is limited in extent with the volume of sediments involved being very small compared with the normal amount of sediments in suspension in the estuary, especially during seasonal storms. Under 'normal' conditions scour zones are therefore likely to infill creating new equilibrium profiles relative to the pre-works profiles with similar if re distributed material. Whilst the beach profile change is likely to be rapid, during extreme events it is anticipated that a new equilibrium profile will form within weeks.

During operation there will be a small permanent loss of habitat, see **Table 1**, and due to the replacement of the existing inclined edge with the vertical wall there will be a very slight decrease in the tidal prism which will make no appreciable change to tidal flow field or sediment transport patterns. The total longshore drift is anticipated to remain unchanged and any longshore transport is likely to be local to the shoreline, and far-field processes, 40-50m from the wall, are unlikely to be affected.

The distribution of the sediments within the tidal profile may therefore be changed by the proposals but in terms of sediment type significant change is unlikely. It is therefore considered reasonable to conclude that the current intertidal and subtidal habitats are likely to remain although there may be changes in their distribution.

(b) Beach Crescent, Section 3

The beach on this section will be replaced by stepped concrete and the extent of any change to existing conditions will be even smaller than that described for Sections 1 and 2.

(c) Grassy Beach, Section 4

The works at Grassy Beach are all above MHWS with no anticipated effect on existing conditions.

4.2.4 Baseline data – habitats

(a) Terrestrial resource

Between Stannergate and Douglas Terrace the footpath intermittently holds marginal vegetation, typically a semi-improved neutral grassland (Phase 1 Habitat Code B2.2). An enriching feature of the B2.2 is the presence of coastal grassland species, encouraged by sea spray and salt laden air, and these include *Lathyrus vulneraria*, *Echium vulgare* and *Centaurea scabiosa*.



Image 1. Western end of the Grassy Beach Walk

Around the yacht club, which is the centre of the MU10 Grassy Beach (Section 4), see Images 2 and 3, the habitat present is mown amenity grassland (Phase 1 Habitat Code J1.2) forming a transition on the seaward side of the footpath to narrow strandline at the head of a steep unvegetated shingle bank. Transition is dominated by *Elymus repens* with *Rumex crispus*, *Tripleurospermum inodorum*, *Atriplex hastata*, *Atriplex patula*, and *Atriplex glabruscula*, all associates of the NVC SD2 *Cakile maritima-Honkenya peploides* strandline plant community. The latter is a common widespread community on the East Coast of Scotland, but at this location shows poor conformity with key species absence. *Lymus arenarius* was an occasional.



Image 2. Transition at the Royal Tay Yacht Club in Section 4.



Image 3. Tripleurospermum and Atriplex on the strandline at the Yacht Club

A similar transition from amenity grassland to vegetated shingle is also present at Fisher Street and Beach Crescent.

(b) Estuarine resource

Detailed surveys of the marine fauna have been limited and pre-date the Tay Wastewater project which was implemented in 2001 and dramatically reduced sewerage input and will have significantly changed avian prey abundance. The most complete survey was Kayrallah and Jones (1975) with local surveys in the Inner Tay by Bentley (1998) and MES (Oakwood (1999). SNH commissioned a broad scale habitat survey (Bates 2004) whilst Jacobs (2009) surveyed the locality of the V&A to inform EIA and HRA. Species diversity decreases with distance upstream as far as the limit of salinity at Mugdrum Island, the Middle Tay supporting half the number of taxa as the Outer Tay. Substrate type is a key factor and the mobility of the shingles at Broughty Ferry further impoverishes the infauna in proximity to MU10 and MU11.

Bates study (ROAME No F01AA401D) audited the biotopes of the Middle Tay identifying five listed in **Table 4.6**. It is likely that the sub-littoral fauna at Broughty Ferry will be like the SNH broad-scale mapping.

Table 4.6. Middle Tay Biotopes

Biotope	Characteristics
IMX MyrtV	Mussel beds
LGSAp	Gravelly sand with polychaete worm bivalve community including <i>Cerastoderma</i>
IGS MobRS	Impoverished mobile clean sand, with few crustacean and typical fish e.g. goby, flounder, smelt
Mixed oligochaetes with FvesX	Inter-tidal seaweed with oligochaete worms and other fucoid bed associates
LMU HedMac	Muddy sand with polychaete and <i>Macoma</i>

David Bell (ECOS) surveyed inter-tidal habitat on the western Stannergate section of MU10, for Forth Ports plc on 10th April 2012. The key features of this section are described below:-

- A wastewater outfall cased in concrete and protected on both sides by rock armour.
- An upper succession halted by a sea wall that variously comprised gabion baskets, demolition waste, reinforced concrete waste, a concrete vertical wall and a concrete wall with stone upper section, all with or without protective rock armour.
- A steep mobile shingle shore in front of the sea wall.
- A eulittoral zone scattered with debris from tipping e.g. brick, concrete.
- A eulittoral zone with scattered natural cobbles and rock, embedded in silt or muddy silt.
- Fucoids were frequent on cobble and rocks throughout. *Fucus vesiculosus*, *F. serratus* and *Ascophyllum nodosum* were most frequent on mid and lower shore. Upper shore held *F. canaliculata* and *F. spiralis* at sea walls.
- Freshwater inflows originating behind the sea wall encouraged locally high frequencies of green *Enteromorpha* algae.



Image 4. Loose shingle and cobbles with fucoids.

There was little or no supra-littoral fauna or flora and only a tiny strandline extending a few metres on detritus in the NW corner where the port land claim projects from Grassy Beach foreshore. *Atriplex* species were frequent and *Rumex crispus* was rare; this would broadly concur with a highly impoverished NVC SD2 *Honkenya peploides*-*Cackile maritima* plant community. The dominant life forms in the eulittoral were frequent brown algal shrubs and a very sparse infauna burrowing in patches of loose sediment, as characterised by very small local populations of *Arenicola*, see Image 5.

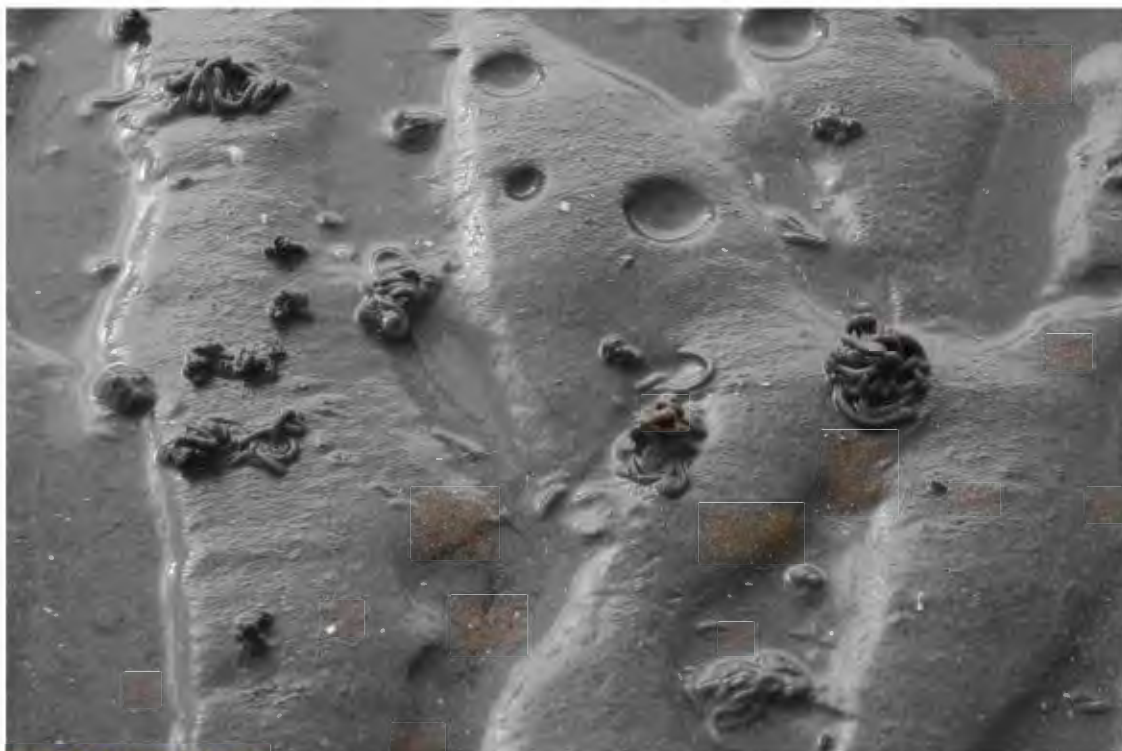


Image 5. *Arenicola* beds

Table 4.7 summarises the inter-tidal biotope complexes as present at Stannergate.

Table 4.7. Inter-tidal biotopes recorded by ECOS, April 2012

Biotope Complex	Biotope
LGS.Sh	LGS.BarSh Barren shingle and gravel
MLR.BF	MLR. Fser.F Frequent <i>Fucus serratus</i> on lower moderately exposed and scattered rocks and cobbles
	MLR.FvesB Barnacles and <i>Patella spp</i> and abundant <i>Fucus vesiculosus</i> (with <i>F.serratus</i> and <i>Ascophyllum nodosum</i>) on exposed rock armour at the sewerage pipe
MLR.Eph	MLR,Ent <i>Enteromorpha spp.</i> on freshwater influenced embedded rock, debris and cobbles in the upper eulittoral
SLR.F	Dense fucoids, <i>F. vesiculosus</i> , on mid-eulittoral rock, debris and cobbles
LMS.MS	LMS.MacAre Impoverished and sparse <i>Arenicola marina</i> beds occupying muddy sand in mosaics with the brown algae attached to rocks and cobbles

An ECOS inter-tidal walkover survey on 12th October 2017 confirmed a similar range of intertidal habitat along Douglas Terrace, Fisher Street and at Beach Crescent. Bare silty mud was a local feature along Douglas Terrace, whilst the very poorly vegetated loose shingle dominated at Fisher Street and Beach Crescent, see Images 6-8. A feature of all sections was the presence of mobile shingle substrate on the upper shore. This held no vegetation and permanent fauna were likely to be absent, and it is within this impoverished zone that the proposed flood protection land claim would take place.



Image 6. Douglas Terrace



Image 7. Fisher Street



Image 8. Beach Crescent

The inter-tidal habitats along Douglas Terrace and Fisher Street were highly disturbed during the laying of the 1metre diameter Tay Wastewater pipe in 2001. Existing baseline is man-made, as recovered from the works shown on Images 9 and 10.



Image 9. Douglas Terrace, Broughty Ferry



Image 10. Fisher Street, Broughty Ferry

(c) Baseline data – birds

(a) British Trust for Ornithology (BTO) Wetland Bird Surveys (WeBS) data

On the north shore of the Middle and Outer Tay there are only two large core WSBs Core Count sectors, 87411 Stannergate and 87413 Monifieth, see **Figure 4.2**. Monifieth is a priority count sector whilst the Stannergate is not, due to low bird interest, and therefore not regularly counted.

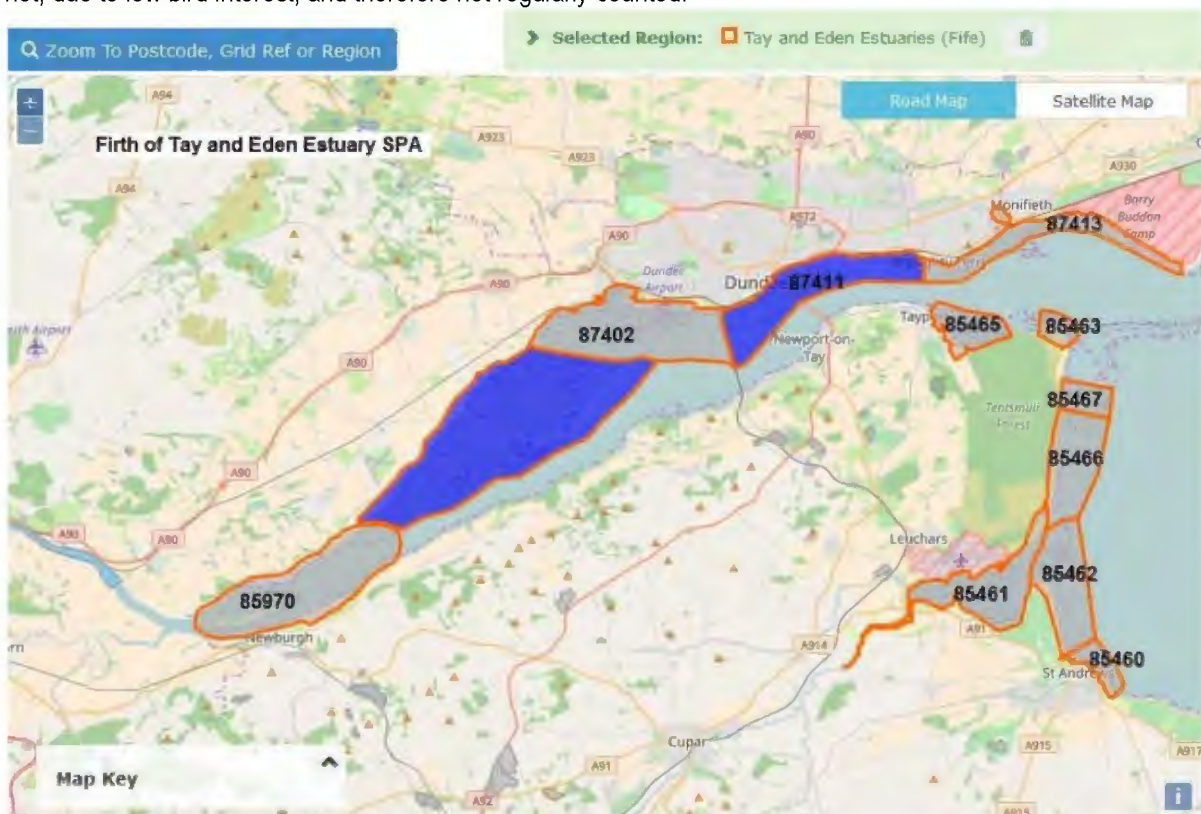


Figure 4.2 From BTO WeBS

(i) Core counts - high tide roost count data, Sector 87411 Stannergate

WeBS high tide core counts sector 87411 covers the coast from the Tay Rail Bridge to the projected line of Westfield Road on Douglas Terrace. Being a low priority WeBS sector, the sector is not often covered and over the last five years has only been counted over one winter season, 2013-14, see Annex A. Numbers of birds roosting onshore or resting/feeding offshore in this sector are very low with a peak total of 42 birds of eight species recorded in 2013-14. Species recorded, with peak counts in parenthesis, were mute swan (2), eider (6), cormorant (7), oystercatcher (8), turnstone (4), black-headed gull (12), herring gull (20) and great black-backed gull (1).

(ii) Core counts - high tide roost count data, Sector 87413, Westfield Road to Buddon Ness (Monifieth)

Monifieth is a key area for roosting waterfowl species on the Tay, primarily due to limited public access at the Army Firing Ranges at Barry Buddon Ness, which means that the roosts are less frequently disturbed than other roost sites in the Tay/Eden complex.

The latest WeBS five-year data summary, for 2010/11-2014/15, is provided in Annex B and shows total counts are highest in winter lying in the range 1,882-3,321 birds with up to 29 species, including gulls and terns, recorded at roost. Key species are curlew, redshank, turnstone and sandwich tern, of which only sandwich tern reach international qualifying thresholds on passage, whilst bar-tailed godwit and sanderling reach national qualifying thresholds, see **Table 4.8**.

Table 4.8. Summary of 5yr and 15yr mean peak counts, in relation to national and international qualifying thresholds

SPECIES	Autumn peak of National Threshold	Winter peak of National Threshold	Spring peak of National Threshold	Annual peak of National Threshold	Autumn peak of International Threshold	Winter peak of International Threshold	Spring peak of International Threshold	Annual peak of International Threshold	Aut 5yr mean of peaks	Win 5yr mean of peaks	Spr 5yr mean of peaks	Ann 5yr mean of peaks
Mute Swan	14%	5%	5%	14%	33%	11%	11%	33%	105	36	36	105
Shelduck	N/A	N/A	0%	0%	N/A	N/A	0%	0%			2	1
Wigeon	2%	1%	1%	2%	0%	0%	0%	1%	68	57	25	94
Gadwall	N/A	0%	N/A	0%	N/A	0%	N/A	0%		1		1
Mallard	1%	1%	0%	1%	0%	0%	0%	0%	50	80	28	85
Eider	38%	9%	36%	43%	2%	0%	2%	2%	207	48	200	236
Goldeneye	N/A	1%	N/A	1%	N/A	0%	N/A	0%		1		1
Red-breasted Merganser	N/A	1%	1%	1%	N/A	0%	0%	0%		1	1	1
Goosander	54%	1%	8%	56%	2%	0%	0%	2%	65	1	10	67
Cormorant	0%	1%	N/A	1%	0%	0%	N/A	0%	1	2		2
Grey Heron	0%	0%	0%	0%	0%	0%	0%	0%	1	1	1	2
Moorhen	N/A	N/A	0%	0%	N/A	N/A	0%	0%			1	0
Oyster-catcher	6%	16%	8%	18%	2%	6%	3%	7%	177	524	250	570
Ringed Plover	50%	25%	N/A	36%	23%	12%	N/A	17%	170	85		122
Golden Plover	2%	N/A	N/A	2%	1%	N/A	N/A	1%	75			75
Grey Plover	1%	4%	0%	5%	0%	1%	0%	1%	5	17	1	20
Knot	3%	6%	N/A	6%	2%	4%	N/A	4%	88	182		184
Sanderling	46%	84%	27%	111%	6%	11%	4%	15%	73	134	43	178
Dunlin	0%	12%	0%	12%	0%	3%	0%	3%	13	416	1	416
Bar-tailed Godwit	218%	182%	26%	234%	69%	58%	8%	74%	827	690	100	888
Curlew	1%	3%	0%	4%	0%	0%	0%	1%	8	41	2	55
Redshank	15%	13%	12%	17%	7%	7%	6%	9%	179	159	140	204
Turnstone	23%	14%	10%	21%	8%	5%	4%	7%	110	68	50	103
Black-headed Gull	0%	0%	N/A	0%	0%	0%	N/A	1%	80	17		103
Lesser Black-backed Gull	0%	N/A	N/A	0%	0%	N/A	N/A	0%	3			3
Herring Gull	4%	0%	0%	4%	3%	0%	0%	3%	267	6	18	278
Great Black-backed Gull	N/A	0%	0%	0%	N/A	0%	0%	0%		3	2	3
Sandwich Tern	*200%	N/A	N/A	*200%	6%	N/A	N/A	6%	100			100

(iii) Roost and sub-roost locations, Sectors 87411 and 87413, Stannergate and Monifieth

Roosting behaviour is determined by human disturbance, which is significant along the Stannergate where there is a busy walkway and cycleway within metres of the edge of the estuary and the beach between Broughty Ferry Castle and the entrance to Buddon Ranges. There are three main roosts within the two core count sectors, one

at the Balmossie sewage outfall and two on Buddon Ness, see **Figure 4.3**. The two further sub-roosts are present at the lifeboat pier on Douglas Terrace and on the outer breakwater of Broughty Harbour (clearly tolerant of disturbance and likely to remain so during construction works which although nearby are not directly affecting the roost). The esplanade beach is totally dependent on lack of disturbance and roosting is quite rare during normal daylight hours. **Figure 4.3** is based on the combined site-specific high and low count knowledge gained by Bruce Lynch and David Bell over 30 years and shows that the main roosts lie outwith the proposed flood protection works, the nearest being 2.5km to the east at Balmossie. The two Buddon roosts are 5km east and absorb birds disturbed from the three other north shore roosts, as well as the frequently disturbed Tentsmuir Point high tide roost on the south shore.

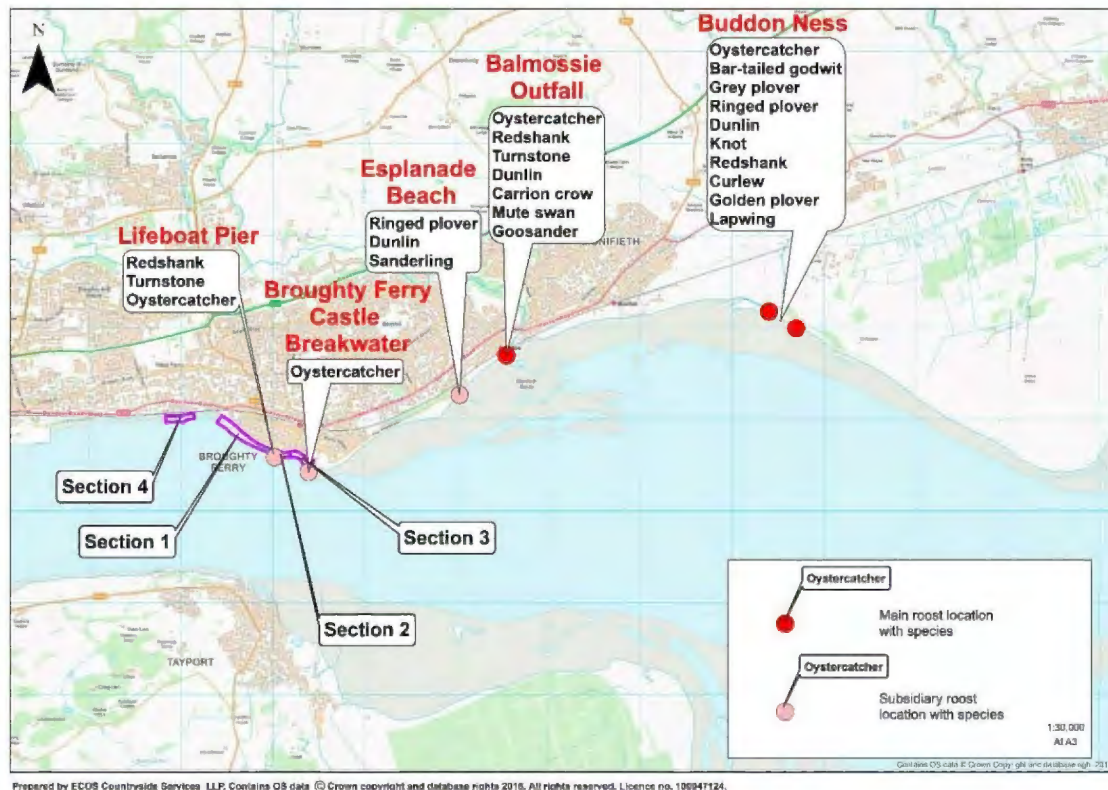


Figure 4.3. High tide roost summary WeBS core Sectors 87411 and 87413, Stannergate and Monifieth

(b) Stannergate and Broughty Ferry Harbour WeBS low tide count data

WeBS low tide counts were last completed November-February 2012-13 when the relevant mudflats BT095, BT096, BT097, BT098 were counted monthly, November-February, see **Figure 4.4** for mudflat count sector locations and their position in relation to sections of the scheme.

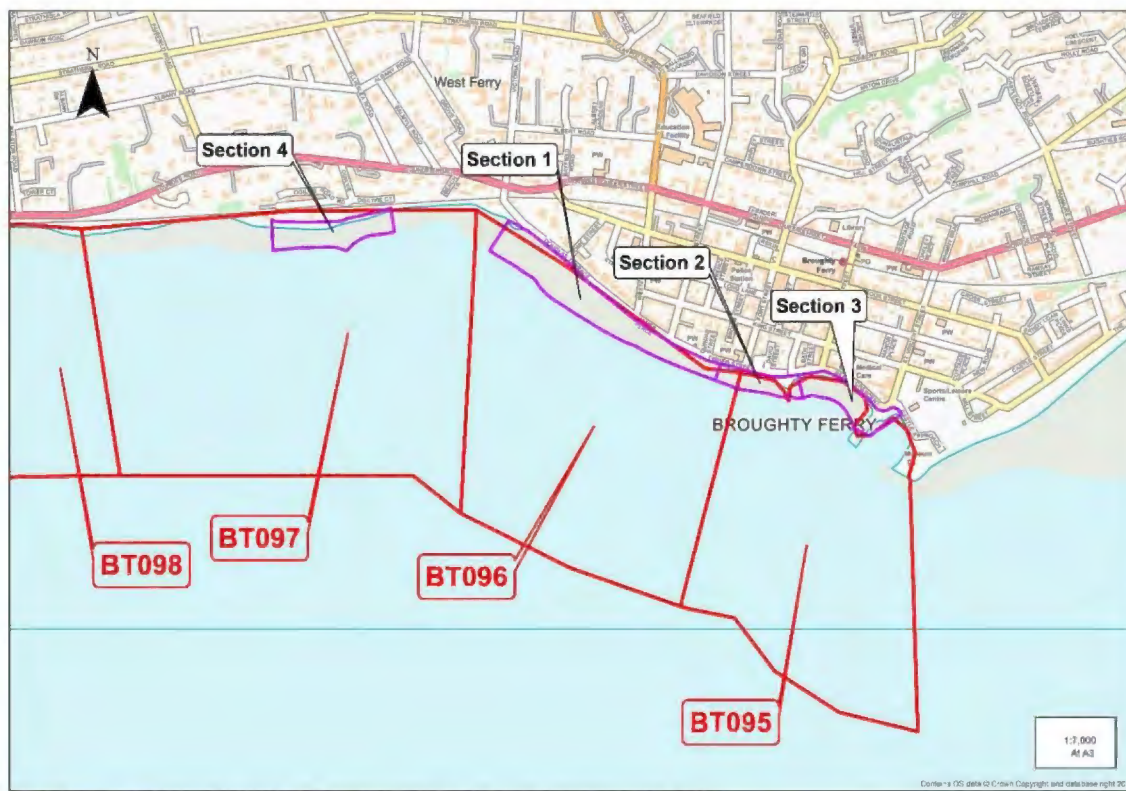


Figure 4.4. WeBS low count sectors, relative to proposed flood protection works

Table 4.8 summarises the extent of the mudflats counted at low tide. Inter-tidal areas are between 3 and 8ha and in total are only 22ha of the inter-tidal mudflat present in these four WeBS sectors and only 9ha of the 22ha are in proximity to the proposed below MHWS works sections (BT095 and BT096). This is an extremely small area by comparison with the total 6,947.2ha of inter-tidal area within the SPA.

Table 4.8. Habitat character of surveyed mudflats

Floodwater Protection Works Sector	Mudflat Sector Code See Fig. 4.4	Inter-tidal Area (ha)	Sub-tidal Area (ha)	Non-tidal Area (ha)	Total Area (ha)
Section 2. Fisher Street and Section 3. Beach Crescent	BT095	3	31	0	34
Section 2. Fisher Street	BT096	6	34	0	40
Section 4. Grassy Beach	BT097	5	49	0	54
Adjacent section (not directly affected by works)	BT098	8	57	0	65
Total area (ha)		22	171	0	193

The total inter-tidal area counted at low tide was 193ha with full details of species peaks and density in Annex B, and a summary in Tables 4.9 and 4.10. Note that BT098 lies to the west of any proposed works and will not be directly impacted, whilst only a small part of Section 4 Grassy Beach (BT097) will be affected and this mudflat holds the lowest total number of birds.

Table 4.9. WeBS low tide count summary, peak winter count 2012/13

Species	Mudflat			
	BT095	BT096	BT097	BT098
Mute swan	7	3	0	0
Mallard	6	0	0	1
Eider	19	22	2	0
Goldeneye	0	0	1	0
Common scoter	0	15	0	0
Red-breasted merganser	10	2	10	33
Slavonian grebe	1	0	0	0
Cormorant	3	1	1	1
Grey heron	2	1	0	1
Oystercatcher	19	18	23	6
lapwing	0	0	0	2
Curlew	2	4	2	1
Redshank	3	10	3	5
Turnstone	5	17	2	0
Black-headed gull	37	20	23	74
Common gull	4	5	1	9
Lesser black-backed gull	1	0	0	0
Herring gull	43	6	4	6
Great black-backed gull	1	0	0	0
Peak total wildfowl, cormorants and herons	48	44	14	36
Peak total waders	29	49	30	14
Peak total gull	86	31	27	89
Peak total	163	124	71	139

Table 4.10. WeBS Low tide summary, peak and mean densities (birds/hectare), 2012/13

Species	Mudflat								Whole of Tay Mean
	BT095		BT096		BT097		BT098		
	Peak	Mean	Peak	Mean	Peak	Mean	Peak	Mean	
Mute swan	0.24	0.16	0.09	0.02	0	0	0	0	0.03
Mallard	0.18	0.07	0	0	0	0	0.02	0	0.06
Eider	0.61	0.23	0.65	0.26	0.04	0.01	0	0	4.13
Goldeneye	0.03	0	0	0	0.02	0.01	0	0	0.02
Common scoter	0	0	0.44	0.11	0	0	0	0	0.20
Red-breasted merganser	0.32	0.25	0.06	0.04	0.20	0.14	0.58	0.26	0.02
Slavonian grebe	0	0.01	0	0	0	0	0	0	0.00
Cormorant	0.09	0.03	0.03	0.01	0.02	0.00	0.02	0.01	0.01
Grey heron	0.067	0.42	0.17	0.04	0	0	0.13	0.06	0.01
Oystercatcher	6.33	1.92	3.00	1.67	4.60	3.10	0.75	0.34	0.43

Species	Mudflat								Whole of Tay
	BT095		BT096		BT097		BT098		
	Peak	Mean	Peak	Mean	Peak	Mean	Peak	Mean	
Lapwing	0	0	0	0	0	0	0.25	0.06	0.10
Curlew	0.67	0.58	0.67	0.33	0.40	0.20	0.13	0.03	0.11
Redshank	1.00	0.58	1.67	0.67	0.60	0.50	0.63	0.19	0.15
Turnstone	1.67	0.42	2.83	1.04	0.40	0.10	0	0	0.07
Black-headed gull	1.09	0.74	0.50	0.29	0.43	0.23	1.14	0.50	0.08
Common gull	0.12	0.08	0.13	0.08	0.02	0.01	0.14	0.07	0.07
Lesser black-backed gull	0.03	0.01	0	0	0	0	0	0	0.00
Herring gull	1.26	0.59	0.15	0.12	0.07	0.06	0.09	0.05	0.04
Great black-backed gull	0.03	0.01	0	0	0	0	0	0	0.00

The following observations are based on the tables above.

- Intertidal habitat is very limited in extent between Stannergate and Broughty Ferry harbour, only 22ha in total, only 0.39% of the SPA total of approximately 6947ha.
- Peak high tide counts of SPA and pSPA qualifying species are low, rarely exceeding 20 birds of any species. This confirms the absence of a main roost and any significant open water assemblage in proximity to the proposed works.
- Low tide counts of the four mudflats potentially affected by the proposed scheme confirm higher peak and mean densities than for the whole of the Tay for gulls, oystercatcher, curlew, redshank and turnstone.
- Offshore Red-breasted merganser prefer BT095 and BT097.

(ii) Forth Ports Data, MU10 and MU11, Stannergate to Broughty Ferry Harbour

For the whole sector from Stannergate to Broughty Ferry harbour, through the tide counts were undertaken by ECOS weekly from October 2010 to March 2011, hourly counts recording numbers of birds throughout the tidal cycle. **Tables 4.11 and 4.12** summarise the results for two points in the tidal cycle, low and high tide.

Roosting bird counts, **Table 4.11**, were higher than those recorded at low tide, although involving similar species. The pier at the lifeboat station was the preferred roost, used by low numbers of oystercatcher, redshank and turnstone. Occasionally when high tide coincided with low levels of human disturbance, there was an oystercatcher sub-roost on Broughty Harbour south east breakwater and rarely, on the slips at the yacht club. The peak count of turnstone in March 2011 were birds feeding at high tide on seaweed mounded against the port bund at the Stannergate, which is outwith the proposed working areas.

Table 4.11. ECOS High tide summary, October 2010-March 2011

Species	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Oct-Mar Peak(Month)
Mute Swan	45	54	127	54	53	57	127 (Dec)
Tufted Duck	0	0	13	0	0	0	13 (Dec)
Eider	0	0	0	8	11	14	14 (Mar)
Mallard	9	0	30	20	32	6	32 (Feb)
Goldeneye	0	0	1	6	6	0	6 (Jan & Feb)
Red-Br. Merganser	1	3	1	2	11	0	11 (Feb)
Oystercatcher	7	0	19	116	23	0	116 (Jan)
Ringed Plover	0	0	2	0	0	0	2 (Dec)
Golden Plover	0	0	3	0	0	0	3 (Dec)
Lapwing	0	0	1	0	0	0	1 (Dec)
Curlew	0	0	2	2	2	0	2 (Dec, Jan & Feb)
Redshank	0	3	8	10	0	15	15 (Mar)
Turnstone	4	8	5	0	12	43	43 (Mar)
Cormorant	3	1	0	0	1	0	3 (Oct)
Heron	0	0	1	0	0	0	1 (Dec)
Peak total	69	69	213	218	151	135	389

In comparison bird numbers at low tide were similar to BTO data with a slightly higher figure for oystercatcher. The swans were feeding on dumped grain at the lifeboat station, which was regularly topped up by swan enthusiasts during these counts, artificially increasing the number of mute swans recorded, with a peak of 121 birds. This swan feed station is no longer maintained.

Table 4.12. ECOS Low tide summary, October 2010-March 2011

Species	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Oct-Mar Peak
Mute Swan	93	43	121	78	54	44	121 (Dec)
Eider	0	0	14	1	5	3	14 (Dec)
Mallard	0	0	48	0	2	8	48 (Dec)
Goldeneye	0	0	1	1	0	0	1 (Dec & Jan)
Red-Br. Merganser	11	3	7	14	17	0	17 (Feb)
Oystercatcher	24	31	54	21	64	21	64 (Feb)
Ringed Plover	0	0	4	0	0	0	4 (Dec)
Golden Plover	0	9	5	0	0	0	9 (Nov)
Lapwing	0	0	2	0	0	0	2 (Dec)
Dunlin	0	0	1	0	0	0	1 (Dec)
Curlew	4	7	7	4	4	6	7 (Nov & Dec)
Redshank	6	13	13	18	28	4	28 (Feb)
Turnstone	22	0	7	2	8	4	22 (Oct)
Cormorant	11	3	1	0	1	0	11 (Oct)
Heron	6	1	2	1	1	0	6 (Oct)
Guillemot	1	0	0	0	0	0	1 (Oct)
Peak Total	178	110	287	140	184	90	356

4.3 Seals

The Firth of Tay is noted for its population of grey and harbour seal, which are monitored by the Scottish Mammal Research Unit (SMRU), based at St Andrews University. Callan Duck (SMRU) provided the summary reproduced below as **Figure 4**.

The Figure includes a histogram summarising the steep decline in numbers of harbour seals since 1996 and the locations of main haulouts for grey seals (blue) and harbour seals (red). On this basis there are no significant aggregations of any seal species on the north shore of Tay at Broughty Ferry and the vulnerable harbour seal, at least in 2016, was only recorded from the vicinity of the Tay rail bridge and on inner estuary mudflats below Newburgh.

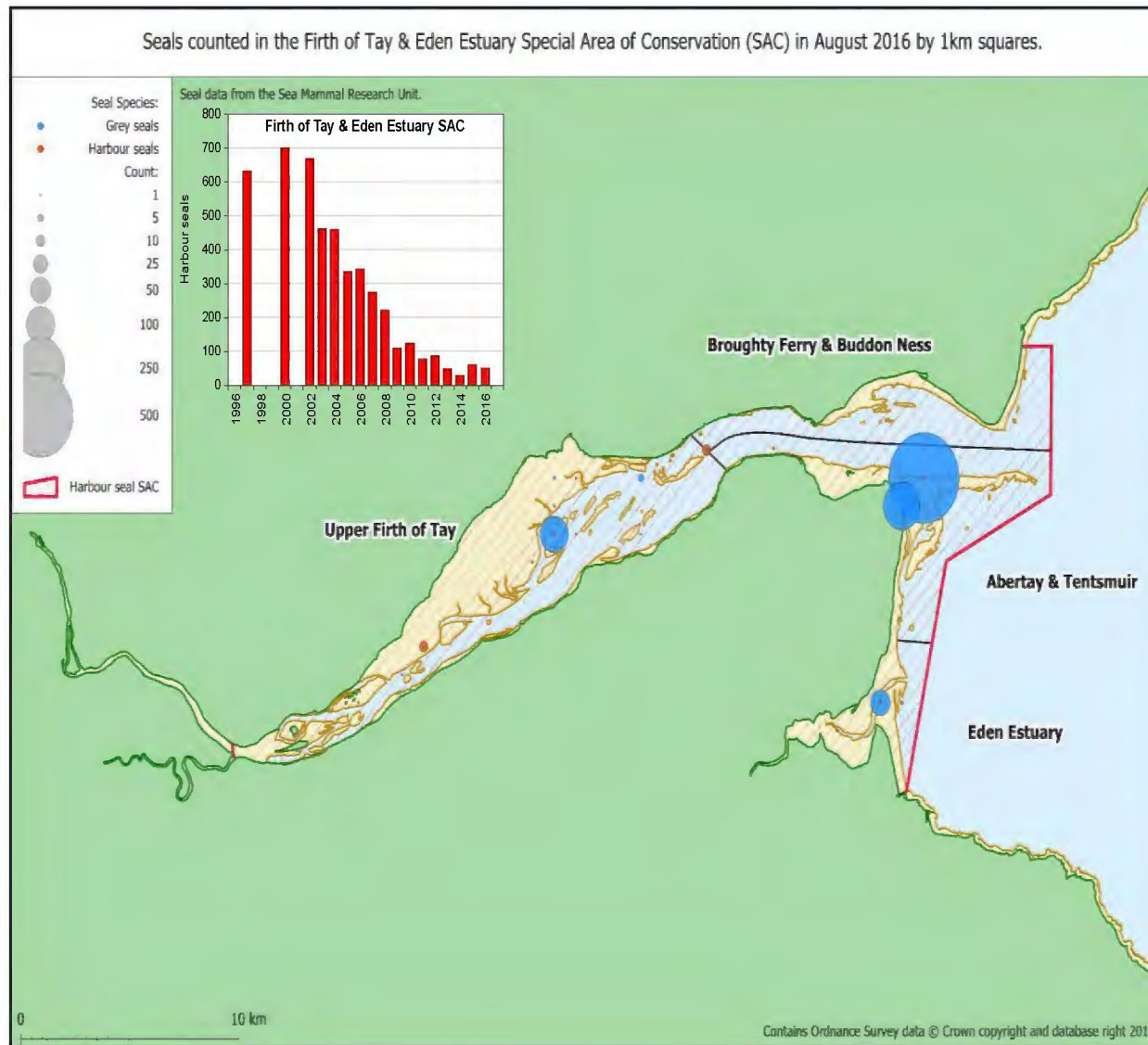


Figure 4.5. Tay Seal summary for 2016, provided by Callan Duck (SMRU)

4.4 Cetaceans

DCC commissioned a data collation from Seawatch, and this was completed by Kathy James (Seawatch) and Professor Peter Evans, Bangor University in September 2017. This report provided an analysis of all the Firth of Tay coastal cell cetacean data held by the Seawatch Foundation data for the periods 1980-2010 and 2011-2017. Fourteen species have been recorded since 1980, four of which are regularly recorded - bottlenose dolphin and harbour porpoise in coastal inshore water and white-beaked dolphin and minke whale offshore, remaining species being casuals or vagrants.

Bottlenose dolphin are the most numerous, and the only species to frequent the outer Tay, see **Figure 4.6**. Animals are present in summer months peaking between May and August, when 20-40 individuals would be normal, 60 exceptional, when penetration would be limited to the Tay rail bridge. Most, if not all, visiting dolphins belong to the Moray Firth population and their use is seasonal, summer only, and recent as a result of the range expansion of this population since the mid-1990s.

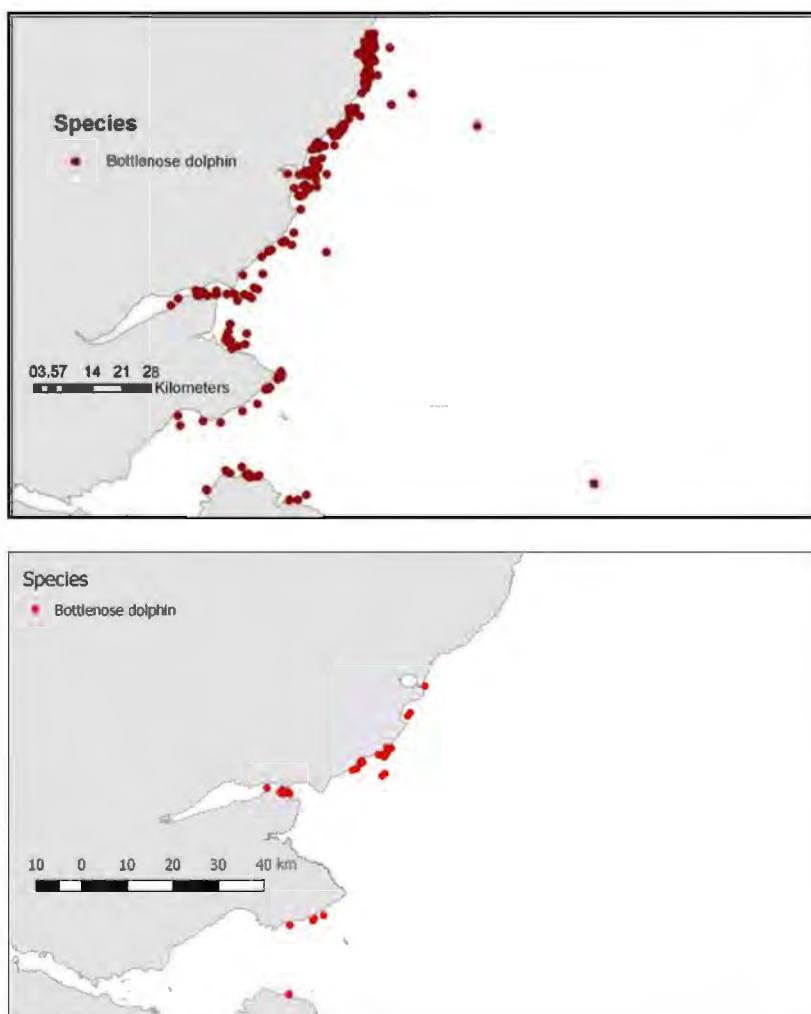


Figure 4.6. Distribution of sightings of bottlenose dolphin (top: 1980-2010; bottom: 2011-17), from Evan and James

Since 2010, common porpoise has been less frequently recorded south of Montrose and records in the Tay area were uncommon when compared to the period 1980-2010. Peak sightings in south-east Scotland usually occur between July and August. Two further species that regularly occur are white-beaked dolphin and minke whale; both are much more likely to be encountered offshore in summer than winter and normally within the range 10-30km from the outer Tay.

5 CONSIDERATION OF PROPOSED DEVELOPMENT IN RELATION TO THE CONSERVATION (NATURAL HABITATS, &C.) REGULATIONS 1994 AS AMENDED, REGULATION 48

5.1 Are the proposals related to conservation management of the Natura Site(s)?

The proposals are **not** directly connected with, or necessary, to conservation management of the Site.

5.2 Is the proposal likely to have a significant effect on the Natura Site(s)?

As the project is not in any way connected to conservation management of designated sites then the potential effects must be scoped to determine whether or not there is a likely significant adverse effect; if so, an appropriate assessment is required.

5.2.1 Scoping of effects

The following initial scoping exercise is intended to identify and remove those sites and their qualifying features which would clearly not be affected by the development and the conclusions below concur with SNH advice, provided in December 2017.

5.2.1.1 Sites removed from scoping

1. **River Tay SAC** qualifying features are: clearwater lakes or lochs with aquatic vegetation and poor to moderate nutrient levels; Atlantic salmon; brook lamprey; river lamprey, sea lamprey; and otter. The lakes and lochs habitat feature will not be affected by the scheme; however fish and otter features could be potentially affected, with the exception of brook lamprey, which are resident in the upper reaches of the Tay river catchment.

Atlantic salmon, river and sea lamprey migrate up the Tay but will not be adversely affected. There will be no change to existing underwater noise levels, because no “in-water” piling is proposed and this will be stipulated in Contractors’ Documents. There will be no new physical impedances in the outer Tay and no loss of inter-tidal or sub-tidal habitat use by any of the fish species for spawning or early development; therefore there is no predicted effect on the three migratory fish species. Otter are present on the outer Tay but uncommonly reported with records from the Port of Dundee (D. Bell per obs). Otter status in Scotland is very favourable and given their tolerance of human activity there will be no adverse effect on this feature.

There will therefore be no adverse effect on the River Tay SAC requiring any further assessment.

2. **Moray Firth SAC** qualifying features are: sub-tidal sandbanks and bottle nose dolphins. Sand banks located in the Moray Firth will not be affected by the Broughty Ferry Flood Protection Scheme. Bottlenose dolphins which are members of the Moray Firth group do visit the outer Tay in summer and can be regularly seen off Broughty Ferry from May-September, (Evans (2017)). No intrusive works e.g. piling will take place below tide level where noise transmission would be an issue. Neither construction nor operation will result in any increase in underwater noise levels and therefore there will be no adverse effects on dolphin communication and activity. No “in-water” piling is proposed and this will be stipulated in Contractors’ Documents.

There will therefore be no adverse effect on the Moray Firth SAC requiring any further assessment.

3. **Isle of May SAC** features are reefs and grey seals and neither will be affected by development. The reefs are remote from the development and grey seals do not any use of the Broughty Ferry area of coastline for breeding. A few can be seen offshore feeding, but these will not be affected for the reasons stated for bottle-nose dolphin. No “in-water” piling is proposed and this will be stipulated in Contractors’ Documents.

There will therefore be no adverse effect on the Isle of May SAC requiring any further assessment.

4. As the **Firth of Tay and Eden Estuary Ramsar Site** interests are the same as the **Firth of Tay and Eden Estuary SPA** the assessment for the SPA, see below, will include an assessment of all of the qualifying features within the Ramsar site and therefore it is not necessary to assess the **Firth of Tay and Eden Estuary Ramsar Site** separately.

For each of the three remaining Natura Sites (Firth of Tay and Eden Estuary SAC, Firth of Tay and Eden Estuary SPA and Outer Firth of Forth and St Andrews Bay Complex pSPA) **Table 5.1** below lists each of the qualifying features. The table also seeks to assess if there is a likelihood of a potentially significant adverse effect on the feature as a consequence of implementing the proposals and presents a brief “Reason” for arriving at the conclusion.

Table 5.1. Scoping matrix

Natura Site Name	Qualifying Feature	Potentially Significant effect?	Reasons
Firth of Tay and Eden Estuary SAC	Estuaries	Yes	There will be net loss of 3.38ha ha, with a temporary impact over a further 16.54ha, a total impact area of 19.92ha. This SAC qualifying habitat is likely to be significantly adversely affected by the scheme.
	Intertidal mud and sandflats	Yes	As above This SAC qualifying habitat is likely to be significantly adversely affected by the scheme.
	Sub-tidal sandbanks	Yes	None in proximity to the development therefore no likely direct effect. Although proposed permanent structures are very local and habitat loss small in scale these changes are likely to have an adverse impact on sedimentary processes creating and maintaining this feature. This SAC qualifying habitat is likely to be significantly adversely affected by the scheme.
	Harbour seal (<i>Phoca vitulina</i>)	No	SMRU data confirms that the main haulouts of harbour seals are at Tentsmuir Point (11km SSE). Local haulouts are on the Lady Bank (4km east) and between the bridges on the Middle Bank (6km west). The distance to the haulouts makes it very unlikely that they would be disturbed, particularly as there will be no underwater noise generation from piling as this will be carried out in the inter-tidal zone when the tide is out. No “in-water” piling is proposed and this will be stipulated in Contractors’ Documents. Harbour seals do forage in the waters off Broughty Ferry but, due to recent local population decline, only in very small numbers and there is no reason why terrestrial activities during construction and operation would affect very local feeding opportunities. This SAC qualifying species will not be significantly adversely affected by the scheme.

Natura Site Name	Qualifying Feature	Potentially Significant effect?	Reasons
Firth of Tay and Eden Estuary SPA	Bar-tailed godwit (<i>Limosa lapponica</i>)	No	This species is not regularly recorded feeding on Mudflats BT095-BT098. <i>This species will not be significantly adversely affected by the scheme.</i>
	Common scoter (<i>Melanitta nigra</i>)	No	A sea duck not commonly frequenting the Broughty Ferry area, 15 birds recorded offshore from BTO96 in 2011/13. Presence likely to be determined by Easterly gales. <i>This species will not be significantly adversely affected by the scheme.</i>
	Cormorant (<i>Phalacrocorax carbo</i>)	No	The nearest significant roosts are the piers of the old and new Tay rail bridge and only during the non-breeding season. This has not been frequently used in the last three years and most tend to roost on Lucky Scaup and on navigation channel light platforms. These roosts are all offshore and will not be disturbed. A few cormorant hunt fish in the estuary off Broughty Ferry but not in numbers likely to cause a significant effect. This is a highly mobile species making wide use of the estuary between Tentsmuir Point and Perth, and, if disturbed, feeding opportunities would not be significantly compromised. <i>This species will not be significantly adversely affected by the scheme.</i>
	Dunlin (<i>Calidris alpina</i>)	No	This species is not regularly recorded feeding on the Mudflats BT095-BT098 <i>This species will not be significantly adversely affected by the scheme.</i>
	Eider (<i>Somateria mollissima</i>)	No	A few eider are present in the estuary off Broughty Ferry, normally fewer than 25 birds, but not in numbers likely to cause a significant effect. Flocks on the southern shore and Tentsmuir Point have exceeded 10,000 birds. <i>This species will not be significantly adversely affected by the scheme.</i>
	Goldeneye (<i>Bucephala clangula</i>)	No	Winter and passage visitor infrequently recorded off Broughty Ferry, maximum of six recently, Jan-Feb 2011. <i>This species will not be significantly adversely affected by the scheme.</i>
	Goosander (<i>Mergus merganser</i>)	No	Other than a summer moulting flock roosting at Lucky Scaup, an island 3km SE, off Tayport in the River Tay, there is no other known regular use in proximity to Broughty Ferry. <i>This species will not be significantly adversely affected by the scheme.</i>
	Grey plover (<i>Pluvialis squatarola</i>)	No	This species is not recorded feeding on the Mudflats BT095-BT098. <i>This species will not be significantly adversely affected by the scheme.</i>

Natura Site Name	Qualifying Feature	Potentially Significant effect?	Reasons
	Greylag goose (<i>Anser anser</i>)	No	Greylag geese are not frequently reported at Broughty Ferry. Presence is only at night when roosting and therefore unlikely to be disturbed by day-time construction activities. <i>This species will not be significantly adversely affected by the scheme.</i>
	Black-tailed godwit (<i>Limosa limosa</i>)	No	Found only on the Eden estuary and a few (<10 birds) in Kingoodie Bay. This species is not recorded feeding on the Mudflats BT095-BT098. <i>This species will not be significantly adversely affected by the scheme.</i>
	Little tern (<i>Sterna albifrons</i>)	No	Summer visitor, none currently nest within the SPA. <i>This species will not be significantly adversely affected by the scheme.</i>
	Long-tailed duck (<i>Clangula hyemalis</i>)	No	Coastal sea duck found off Tentsmuir and in St Andrews Bay but not normally frequenting the Tay at Broughty Ferry. <i>This species will not be significantly adversely affected by the scheme.</i>
	Marsh harrier (<i>Circus aeruginosus</i>)	No	This species is a migrant summer breeder in the inner Tay reedbeds and makes no use of the outer Tay for hunting. <i>This species will not be significantly adversely affected by the scheme.</i>
	Oyster-catcher (<i>Haematopus ostralegus</i>)	Yes	Feeds and roosts in relatively small numbers in proximity to proposed works. <i>This SPA qualifying habitat is likely to be significantly adversely affected by the scheme</i>
	Pink-footed goose (<i>Anser brachyrhynchus</i>)	No	As for greylag geese. Although more frequently recorded roosting offshore at night, when works will not be taking place. <i>This species will not be significantly adversely affected by the scheme.</i>
	Red-breasted merganser (<i>Mergus serrator</i>)	Yes	A highly mobile wildfowl species found in low numbers off Broughty Ferry outside the breeding season. <i>This SPA qualifying habitat is likely to be significantly adversely affected by the scheme</i>
	Redshank (<i>Tringa totanus</i>)	Yes	Redshank feed and roost in low numbers in proximity to the proposed works <i>This SPA qualifying habitat is likely to be significantly adversely affected by the scheme</i>
	Sanderling (<i>Calidris alba</i>)	No	This species is not regularly recorded feeding on the Mudflats BT095-BT098. <i>This species will not be significantly adversely affected by the scheme.</i>

Natura Site Name	Qualifying Feature	Potentially Significant effect?	Reasons
	Shelduck (<i>Tadorna tadorna</i>)	No	This species is not regularly recorded feeding on the Mudflats BT095-BT098 <i>This species will not be significantly adversely affected by the scheme.</i>
	Velvet scoter (<i>Melanitta fusca</i>)	No	A sea duck frequenting St Andrews Bay and open sea off Tentsmuir. Not regularly recorded at Broughty Ferry. <i>This species will not be significantly adversely affected by the scheme.</i>
	Waterfowl assemblage	No	Due to low numbers of birds found at Broughty Ferry, peak roosting 218 in January 2011 and peak total feeding of 163 birds. In the context of an estuary that has held up to 48,000 waterfowl a local displacement of such low order is not significant. <i>The species assemblage will not be significantly adversely affected by the scheme.</i>
	Un-named waterfowl assemblage: Turnstone	Yes	Feeding and roosting turnstone frequent the areas of proposed works in small numbers. <i>This SPA qualifying habitat is likely to be significantly adversely affected by the scheme.</i>
Outer Firth of Forth and St Andrews Bay Complex pSPA	All	Yes	None of the breeding qualifying features nest in proximity to the Middle Tay, therefore impacts are limited to feeding birds during the breeding season, or non-breeding bird aggregations at other times. Although the potential number of pSPA bird species using the area is small, the loss of habitat and potential physical changes to habitat used could have a significant adverse effect on feeding opportunities. <i>This SAC qualifying habitat is likely to be significantly adversely affected by the scheme.</i>

6 CONCLUSION OF HRA SCOPING

According to scoping, and advice from SNH, several qualifying interests of the Firth of Tay and Eden Estuary SAC and SPA and Outer Firth of Forth and St Andrews Bay Complex pSPA could be significantly adversely affected by the proposed scheme, see **Table 6.1**.

Table 6.1. Summary of sites and features to be assessed in the HRA.

European Site	Feature (s) likely to be adversely affected by proposals.
Firth of Tay and Eden Estuary SAC	Estuaries; inter-tidal mudflats and sandflats; sub-tidal sandbanks
Firth of Tay and Eden Estuary SPA	Red-breasted merganser; oystercatcher; redshank; unnamed assemblage- turnstone
Outer Firth of Forth and St Andrews Bay Complex pSPA	Breeding bird features (feeding only); Non-breeding aggregations

7 ASSESSMENT OF EFFECTS ON EUROPEAN SITES POTENTIALLY ADVERSELY AFFECTED BY DEVELOPMENT

The following assessment focuses on those Sites and features of those Sites that are likely to be adversely affected by flood protection proposals, as summarised in Sections 7.1, and 7.2 assesses potential impact on targeted qualifying species in terms of their Conservation Objectives (COs).

7.1 Firth of Tay and Eden Estuary SAC

Qualifying Feature	Conservation Objective (CO)						
	Extent of the habitat on site	Distribution of the habitat within site	Structure and function of the habitat	Processes supporting the habitat	Distribution of the typical species of the habitat	Viability of typical species as components of the habitat	No significant disturbance of typical species of the habitat
Estuaries	<p>The total area of habitat within the SAC is 15,441ha and the area of permanent habitat loss will be 3.36ha (0.022%), whilst a further 16.54ha (0.11%) is likely to be indirectly impacted. Habitats impacted are largely mobile shingle of lower value and man-made.</p> <p>This tiny permanent loss will have no significant adverse impact on the extent of this habitat.</p> <p>Studies have shown that the area indirectly impacted will recover quickly after completion of works and the changes are therefore of short duration and, with restoration to a</p>	<p>Potential impacts are limited only to the Firth of Tay and there will be no impact on the Eden Estuary component of the SAC. The greatest majority of the Firth of Tay, approximately 99.99% of the SAC, will remain at its current baseline condition and there will be no significant adverse effect on distribution of habitat. Total habitat loss is low and duration of indirect impact is very short with natural restoration to similar habitats present prior to disturbance.</p>	<p>The Firth of Tay and Eden estuary SAC has been denigrated by human activities, that currently include port activities, industrial and sewerage discharges, new annual dredging for port access, recreational land-claim and former land-fills on the Inner Tay and Eden. The Eden has been heavily constrained by gabion type coastal defences along its northern shore to protect RAF Leuchars and in Balgove Bay to protect the Old Course golf links. The southern Eden shoreline is constrained by a flood embankment, behind which pumps artificially lower the water levels on the Eden Course and adjacent farmland.</p> <p>Against these background activities the scale of the proposed</p>	<p>Extensive modelling by Mott Macdonald and a data review by Dong (2018) have shown that the hydrodynamic processes on the Tay are high energy and the estuarine substrates undergo rapid, and periodically catastrophic, changes influenced by tide height and wind direction. The area impacted by the scheme is tiny and will not have a significant adverse effect on these processes,</p>	<p>The habitats affected by the works are very small in area and not species-rich. The type of habitat impacted by the scheme is widespread in the estuary and the distribution of species and their abundance will not change as a result of the habitat loss.</p> <p>Indirectly disturbed habitat will reach a new equilibrium within a matter of days or weeks (Dong 2018) of completing works.</p> <p>The distribution of typical species will not change.</p>	<p>The greatest majority of the estuarine habitat, and the most species-rich habitat will not be affected and this also applies to the typical species.</p> <p>Those habitats that are affected are largely man-made, mobile shingle, species poor and works will not have a significant adverse effect.</p>	<p>Species associated with mobile shingle and mud are mobile and capable of rapidly recolonising any disturbed habitat.</p> <p>The area directly affected is so small that there will be no significant disturbance.</p>

Qualifying Feature	Conservation Objective (CO)						
	Extent of the habitat on site	Distribution of the habitat within site	Structure and function of the habitat	Processes supporting the habitat	Distribution of the typical species of the habitat	Viability of typical species as components of the habitat	No significant disturbance of typical species of the habitat
	similar particulate equilibrium, reversible.		flood protection scheme will not have a significant adverse impact.				
Inter-tidal Mudflats and sandflats	<p>Direct impact is largely limited to unstable, mobile shingle.</p> <p>The normal maximum extent of any indirect impact on the mudflats and sandflats will be 20m, affecting a tiny area of the mudflat and sandflat beyond the shingle. Sampled sediments are single grain sized and will resettle quickly to form a similar habitat in the new equilibrium.</p> <p>No adverse effect on the extent of this habitat.</p>	The distribution of the habitat will remain unchanged due to absence of any significant impact.	As for the estuaries feature, there will be no significant change.	As for estuaries, there will be no significant change	As for estuaries, there will be no significant change	As for estuaries, there will be no significant change	As for estuaries, there will be no significant change.
Sub-tidal sandbanks	Review of available data has shown that there will be no impact on this habitat due to the very limited footprint of the works.	The current baseline for this habitat will remain unaffected.	There will be no change to the structure function of the habitat.	Processes supporting the habitat will remain unaltered.	Species distribution will not change.	The viability of the associated species is determined by an estuary wide scale of influences e.g. lunar cycle, tidal height, wind direction, wave	Compared to the naturally high background levels of disturbance there will be no significant

Qualifying Feature	Conservation Objective (CO)						
	Extent of the habitat on site	Distribution of the habitat within site	Structure and function of the habitat	Processes supporting the habitat	Distribution of the typical species of the habitat	Viability of typical species as components of the habitat	No significant disturbance of typical species of the habitat
						height. These determine sediment transport and sediment stability that would be unaffected by the small scale changes as a result of the scheme.	disturbance.
Conclusion	For these three SAC qualifying features, this conservation objective will continue to be met during and after development.	For these three SAC qualifying features, this conservation objective will continue to be met during and after development.	For these three SAC qualifying features, this conservation objective will continue to be met during and after development.	For these three SAC qualifying features, this conservation objective will continue to be met during and after development.	For these three SAC qualifying features, this conservation objective will continue to be met during and after development.	For these three SAC qualifying features, this conservation objective will continue to be met during and after development.	For these three SAC qualifying features, this conservation objective will continue to be met during and after development.

7.2 Firth of Tay and Eden Estuary SPA and Outer Firth of Forth and St Andrews Bay pSPA

European Site	Feature (s) likely to be adversely affected by proposals.	Conservation Objective (CO)				
		Objective 1 Population of the species as a viable component of the site	Objective 2 Distribution of the species within site	Objective 3 Distribution and extent of habitats supporting the species	Objective 4 Structure, function and supporting processes of habitats supporting the species	Objective 5 No significant disturbance of the species
Firth of Tay and Eden Estuary SPA	Red-breasted merganser	Numbers in Stannergate are very low, only one bird on recent WeBS Core counts, therefore works will not have any significant adverse impact on the Tay SPA population, which has peaked at 109 birds in recent years (WeBS online data).	Red-breasted merganser are a highly mobile wintering species regularly commuting upstream to Perth, to Tayport Bay (where most congregate) and to the Edenmouth and these more important sectors of the SPA will not be impacted by works.	This is an open water feeding species, dependent on local fish populations and typically present at Stannergate only on higher states of the tide when there is no water-based reactional disturbance. The works will have no impact on the extent of open water use of prey species availability.	Climate change, tidal cycles, port dredging, fish migration and shipping disturbance could have an adverse effect on the structure and function of supporting processes but not the very local, small scale proposed works of short duration.	On the open water of the Tay, red-breasted merganser are frequently disturbed by port activities, lifeboat practice, jet skiers, yacht club regattas and races that take place all year round. Shore-based construction is unlikely to have any additional impact due to high background levels of disturbance from public on footpath that follows the seawall at Stannergate.
	Oystercatcher	According to the WeBS online database, the latest annual five year mean of peaks for the Tay is 2293 birds and Eden 2194, both peak in January. On the north shore of the Tay the primary roost is at Buddon Ness, where the latest annual five year mean peak was 570 birds WeBS core data for the Stannergate suggests that high tide roosts are small (peak 8 birds) and presence is highly dependent on	Buddon Ness is the main north shore roost for the Outer and Middle Tay and this will not be impacted by the works. Few birds roost in the Middle Tay. Oystercatcher is a non-obligate species frequently roosting and feeding inland on fields, play parks, sports pitches and greenspace	Mussel beds are the key habitat for this species and they are located outwith the area of any impact of the works. The largest being the formerly seeded and managed commercial beds on the Eden. At Stannergate a small number do forage over a wider range of habitat,	The distribution of preferred feeding habitats are dependent on the large scale processes which determine the distribution and stability of sediments and nutrient input and not the very local small scale ones associated with proposed structures.	Peak numbers of this species occur in January, a month when there is likely to be little work on the scheme. This species does habituate to regular benign disturbance (Hill et al. 1997). At the Stannergate, high background levels of human activity created by walkers, cyclists and

European Site	Feature (s) likely to be adversely affected by proposals.	Conservation Objective (CO)				
		Objective 1 Population of the species as a viable component of the site	Objective 2 Distribution of the species within site	Objective 3 Distribution and extent of habitats supporting the species	Objective 4 Structure, function and supporting processes of habitats supporting the species	Objective 5 No significant disturbance of the species
		<p>human activity at the Yacht Club slipway, on the harbour breakwater and in the harbour.</p> <p>These sub-roosts are often absent when public activities e.g. walking or jet-skiing are taking place at roost locations. These are clearly sub-roosts used intermittently according to prevailing conditions and not important to maintaining the population.</p> <p>The most recent Stannergate WeBS low tide peak was very low - 23 birds.</p> <p>Works will therefore not adversely affect viability of this component.</p>	<p>around the town.</p> <p>Numbers of feeding birds are low along the Stannergate compared to Monifieth, Tayport Bay and the Eden where extensive mussel beds are present.</p> <p>Works will not adversely affect current distribution.</p>	<p>particularly the young <i>Arenicola</i> beds and fucoid covered cobbles which may have mussels attached and these will not be directly or indirectly impacted by works.</p> <p>Distribution and extent of key supporting habitats will not be adversely affected.</p>		<p>cars is likely to reduce likelihood of disturbance to a very small number of birds present during the main spring and summer construction period.</p> <p>There will be no significant disturbance of this species.</p>
	Redshank	<p>Found in low numbers roosting and feeding in proximity to the proposed locations of works. Feeding birds number less than 10, whilst roosting birds may be slightly higher, less than 15 birds and exclusively associated with the lifeboat pier where they line the wooden pile supports. Presence and number of birds is determined by lifeboat activities.</p> <p>The most important redshank roosts on the north shore of the Tay are the Balmossie outfall where</p>	<p>Key high tide roosts will not be disturbed by works.</p> <p>Main feeding numbers on the Firth of Tay are concentrated on the southern shore and will not be affected by works.</p> <p>There will be no change to the distribution of redshank on the Tay.</p>	<p>The north shore habitats, especially those at Stannergate, do not make a significant contribution to maintaining passage and winter populations, which are dependent on the muddy southern shore.</p> <p>Any changes will be very local, small scale and will not adversely affect the distribution</p>	<p>Proposed works are very small scale and indirect impact will be very short term, therefore they will have no effect on the hydrodynamic processes.</p>	<p>The main roosts and feeding areas are outwith the works area. The lifeboat sub-roost is dependent on lifeboat activities and regularly disturbed.</p> <p>Redshank feeding on the Stannergate feed on a very narrow inter-tidal margin shared with dog walkers, close to well used footpaths and will be habituated to human</p>

European Site	Feature (s) likely to be adversely affected by proposals.	Conservation Objective (CO)				
		Objective 1 Population of the species as a viable component of the site	Objective 2 Distribution of the species within site	Objective 3 Distribution and extent of habitats supporting the species	Objective 4 Structure, function and supporting processes of habitats supporting the species	Objective 5 No significant disturbance of the species
		<p>more than 100 birds regularly roost and, if disturbed, they move to Buddon Ness.</p> <p>Feeding birds at Stannergate are low in comparison to the Firth of Tay 2012/13 maximum of 437 birds and, due to low numbers, viability of the population will not be adversely affected.</p>		and extent of habitats.		<p>activity.</p> <p>There will be no significant disturbance.</p>
	Unnamed assemblage-turnstone	<p>The main turnstone roost on the Firth of Tay is on the Balmossie Outfall, up to 130 birds, with a small sub-roost on lifeboat pier.</p> <p>Lifeboat Pier sub-roost numbers vary within a normal range of 10-30 birds. At this location they roost 30m offshore and are undisturbed, unless there are lifeboat activities. Proposed flood protection works will not disturb this roost.</p> <p>WeBS Low tide data for the Stannergate mudflats recorded peak of 17 feeding birds in BT096 and a mean of 1-6 for the three mudflats affected by works.</p> <p>Accumulations of seaweed at the west end of the Stannergate (NGR NO 43585 30930), outwith the proposed work area have rarely attracted up to 43 feeding birds at high tide.</p>	<p>Main feeding and roosting sites are outwith proposed works.</p> <p>The distribution of roosting birds will not change significantly as a result of works.</p>	There will be no changes to distribution or extent of habitats supporting turnstone.	Proposed works are very small scale and will have no effect on the hydrodynamic processes.	<p>Turnstone have one of the lowest FID ranges, 5-75m (Collop 2016) and can tolerate close approach.</p> <p>Timing work during spring and summer will reduce winter disturbance to a small number of birds in a sector that has a high level of background human use.</p> <p>There will be no significant disturbance.</p>

European Site	Feature (s) likely to be adversely affected by proposals.	Conservation Objective (CO)				
		Objective 1 Population of the species as a viable component of the site	Objective 2 Distribution of the species within site	Objective 3 Distribution and extent of habitats supporting the species	Objective 4 Structure, function and supporting processes of habitats supporting the species	Objective 5 No significant disturbance of the species
		Roosting and feeding birds are low in number and will not adversely affect the viability of the population.				
Conclusion		For these qualifying features, this conservation objective will continue to be met during and after development.	For these qualifying features, this conservation objective will continue to be met during and after development.	For these qualifying features, this conservation objective will continue to be met during and after development.	For these qualifying features, this conservation objective will continue to be met during and after development.	For these qualifying features, this conservation objective will continue to be met during and after development.
Outer Firth of Forth and St Andrews Bay Complex pSPA	Breeding bird features:	None of the proposed qualifying breeding interests breed in the Firth of Tay. CO Maintained	None of proposed qualifying breeding interests breed in the Firth of Tay. CO Maintained	None of proposed qualifying breeding interests breed in the Firth of Tay. CO Maintained	None of proposed qualifying breeding interests breed in the Firth of Tay. CO Maintained	None of proposed qualifying breeding interests breed in the Firth of Tay. CO Maintained
	Non-breeding aggregations					
	Gulls, excluding little gull	Three common wintering gulls are listed as qualifying interests to the pSPA. Non-breeding herring, common and black-headed gulls frequent the locality of the works at	A very small number may be dispersed from the area of works, which often occurs anyway due to high background	Gulls are supported by a very wide range of food sources across a wide geographical area and the habitat loss to	Habitats visited by gulls are determined by estuary-wide processes that will not be adversely affected by	A small number of gulls may be disturbed but this will not be significant in terms

European Site	Feature (s) likely to be adversely affected by proposals.	Conservation Objective (CO)				
		Objective 1 Population of the species as a viable component of the site	Objective 2 Distribution of the species within site	Objective 3 Distribution and extent of habitats supporting the species	Objective 4 Structure, function and supporting processes of habitats supporting the species	Objective 5 No significant disturbance of the species
		<p>all times of the year, but numbers are not normally included in the WeBS core counts.</p> <p>Recent WeBS Monifieth Core Counts by David Bell have included these gull species and for 2017-18 they lie in the lower ranges of abundance: common gull 3-12 birds; and black-headed gull 48-116; herring gull 14-198 birds.</p> <p>Stannergate WeBS Core Counts included gulls in 2013/14 recording peaks of 20 herring gull and 3 black-headed gull.</p> <p>Sustainability of these species will not be determined by the proposed works, but by breeding opportunity on the Forth Islands and adjacent coastline and by all year round food availability within the pSPA, as well as inland agriculture and landfills outwith the breeding season.</p> <p>Note: An NCC herring gull cull in the 1970s, using poison bait on the Isle of May, part of the pSPA, removed 44,000 birds from the population (Forester & Andrews 2007).</p>	<p>levels of human activity e.g. walkers, jets skiers and sailing boats</p>	<p>the scheme will not have an adverse effect.</p>	<p>the proposed works.</p>	
	Little gull	This species is recorded throughout	A recent peak of 62	Habitats impacted by	Dong (2018) has shown	Do not frequent the

European Site	Feature (s) likely to be adversely affected by proposals.	Conservation Objective (CO)				
		Objective 1 Population of the species as a viable component of the site	Objective 2 Distribution of the species within site	Objective 3 Distribution and extent of habitats supporting the species	Objective 4 Structure, function and supporting processes of habitats supporting the species	Objective 5 No significant disturbance of the species
		the year within the pSPA with lower frequency but higher counts in July (Elkins 2016), and are likely to be dispersing Baltic and Russian breeding birds (Wernham 2002). Their occurrence is widespread on the east coast of Scotland and but do not frequent the Middle or Inner Tay.	birds was recorded in the Outer Tay. They do not visit the middle or Inner Tay and current distribution will not be affected by the scheme.	the proposed scheme at Broughty Ferry are not visited by little gulls	no significant change to the processes supporting wider estuary structure and function.	area of proposed works, therefore will not be disturbed.
Conclusion		For these qualifying features, this conservation objective will continue to be met during and after development.	For these qualifying features, this conservation objective will continue to be met during and after development.	For these qualifying features, this conservation objective will continue to be met during and after development.	For these qualifying features, this conservation objective will continue to be met during and after development.	For these qualifying features, this conservation objective will continue to be met during and after development.

8 IN-COMBINATION EFFECTS OF THE PROPOSED FLOOD PROTECTION SCHEME

In addition to the Broughty Ferry Protection Scheme there are four present and future developments on the Tay estuary that potentially have impacts that could act, or have acted, in combination to change the baseline ecology addressed in the RIAA.

- A. Broughty Ferry Flood Protection Scheme (Earliest start late summer 2018)
- B. Marine Scotland licence dredging at Port of Dundee, Forth Ports plc (Ongoing)
- C. Port of Dundee, Proposed new Quayside Extension, Forth Ports plc
- D. Fife Shoreline Management Plan 2011

Offshore wind farms have been scoped out of the cumulative assessment because they are so remote from the proposals for Broughty Ferry and have potentially significant marine issues, e.g. seabird collisions and noise disturbance to cetaceans that do not overlap with the local range of impact and receptors for the Broughty Ferry scheme.

A. Broughty Ferry Flood Protection Scheme

Management options for Broughty Ferry Beach have been assessed in further detail (Macleod Consulting (UK) Ltd report in prep.) and the preferred option is for new dune stabilisation works above the MHWST associated fencing / access management. An earlier proposal for a dune / beach recharge project inserting a rip rap armour and using covering sand won from the Lady Bank in the outer Tay has been further appraised (Macleod Consulting (UK) Ltd, report in prep.) and is no longer included within the current proposals.

Rock armour may be installed at MHSW in the Balmossie sector of the scheme between May and September 2108, i.e. ahead of the earliest anticipated start to the Broughty Ferry works. In any event any loss of habitat to the footprint will be *de minimis* and have no adverse impact on the overall habitat available to the SAC qualifying interests. Timing of works will be agreed with SNH to ensure there will be no disturbance to the Balmossie outfall high tide bird roost.

Conclusion

There will be no cumulative impact arising from the Broughty Ferry Dunes / Esplanade Flood Protection Scheme (MU12) with the Broughty Ferry proposals.

B. Dredging at Port of Dundee, Forth Ports plc

Surveying and licensed dredging takes place annually at Port of Dundee where sediments and silt are removed from wharfside and disposed of at a licensed site in the near North Sea. This is an existing and long term feature of port activities and as such should be considered part of the environmental baseline and not a new activity to be considered as a cumulative impact and for this reason there will be no cumulative impact.

Conclusion

There will be no cumulative impacts arising from the Dredging at Port of Dundee with the Broughty Ferry proposal.

C. Port of Dundee, Proposed new Quayside Extension, Forth Ports plc

Forth Ports plc are in the process of delivering a new hub for North Sea oil and gas operations and offshore wind farms at Port of Dundee. This will include a Quayside breakwater extension, 200m in length, and a new heavy lifting pad. **Figure 1** shows the development footprint and these works will be completed January – February 2018.



Figure 1. Location and extent of proposed works © Dredging Today

Initial EIA screening by Royal Haskoning suggested that there will be potentially significant adverse impacts which will require mitigation. Main impacts were a very small permanent small loss of sub-tidal habitat and potential noise disturbance to marine mammals in the Firth of Tay and its adjacent coastal cell. The latter is a project-specific impact and, due to timing, not cumulative with the Broughty Ferry Flood Protection Scheme. The former is cumulative, but due to the very small area potentially being permanently lost, in-combination effects are likely but not of a scale likely to significantly adversely affect qualifying interests or the habitats supporting those species.

Conclusion

There will be no cumulative impacts with the Broughty Ferry proposal.

D. Fife Shoreline Management Plan 2011

This plan states Fife Council's policy covering three epochs to 2110, specifically 2030, 2060 and 2110, relying on three preferred options.

- No active intervention (NAI)
- Hold the line (HTL)
- Managed realignment (MR)

Policy units 52-55 on the south side of the Tay between Tentsmuir and Newport-on-Tay are: Tentsmuir (PU52 - NAI); Shanwell Farm -Tayport (PU53 - MR then HTL); Tayport (PU54 - HTL), and Tayport to Newport-on Tay (PU55 - NAI). Intervention actions and potential effects of MR and HTL options for PU53 and PU54 are not detailed and cannot be assessed at this time. Policy units PU52 and PU55 will have no cumulative impact.

Conclusion

There will be no cumulative impacts with the Broughty Ferry proposal.

Table 8.1 summarises the cumulative impact assessment.

Table 8.1. Cumulative impact summary

Potential impacts	Project/ Cumulative impacts	Amplified impacts	Threshold effects	Overall cumulative significance
Habitat loss	A and C	None	None	Will not be significantly adverse
Reason	Very small areas of permanently lost habitat and the poor quality of widespread habitat to be lost			
Ornithological disturbance	A, C and D	None	None	Will not be significantly adverse
Reason	Disturbance will be substantially avoided through timing of works			
Noise impacts on seals	D	None	None	Will not be significantly adverse
Reason	No piling removal work during pupping/moulting season			
Noise impacts on sea mammals	C and D	None	None	Will not be significantly adverse
Reason	Both projects will employ MMOs to avoid disturbance to cetaceans			

9 OVERALL CONCLUSION OF ASSESSMENT

A scoping of the effects of the proposals concluded that three European sites could potentially be adversely affected by the proposed Broughty Ferry Flood Protection Scheme.

European Site	Feature (s) likely to be adversely affected by proposals.
Firth of Tay and Eden Estuary SAC	Estuaries; inter-tidal mudflats and sandflats; sub-tidal sandbanks
Firth of Tay and Eden Estuary SPA	Red-breasted merganser; oystercatcher; redshank; unnamed assemblage- turnstone
Outer Firth of Forth and St Andrews Bay Complex pSPA	Breeding bird features (feeding only); Non-breeding aggregations

The assessment undertaken has identified that the scale of the flood protection works is very small, permanently impacting on less than 0.022% of the total area of the SAC. Modelling and a literature review has concluded that the extent of the inter tidal and sub tidal area indirectly affected is local and impacted habitat will recover quickly with material of a similar type. The Broughty Ferry flood protection scheme will therefore not adversely affect the site integrity for any of the qualifying features of the Firth of Tay and Eden Estuary SAC.

In relation to the Firth of Tay and Eden Estuary SPA and the Outer Firth of Forth and St Andrews Bay Complex pSPA, the four sections of the Broughty Ferry Flood Protection Scheme are located on the north shore, in areas of the Firth of Tay where the numbers of roosting and feeding birds are low in comparison to the wider Firth of Tay and Eden Estuary. Reduced bird numbers are due to the relatively small area of impoverished available habitat and human influences on the north shore. At Stannergate, the latter have denigrated the inter-tidal habitat by contributing to the creation of an unstable shingle habitat and most recently through disturbance caused by installing wastewater pipes.

The existing Grassy Beach footpath and seawall footpath along Douglas Terrace to Broughty Harbour is heavily used by a wide range of shore-based recreation, whilst inter-tidal habitat is often disturbed by walkers and

individual and commercial dog walkers. In addition the offshore open water is a popular area for water sports and the two local yacht clubs hold regular regattas and races with on open water.

Within the potentially affected inter tidal areas there is little or no supra-littoral fauna or flora which is broadly indicative of a highly impoverished plant community. The dominant life forms in the eulittoral zone are frequent brown algal shrubs and a very sparse infauna burrowing in patches of loose sediment and a very poorly vegetated mobile shingle substrate on the upper shore. The effect of the proposals on this habitat have been assessed, see above, and it has been concluded that whilst the sediments may be dynamically altered they will become re established very quickly with no significant effect, in terms of sediment type, on the habitat or the bird interests which are qualifying features of the Firth of Tay and Eden Estuary SPA or Outer Firth of Forth and St Andrews Bay Complex pSPA.

It is therefore reasonable to reach the final conclusion that the Broughty Ferry flood protection scheme will not adversely affect the site integrity for any of the qualifying features of the seven listed European Sites and for these features conservation objectives will continue to be met during and after development:-

- Firth of Tay and Eden Estuary Special Area of Conservation (SAC);
- River Tay SAC;
- Isle of May SAC;
- Moray Firth SAC; and
- The Firth of Tay and Eden Estuary Special Protection Area (SPA); and
- Outer Firth of Forth and St Andrews Bay Complex pSPA
- Firth of Tay Ramsar

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ANNEX A. BTO WeBS Core High Tide Data, Broughty Ferry to Buddon Ness (Monifieth 87413)

Five year summary for Broughty Ferry to Buddon Ness (Monifieth)

Table 1: Total Counts - All Species Combined.

Peak monthly total = maximum of the sum of the counts of all species within each month.

Seasonal peaks = sum of the maximum counts of for each species within each Season.

Year	Peak Monthly Total	Autumn Peak	Winter Peak	Spring Peak
10/11	2888 (JAN)	3020	3321	N/C
11/12	1671 (SEP)	1671	2059	395
12/13	1615 (DEC)	867	1882	N/C
13/14	2431 (SEP)	2598	2608	1418
14/15	1702 (JAN)	2543	2683	N/C
MEAN	2061	2140	2511	907

Data provided by the British Trust for Ornithology on behalf of The Wetland Bird Survey.
 These tabulations are based exclusively on data collected as part of the monthly Core Counts.
 For some species (e.g. wintering geese) data collected by other surveys may be more appropriate for the purpose of site assessment.
 Missing or unexpectedly low counts for gulls and terns should be treated with caution - counting these groups is optional and determination of count effort not always possible

The Wetland Bird Survey is a partnership between the British Trust for Ornithology,
 the Royal Society for the Protection of Birds and the Joint Nature Conservation Committee,
 (the last on behalf of Natural England, Scottish Natural Heritage, Natural Resources Wales and
 Department of the Environment Northern Ireland) in association with the Wildfowl and Wetlands Trust.

Five year summary for Broughty Ferry to Buddon Ness (Monifieth)

Table 2: Five-year average monthly counts of each species.

Figure in parentheses give number of complete and incomplete counts upon which the average is based.
Incomplete counts are excluded from calculations where, if included, they would depress the mean.

Species	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Mute Swan	N/C	139(1,1)	88(3,2)	39(2,2)	35(2,1)	6(3,.)	47(3,2)	19(4,1)	26(5,.)	36(2,.)	N/C	27(1,.)
Shelduck	N/C	0(1,1)	0(3,2)	0(2,2)	0(2,1)	0(3,.)	0(3,2)	0(4,1)	0(5,.)	2(2,.)	N/C	0(1,.)
Wigeon	N/C	0(1,1)	58(3,2)	17(2,2)	39(2,1)	24(3,.)	87(3,2)	0(4,1)	8(5,.)	25(2,.)	N/C	0(1,.)
Gadwall	N/C	0(1,1)	0(3,2)	0(2,2)	0(2,1)	0(3,.)	0(3,2)	0(4,1)	1(5,.)	0(2,.)	N/C	0(1,.)
Mallard	N/C	18(1,1)	34(3,2)	27(2,2)	20(2,1)	43(3,.)	107(3,2)	9(4,1)	5(5,.)	6(2,.)	N/C	48(1,.)
Eider	N/C	310(1,1)	24(3,2)	11(2,2)	2(2,1)	1(3,.)	27(3,2)	5(4,1)	39(5,.)	5(2,.)	N/C	400(1,.)
Goldeneye	N/C	0(1,1)	0(3,2)	0(2,2)	1(2,1)	0(3,.)	1(3,2)	0(4,1)	0(5,.)	0(2,.)	N/C	0(1,.)
Red-breasted Merganser	N/C	0(1,1)	0(3,2)	0(2,2)	1(2,1)	0(3,.)	0(3,2)	1(4,1)	0(5,.)	1(2,.)	N/C	0(1,.)
Goosander	N/C	80(1,1)	44(3,2)	11(2,2)	0(2,1)	0(3,.)	1(3,2)	1(4,1)	0(5,.)	0(2,.)	N/C	19(1,.)
Cormorant	N/C	1(1,1)	0(3,2)	1(2,2)	0(2,1)	0(3,.)	1(3,2)	1(4,1)	0(5,.)	0(2,.)	N/C	0(1,.)
Grey Heron	N/C	2(1,1)	0(3,2)	0(2,2)	1(2,1)	0(3,.)	0(3,2)	0(4,1)	0(5,.)	1(2,.)	N/C	0(1,.)
Moorhen	N/C	0(1,1)	0(3,2)	0(2,2)	0(2,1)	0(3,.)	0(3,2)	0(4,1)	0(5,.)	1(2,.)	N/C	0(1,.)
Oystercatcher	N/C	77(1,1)	116(3,2)	122(2,2)	200(2,1)	325(3,.)	463(3,2)	305(4,1)	138(5,.)	190(2,.)	N/C	300(1,.)
Ringed Plover	N/C	11(1,1)	125(3,2)	30(2,2)	67(2,1)	27(3,.)	79(3,2)	15(4,1)	4(5,.)	0(2,.)	N/C	0(1,.)
Golden Plover	N/C	3(1,1)	50(3,2)	0(2,2)	0(2,1)	0(3,.)	0(3,2)	0(4,1)	0(5,.)	0(2,.)	N/C	0(1,.)
Grey Plover	N/C	10(1,1)	0(3,2)	2(2,2)	4(2,1)	5(3,.)	7(3,2)	15(4,1)	2(5,.)	1(2,.)	N/C	0(1,.)
Knot	N/C	0(1,1)	117(3,2)	100(2,2)	70(2,1)	33(3,.)	167(3,2)	68(4,1)	20(5,.)	0(2,.)	N/C	0(1,.)
Sanderling	N/C	100(1,1)	39(3,2)	8(2,2)	43(2,1)	77(3,.)	62(3,2)	15(4,1)	53(5,.)	43(2,.)	N/C	0(1,.)
Dunlin	N/C	3(1,1)	14(3,2)	10(2,2)	270(2,1)	167(3,.)	403(3,2)	111(4,1)	13(5,.)	1(2,.)	N/C	0(1,.)
Snipe	N/C	0(1,1)	0(3,2)	1(2,2)	0(2,1)	0(3,.)	0(3,2)	0(4,1)	0(5,.)	0(2,.)	N/C	0(1,.)
Bar-tailed Godwit	N/C	155(1,1)	575(3,2)	660(2,2)	520(2,1)	117(3,.)	580(3,2)	352(4,1)	280(5,.)	100(2,.)	N/C	0(1,.)
Curlew	N/C	0(1,1)	6(3,2)	0(2,2)	0(2,1)	1(3,.)	2(3,2)	40(4,1)	9(5,.)	2(2,.)	N/C	0(1,.)
Redshank	N/C	110(1,1)	217(3,2)	115(2,2)	94(2,1)	92(3,.)	157(3,2)	82(4,1)	135(5,.)	140(2,.)	N/C	0(1,.)
Turnstone	N/C	49(1,1)	67(3,2)	110(2,2)	46(2,1)	45(3,.)	52(3,2)	32(4,1)	56(5,.)	50(2,.)	N/C	0(1,.)
Black-headed Gull	N/C	64(1,1)	48(3,2)	0(2,2)	0(2,1)	23(3,.)	0(3,2)	0(4,1)	0(5,.)	0(2,.)	N/C	0(1,.)
Lesser Black-backed Gull	N/C	2(1,1)	2(3,2)	0(2,2)	0(2,1)	0(3,.)	0(3,2)	0(4,1)	0(5,.)	0(2,.)	N/C	0(1,.)
Herring Gull	N/C	8(1,1)	160(3,2)	0(2,2)	0(2,1)	7(3,.)	0(3,2)	0(4,1)	0(5,.)	0(2,.)	N/C	35(1,.)
Great Black-backed Gull	N/C	0(1,1)	0(3,2)	0(2,2)	0(2,1)	0(3,.)	0(3,2)	0(4,1)	2(5,.)	0(2,.)	N/C	3(1,.)
Sandwich Tern	N/C	20(.1)	67(3,1)	0(1,2)	0(1,1)	0(2,.)	0(3,1)	0(3,1)	0(5,.)	0(2,.)	N/C	0(1,.)

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Five year summary for Broughty Ferry to Buddon Ness (Monifieth)

Table 3: Five-year peak monthly counts of each species.

The value reported represents the highest count obtained over the five-year period during the month in question and the species in question.

Species	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Mute Swan	N/C	196	123	55	63	10	110	50	58	40	N/C	27
Shelduck	N/C	0	0	0	0	0	0	0	0	2	N/C	0
Wigeon	N/C	0	160	30	46	48	100	1	20	44	N/C	0
Gadwall	N/C	0	0	0	0	0	0	0	3	0	N/C	0
Mallard	N/C	36	56	38	40	55	220	20	13	7	N/C	48
Eider	N/C	400	60	22	3	4	50	11	150	10	N/C	400
Goldeneye	N/C	0	0	0	2	0	1	0	1	0	N/C	0
Red-breasted Merganser	N/C	0	0	0	2	0	0	2	0	1	N/C	0
Goosander	N/C	85	90	12	0	0	2	2	1	0	N/C	19
Cormorant	N/C	1	0	1	0	1	3	1	0	0	N/C	0
Grey Heron	N/C	3	0	1	2	0	1	1	1	1	N/C	0
Moorhen	N/C	0	0	0	0	0	0	0	0	1	N/C	0
Oystercatcher	N/C	77	380	160	250	780	800	460	200	200	N/C	300
Ringed Plover	N/C	22	190	60	110	50	100	40	11	0	N/C	0
Golden Plover	N/C	5	150	0	0	0	0	0	0	0	N/C	0
Grey Plover	N/C	20	1	3	7	15	20	40	10	2	N/C	0
Knot	N/C	0	300	200	100	100	500	250	80	0	N/C	0
Sanderling	N/C	200	80	12	75	160	100	30	250	80	N/C	0
Dunlin	N/C	3	40	10	540	300	900	250	40	1	N/C	0
Snipe	N/C	0	0	1	0	0	0	0	0	0	N/C	0
Bar-tailed Godwit	N/C	210	1200	1200	600	350	1000	800	800	200	N/C	0
Curlew	N/C	0	30	0	0	4	3	160	45	4	N/C	0
Redshank	N/C	165	340	140	110	100	200	150	220	190	N/C	0
Turnstone	N/C	90	85	140	78	56	80	50	82	50	N/C	0
Black-headed Gull	N/C	64	240	0	0	68	0	0	0	0	N/C	0
Lesser Black-backed Gull	N/C	2	8	0	0	0	0	0	0	0	N/C	0
Herring Gull	N/C	8	800	0	0	22	0	0	0	0	N/C	35
Great Black-backed Gull	N/C	0	0	0	0	0	1	1	10	0	N/C	3
Sandwich Tern	N/C	20	200	0	0	0	0	0	0	0	N/C	0

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Five year summary for Broughty Ferry to Buddon Ness (Monifieth)

Table 4a: Five-year autumn peak counts, and month in which this was recorded, of each species.

The value reported represents the highest count obtained between July and October for the year in question and the species in question. Where a count is enclosed by parentheses this indicates that it was considered incomplete i.e. those parts of the site not visited typically holds at least 25% of the species in question. Incomplete counts are excluded from calculation where, if included, they would depress the mean. When all counts are considered to be incomplete the maximum replaces the mean.

Species	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	Mean of Peaks
Mute Swan	(196) (AUG)	(35) (SEP)	27 (SEP)	114 (SEP)	82 (AUG)	105
Wigeon	30 (OCT)	(13) (SEP)	15 (SEP)	160 (SEP)	(20) (OCT)	68
Mallard	(36) (AUG)	(25) (SEP)	56 (SEP)	44 (SEP)	(38) (OCT)	50
Eider	(400) (AUG)	(0)	1 (OCT)	(22) (OCT)	220 (AUG)	207
Goosander	(85) (AUG)	(6) (SEP)	90 (SEP)	10 (SEP)	75 (AUG)	65
Cormorant	(1) (AUG)	(0)	1 (OCT)	0	0	1
Grey Heron	(3) (AUG)	(0)	0	(1) (OCT)	0	1
Oystercatcher	55 (OCT)	(380) (SEP)	150 (OCT)	(160) (OCT)	(140) (SEP)	177
Ringed Plover	(22) (AUG)	(140) (SEP)	190 (SEP)	150 (SEP)	(22) (SEP)	170
Golden Plover	(5) (AUG)	(0)	0	150 (SEP)	(1) (SEP)	75
Grey Plover	(20) (AUG)	(0)	0	0	0	5
Knot	300 (SEP)	(1) (SEP)	0	50 (SEP)	0	88
Sanderling	(200) (AUG)	(0)	12 (OCT)	80 (SEP)	0	73
Dunlin	10 (OCT)	(40) (SEP)	10 (OCT)	1 (SEP)	3 (AUG)	13
Suipe	1 (OCT)	(0)	0	0	0	0
Bar-tailed Godwit	1200 (OCT)	(800) (SEP)	80 (OCT)	1200 (SEP)	(700) (OCT)	827
Curlew	(0)	(30) (SEP)	0	0	0	8
Redshank	340 (SEP)	(130) (SEP)	140 (OCT)	180 (SEP)	54 (AUG)	179
Turnstone	96 (OCT)	(70) (SEP)	95 (OCT)	(76) (OCT)	(140) (OCT)	110
Black-headed Gull	(0)	(0)	0	0	(240) (SEP)	80
Lesser Black-backed Gull	(0)	(0)	0	0	(8) (SEP)	3
Herring Gull	(0)	(0)	0	0	(800) (SEP)	267
Sandwich Tern	(20) (AUG)	(1) (SEP)	0	200 (SEP)	(0)	100

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Five year summary for Broughty Ferry to Buddon Ness (Monifieth)

Table 4b: Five-year winter peak counts, and month in which this was recorded, of each species.

The value reported represents the highest count obtained between November and March for the winter in question and the species in question

Where a count is enclosed by parentheses this indicates that it was considered incomplete i.e. those parts of the site not visited typically holds at least 25% of the species in question. Incomplete counts are excluded from calculation where, if included, they would depress the mean. When all counts are considered to be incomplete the maximum replaces the mean.

Species	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	Mean Peak
Mute Swan	110 (JAN)	16 (MAR)	11 (MAR)	20 (MAR)	23 (MAR)	36
Wigeon	100 (JAN)	12 (DEC)	12 (DEC)	60 (JAN)	100 (JAN)	57
Gadwall	2 (MAR)	3 (MAR)	(0)	0	0	1
Mallard	220 (JAN)	43 (DEC)	30 (DEC)	55 (DEC)	50 (JAN)	80
Eider	30 (JAN)	11 (FEB)	150 (MAR)	50 (JAN)	0	48
Goldeneye	1 (JAN)	0	(1) (NOV)	2 (NOV)	1 (MAR)	1
Red-breasted Merganser	2 (NOV)	0	(0)	0	0	1
Goosander	0	2 (FEB)	(1) (FEB)	0	2 (JAN)	1
Cormorant	1 (FEB)	1 (DEC)	(0)	3 (JAN)	1 (FEB)	2
Grey Heron	1 (NOV)	1 (MAR)	(2) (NOV)	1 (JAN)	1 (MAR)	1
Oystercatcher	460 (FEB)	340 (FEB)	780 (DEC)	800 (JAN)	240 (JAN)	524
Ringed Plover	80 (NOV)	(100) (JAN)	(110) (NOV)	85 (JAN)	50 (JAN)	85
Grey Plover	7 (NOV)	0	15 (DEC)	21 (FEB)	40 (FEB)	17
Knot	500 (JAN)	250 (FEB)	100 (DEC)	40 (NOV)	20 (MAR)	182
Sanderling	26 (JAN)	160 (DEC)	(40) (NOV)	250 (MAR)	100 (JAN)	134
Dunlin	540 (NOV)	(350) (JAN)	110 (DEC)	115 (FEB)	900 (JAN)	416
Bar-tailed Godwit	1000 (JAN)	600 (FEB)	350 (DEC)	700 (JAN)	800 (MAR)	690
Curlew	0	0	(0)	4 (DEC)	160 (FEB)	41
Redshank	200 (JAN)	100 (DEC)	(120) (JAN)	220 (MAR)	115 (MAR)	159
Turnstone	40 (MAR)	70 (MAR)	(50) (NOV)	82 (MAR)	80 (JAN)	68
Black-headed Gull	0	0	(0)	68 (DEC)	0	17
Herring Gull	0	0	(0)	22 (DEC)	0	6
Great Black-backed Gull	1 (JAN)	0	(0)	10 (MAR)	0	3

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Five year summary for Broughty Ferry to Buddon Ness (Monifieth)

Table 4c: Five-year spring peak counts, and month in which this was recorded, of each species.

The value reported represents the highest count obtained between April and June for the year in question and the species in question
Where a count is enclosed by parentheses this indicates that it was considered incomplete
i.e. those parts of the site not visited typically holds at least 25% of the species in question.
Incomplete counts are excluded from calculation where, if included, they would depress the mean.
When all counts are considered to be incomplete the maximum replaces the mean.

Species	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	Mean Peak
Mute Swan	N/C	32 (APR)	N/C	40 (APR)	N/C	36
Shelduck	N/C	2 (APR)	N/C	2 (APR)	N/C	2
Wigeon	N/C	5 (APR)	N/C	44 (APR)	N/C	25
Mallard	N/C	7 (APR)	N/C	48 (JUN)	N/C	28
Eider	N/C	0	N/C	400 (JUN)	N/C	200
Red-breasted Merganser	N/C	0	N/C	1 (APR)	N/C	1
Goosander	N/C	0	N/C	19 (JUN)	N/C	10
Grey Heron	N/C	0	N/C	1 (APR)	N/C	1
Moorhen	N/C	0	N/C	1 (APR)	N/C	1
Oystercatcher	N/C	200 (APR)	N/C	300 (JUN)	N/C	250
Grey Plover	N/C	2 (APR)	N/C	0	N/C	1
Sanderling	N/C	6 (APR)	N/C	80 (APR)	N/C	43
Dunlin	N/C	1 (APR)	N/C	0	N/C	1
Bar-tailed Godwit	N/C	0	N/C	200 (APR)	N/C	100
Curlew	N/C	0	N/C	4 (APR)	N/C	2
Redshank	N/C	90 (APR)	N/C	190 (APR)	N/C	140
Turnstone	N/C	50 (APR)	N/C	50 (APR)	N/C	50
Herring Gull	N/C	0	N/C	35 (JUN)	N/C	18
Great Black-backed Gull	N/C	0	N/C	3 (JUN)	N/C	2

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Five year summary for Broughty Ferry to Buddon Ness (Monifieth)
Table 4d: Five-year annual peak counts, and month in which this was recorded, of each species.

The value reported represents the highest count obtained between July and June for the year in question and the species in question
Where a count is enclosed by parentheses this indicates that it was considered incomplete
i.e. those parts of the site not visited typically holds at least 25% of the species in question.
Incomplete counts are excluded from calculation where, if included, they would depress the mean.
When all counts are considered to be incomplete the maximum replaces the mean.

Species	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015	Mean Peak
Mute Swan	(196) (AUG)	(35) (SEP)	27 (SEP)	114 (SEP)	82 (AUG)	105
Shelduck	(0)	2 (APR)	0	2 (APR)	0	1
Wigeon	100 (JAN)	(13) (SEP)	15 (SEP)	160 (SEP)	100 (JAN)	94
Gadwall	2 (MAR)	3 (MAR)	0	0	0	1
Mallard	220 (JAN)	43 (DEC)	56 (SEP)	55 (DEC)	50 (JAN)	85
Eider	(400) (AUG)	11 (FEB)	150 (MAR)	400 (JUN)	220 (AUG)	236
Goldeneye	1 (JAN)	(0)	(1) (NOV)	2 (NOV)	1 (MAR)	1
Red-breasted Merganser	2 (NOV)	(0)	0	1 (APR)	0	1
Goosander	(85) (AUG)	(6) (SEP)	90 (SEP)	19 (JUN)	75 (AUG)	67
Cormorant	(1) (AUG)	1 (DEC)	1 (OCT)	3 (JAN)	1 (FEB)	2
Grey Heron	(3) (AUG)	1 (MAR)	(2) (NOV)	(1) (OCT)	1 (MAR)	2
Moorhen	(0)	(0)	0	1 (APR)	0	0
Oystercatcher	460 (FEB)	(380) (SEP)	780 (DEC)	800 (JAN)	240 (JAN)	570
Ringed Plover	80 (NOV)	(140) (SEP)	190 (SEP)	150 (SEP)	50 (JAN)	122
Golden Plover	(5) (AUG)	(0)	0	150 (SEP)	(1) (SEP)	75
Grey Plover	(20) (AUG)	2 (APR)	15 (DEC)	21 (FEB)	40 (FEB)	20
Knot	500 (JAN)	250 (FEB)	100 (DEC)	50 (SEP)	20 (MAR)	184
Sanderling	(200) (AUG)	160 (DEC)	(40) (NOV)	250 (MAR)	100 (JAN)	178
Dunlin	540 (NOV)	(350) (JAN)	110 (DEC)	115 (FEB)	900 (JAN)	416
Snipe	1 (OCT)	(0)	0	0	0	0
Bar-tailed Godwit	1200 (OCT)	(800) (SEP)	350 (DEC)	1200 (SEP)	800 (MAR)	888
Curlew	(0)	(30) (SEP)	0	4 (APR)	160 (FEB)	55
Redshank	340 (SEP)	(130) (SEP)	140 (OCT)	220 (MAR)	115 (MAR)	204
Turnstone	96 (OCT)	(70) (SEP)	95 (OCT)	82 (MAR)	(140) (OCT)	103
Black-headed Gull	(0)	(0)	0	68 (DEC)	(240) (SEP)	103
Lesser Black-backed Gull	(0)	(0)	0	0	(8) (SEP)	3
Herring Gull	(0)	(0)	0	35 (JUN)	(800) (SEP)	278
Great Black-backed Gull	1 (JAN)	(0)	0	10 (MAR)	0	3
Sandwich Tern	(20) (AUG)	(1) (SEP)	0	200 (SEP)	(0)	100

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Five year summary for Broughty Ferry to Buddon Ness (Monifieth)

Table 5: National and International importance of the site for each species.

Figures given indicate the percentage of the relevant threshold level in operation during 2014/2015 represented by the five-winter mean of peak counts for the species in question

e.g. 50% would indicate that the five-winter mean of peak counts is half the threshold level. It follows that values of 100% or higher indicate nationally or internationally important numbers of a given species occur on the site.

Where a count is enclosed by parentheses this indicates that it was considered incomplete (i.e. those parts of the site not visited typically hold at least 25% of the species in question).

(an asterisk indicates that a 50-bird minimum (typically used for designation) has been used rather than 1% of National population)

Species	Autumn peak of National Threshold	Winter peak of National Threshold	Spring peak of National Threshold	Annual peak of National Threshold	Autumn peak of International Threshold	Winter peak of International Threshold	Spring peak of International Threshold	Annual peak of International Threshold
Mute Swan	14%	5%	5%	14%	33%	11%	11%	33%
Shelduck	N/A	N/A	0%	0%	N/A	N/A	0%	0%
Wigeon	2%	1%	1%	2%	0%	0%	0%	1%
Gadwall	N/A	0%	N/A	0%	N/A	0%	N/A	0%
Mallard	1%	1%	0%	1%	0%	0%	0%	0%
Eider	38%	9%	36%	43%	2%	0%	2%	2%
Goldeneye	N/A	1%	N/A	1%	N/A	0%	N/A	0%
Red-breasted Merganser	N/A	1%	1%	1%	N/A	0%	0%	0%
Goosander	54%	1%	8%	56%	2%	0%	0%	2%
Cormorant	0%	1%	N/A	1%	0%	0%	N/A	0%
Grey Heron	0%	0%	0%	0%	0%	0%	0%	0%
Moorhen	N/A	N/A	0%	0%	N/A	N/A	0%	0%

Species	Autumn 5yr mean of peaks	Winter 5yr mean of peaks	Spring 5yr mean of peaks	Annual 5yr mean of peaks
Mute Swan	105	36	36	105
Shelduck			2	1
Wigeon	68	57	25	94
Gadwall		1		1
Mallard	50	80	28	85
Eider	207	48	200	236
Goldeneye		1		1
Red-breasted Merganser		1	1	1
Goosander	65	1	10	67
Cormorant	1	2		2
Grey Heron	1	1	1	2
Moorhen			1	0

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Five year summary for Broughty Ferry to Buddon Ness (Monifieth)

Table 5: National and International importance of the site for each species.

Figures given indicate the percentage of the relevant threshold level in operation during 2014/2015

represented by the five-winter mean of peak counts for the species in question

e.g. 50% would indicate that the five-winter mean of peak counts is half the threshold level. It follows that values of 100% or higher indicate nationally or internationally important numbers of a given species occur on the site.

Where a count is enclosed by parentheses this indicates that it was considered incomplete

(i.e. those parts of the site not visited typically hold at least 25% of the species in question).

(an asterisk indicates that a 50-bird minimum (typically used for designation) has been used rather than 1% of National population)

Species	Autumn peak cf National Threshold	Winter peak cf National Threshold	Spring peak cf National Threshold	Annual peak cf National Threshold	Autumn peak cf International Threshold	Winter peak cf International Threshold	Spring peak cf International Threshold	Annual peak cf International Threshold
Oystercatcher	6%	16%	8%	18%	2%	6%	3%	7%
Ringed Plover	50%	25%	N/A	36%	23%	12%	N/A	17%
Golden Plover	2%	N/A	N/A	2%	1%	N/A	N/A	1%
Grey Plover	1%	4%	0%	5%	0%	1%	0%	1%
Knot	3%	6%	N/A	6%	2%	4%	N/A	4%
Sanderling	46%	84%	27%	111%	6%	11%	4%	15%
Dunlin	0%	12%	0%	12%	0%	3%	0%	3%
Bar-tailed Godwit	218%	182%	26%	234%	69%	58%	8%	74%
Curlew	1%	3%	0%	4%	0%	0%	0%	1%
Redshank	15%	13%	12%	17%	7%	7%	6%	9%
Turnstone	23%	14%	10%	21%	8%	5%	4%	7%
Black-headed Gull	0%	0%	N/A	0%	0%	0%	N/A	1%

Species	Autumn 5yr mean of peaks	Winter 5yr mean of peaks	Spring 5yr mean of peaks	Annual 5yr mean of peaks
Oystercatcher	177	524	250	570
Ringed Plover	170	85		122
Golden Plover	75			75
Grey Plover	5	17	1	20
Knot	88	182		184
Sanderling	73	134	43	178
Dunlin	13	416	1	416
Bar-tailed Godwit	827	690	100	888
Curlew	8	41	2	55
Redshank	179	159	140	204
Turnstone	110	68	50	103
Black-headed Gull	80	17		103

Data provided by the British Trust for Ornithology on behalf of The Wetland Bird Survey.

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Five year summary for Broughty Ferry to Buddon Ness (Monifieth)

Table 5: National and International importance of the site for each species.

Figures given indicate the percentage of the relevant threshold level in operation during 2014/2015

represented by the five-winter mean of peak counts for the species in question

e.g. 50% would indicate that the five-winter mean of peak counts is half the threshold level. It follows that values of 100% or higher indicate nationally or internationally important numbers of a given species occur on the site.

Where a count is enclosed by parentheses this indicates that it was considered incomplete

(i.e. those parts of the site not visited typically hold at least 25% of the species in question).

(an asterisk indicates that a 50-bird minimum (typically used for designation) has been used rather than 1% of National population)

Species	Autumn peak cf National Threshold	Winter peak cf National Threshold	Spring peak cf National Threshold	Annual peak cf National Threshold	Autumn peak cf International Threshold	Winter peak cf International Threshold	Spring peak cf International Threshold	Annual peak cf International Threshold
Lesser Black-backed Gull	0%	N/A	N/A	0%	0%	N/A	N/A	0%
Herring Gull	4%	0%	0%	4%	3%	0%	0%	3%
Great Black-backed Gull	N/A	0%	0%	0%	N/A	0%	0%	0%
Sandwich Tern	*200%	N/A	N/A	*200%	6%	N/A	N/A	6%

Species	Autumn 5yr mean of peaks	Winter 5yr mean of peaks	Spring 5yr mean of peaks	Annual 5yr mean of peaks
Lesser Black-backed Gull	3			3
Herring Gull	267	6	18	278
Great Black-backed Gull		3	2	3
Sandwich Tern	100			100

Data provided by the British Trust for Ornithology on behalf of The Wetland Bird Survey

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For some species (e.g. wintering pease) data collected by other surveys may be more appropriate for the purpose of site assessment.

Missing or unexpectedly low counts for gulls and terns should be treated with caution - counting these groups is optional and determination of count effort not always possible.

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ANNEX B. BTO WeBS Core High Tide data, Tay Bridge to Broughty Ferry (Stannergate 87411)

WeBS
The Wetland Bird Survey



Five year summary for Tay - Dundee to Broughty Ferry (Stannergate)

Table 1: Total Counts - All Species Combined.

Peak monthly total = maximum of the sum of the counts of all species within each month.

Seasonal peaks = sum of the maximum counts of for each species within each Season.

Year	Peak Monthly Total	Autumn Peak	Winter Peak	Spring Peak
11/12	()	N/C	N/C	N/C
12/13	()	N/C	N/C	N/C
13/14	38 (APR)	N/C	42	44
14/15	()	N/C	N/C	N/C
15/16	()	N/C	N/C	N/C
MEAN	38	N/C	42	44

Data provided by the British Trust for Ornithology on behalf of The Wetland Bird Survey.

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For some species (e.g. wintering geese) data collected by other surveys may be more appropriate for the purpose of site assessment.

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Five year summary for Tay - Dundee to Broughty Ferry (Stannergate)

Table 2: Five-year average monthly counts of each species.

Figure in parentheses give number of complete and incomplete counts upon which the average is based. Incomplete counts are excluded from calculations where, if included, they would depress the mean.

Species	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Mute Swan	N/C	N/C	N/C	N/C	0(1,)	0(1,)	2(1,)	N/C	N/C	2(1,)	0(1,)	N/C
Eider	N/C	N/C	N/C	N/C	0(1,)	0(1,)	0(1,)	N/C	N/C	6(1,)	0(1,)	N/C
Red-breasted Merganser	N/C	N/C	N/C	N/C	0(1,)	0(1,)	0(1,)	N/C	N/C	0(1,)	1(1,)	N/C
Goosander	N/C	N/C	N/C	N/C	0(1,)	0(1,)	0(1,)	N/C	N/C	0(1,)	3(1,)	N/C
Cormorant	N/C	N/C	N/C	N/C	0(1,)	0(1,)	2(1,)	N/C	N/C	7(1,)	0(1,)	N/C
Oystercatcher	N/C	N/C	N/C	N/C	0(1,)	0(1,)	8(1,)	N/C	N/C	0(1,)	1(1,)	N/C
Turnstone	N/C	N/C	N/C	N/C	0(1,)	0(1,)	4(1,)	N/C	N/C	0(1,)	0(1,)	N/C
Black-headed Gull	N/C	N/C	N/C	N/C	0(1,)	12(1,)	0(1,)	N/C	N/C	3(1,)	0(1,)	N/C
Herring Gull	N/C	N/C	N/C	N/C	0(1,)	6(1,)	14(1,)	N/C	N/C	20(1,)	8(1,)	N/C
Great Black-backed Gull	N/C	N/C	N/C	N/C	0(1,)	0(1,)	0(1,)	N/C	N/C	0(1,)	1(1,)	N/C

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Five year summary for Tay - Dundee to Broughty Ferry (Stannergate)

Table3: Five-year peak monthly counts of each species.

The value reported represents the highest count obtained over the five-year period during the month in question and the species in question.

Species	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Mute Swan	N/C	N/C	N/C	N/C	0	0	2	N/C	N/C	2	0	N/C
Eider	N/C	N/C	N/C	N/C	0	0	0	N/C	N/C	6	0	N/C
Red-breasted Merganser	N/C	N/C	N/C	N/C	0	0	0	N/C	N/C	0	1	N/C
Goosander	N/C	N/C	N/C	N/C	0	0	0	N/C	N/C	0	3	N/C
Cormorant	N/C	N/C	N/C	N/C	0	0	2	N/C	N/C	7	0	N/C
Oystercatcher	N/C	N/C	N/C	N/C	0	0	8	N/C	N/C	0	1	N/C
Turnstone	N/C	N/C	N/C	N/C	0	0	4	N/C	N/C	0	0	N/C
Black-headed Gull	N/C	N/C	N/C	N/C	0	12	0	N/C	N/C	3	0	N/C
Herring Gull	N/C	N/C	N/C	N/C	0	6	14	N/C	N/C	20	8	N/C
Great Black-backed Gull	N/C	N/C	N/C	N/C	0	0	0	N/C	N/C	0	1	N/C

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Five year summary for Tay - Dundee to Broughty Ferry (Stannergate)
Table4b: Five-year winter peak counts, and month in which this was recorded, of each species.

The value reported represents the highest count obtained between November and March for the winter in question and the species in question

Where a count is enclosed by parentheses this indicates that it was considered incomplete i.e. those parts of the site not visited typically holds at least 25% of the species in question. Incomplete counts are excluded from calculation where, if included, they would depress the mean. When all counts are considered to be incomplete the maximum replaces the mean.

Species	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	Mean Peak
Mute Swan	N/C	N/C	2 (JAN)	N/C	N/C	2
Cormorant	N/C	N/C	2 (JAN)	N/C	N/C	2
Oystercatcher	N/C	N/C	8 (JAN)	N/C	N/C	8
Turnstone	N/C	N/C	4 (JAN)	N/C	N/C	4
Black-headed Gull	N/C	N/C	12 (DEC)	N/C	N/C	12
Herring Gull	N/C	N/C	14 (JAN)	N/C	N/C	14

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Five year summary for Tay - Dundee to Broughty Ferry (Stannergate)
Table 4c: Five-year spring peak counts, and month in which this was recorded, of each species.

The value reported represents the highest count obtained between April and June for the year in question and the species in question
Where a count is enclosed by parentheses this indicates that it was considered incomplete
i.e. those parts of the site not visited typically holds at least 25% of the species in question.
Incomplete counts are excluded from calculation where, if included, they would depress the mean.
When all counts are considered to be incomplete the maximum replaces the mean.

Species	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	Mean Peak
Mute Swan	N/C	N/C	2 (APR)	N/C	N/C	2
Eider	N/C	N/C	6 (APR)	N/C	N/C	6
Red-breasted Merganser	N/C	N/C	1 (MAY)	N/C	N/C	1
Goosander	N/C	N/C	3 (MAY)	N/C	N/C	3
Cormorant	N/C	N/C	7 (APR)	N/C	N/C	7
Oystercatcher	N/C	N/C	1 (MAY)	N/C	N/C	1
Black-headed Gull	N/C	N/C	3 (APR)	N/C	N/C	3
Herring Gull	N/C	N/C	20 (APR)	N/C	N/C	20
Great Black-backed Gull	N/C	N/C	1 (MAY)	N/C	N/C	1

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Five year summary for Tay - Dundee to Broughty Ferry (Stannergate)
Table4d: Five-year annual peak counts, and month in which this was recorded, of each species.

The value reported represents the highest count obtained between July and June for the year in question and the species in question
Where a count is enclosed by parentheses this indicates that it was considered incomplete
i.e. those parts of the site not visited typically holds at least 25% of the species in question.
Incomplete counts are excluded from calculation where, if included, they would depress the mean.
When all counts are considered to be incomplete the maximum replaces the mean.

Species	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	Mean Peak
Mute Swan	N/C	N/C	2 (APR)	N/C	N/C	2
Eider	N/C	N/C	6 (APR)	N/C	N/C	6
Red-breasted Merganser	N/C	N/C	1 (MAY)	N/C	N/C	1
Goosander	N/C	N/C	3 (MAY)	N/C	N/C	3
Cormorant	N/C	N/C	7 (APR)	N/C	N/C	7
Oystercatcher	N/C	N/C	8 (JAN)	N/C	N/C	8
Turnstone	N/C	N/C	4 (JAN)	N/C	N/C	4
Black-headed Gull	N/C	N/C	12 (DEC)	N/C	N/C	12
Herring Gull	N/C	N/C	20 (APR)	N/C	N/C	20
Great Black-backed Gull	N/C	N/C	1 (MAY)	N/C	N/C	1

Data provided by the British Trust for Ornithology on behalf of The Wetland Bird Survey.
These tabulations are based exclusively on data collected as part of the monthly Core Counts.
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Five year summary for Tay - Dundee to Broughty Ferry (Stannergate)

Table 5: National and International importance of the site for each species.

Figures given indicate the percentage of the relevant threshold level in operation during 2015/2016 represented by the five-winter mean of peak counts for the species in question

e.g. 50% would indicate that the five-winter mean of peak counts is half the threshold level. It follows that values of 100% or higher indicate nationally or internationally important numbers of a given species occur on the site.

Where a count is enclosed by parentheses this indicates that it was considered incomplete

(i.e. those parts of the site not visited typically hold at least 25% of the species in question).

(an asterisk indicates that a 50-bird minimum (typically used for designation) has been used rather than 1% of National population)

Species	Autumn peak of National Threshold	Winter peak of National Threshold	Spring peak of National Threshold	Annual peak of National Threshold	Autumn peak of International Threshold	Winter peak of International Threshold	Spring peak of International Threshold	Annual peak of International Threshold
Mute Swan	N/A	0%	0%	0%	N/A	1%	1%	1%
Eider	N/A	N/A	1%	1%	N/A	N/A	0%	0%
Red-breasted Merganser	N/A	N/A	1%	1%	N/A	N/A	0%	0%
Goosander	N/A	N/A	3%	3%	N/A	N/A	0%	0%
Cormorant	N/A	1%	2%	2%	N/A	0%	1%	1%
Oystercatcher	N/A	0%	0%	0%	N/A	0%	0%	0%
Turnstone	N/A	1%	N/A	1%	N/A	0%	N/A	0%
Black-headed Gull	N/A	0%	0%	0%	N/A	0%	0%	0%
Herring Gull	N/A	0%	0%	0%	N/A	0%	0%	0%
Great Black-backed Gull	N/A	N/A	0%	0%	N/A	N/A	0%	0%

Species	Autumn 5yr mean of peaks	Winter 5yr mean of peaks	Spring 5yr mean of peaks	Annual 5yr mean of peaks
Mute Swan		2	2	2
Eider			6	6
Red-breasted Merganser			1	1
Goosander			3	3
Cormorant		2	7	7
Oystercatcher		8	1	8
Turnstone		4		4
Black-headed Gull		12	3	12
Herring Gull		14	20	20
Great Black-backed Gull			1	1

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Assessing or unexpectedly low counts for gulls and terns should be treated with caution - counting these groups is optional and determination of count effort not always possible

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ANNEX B. BTO WEBS Low tide data, 2012/13

Firth of Tay (Low Tide)
WeBS Low Tide Count data for the winter 2012/13

Table 1: Raw monthly totals counted for the whole site

Date for all groups were requested - if data for gulls or terns were available note counting of both is optional (so statistics questionable)

Species	Nov	Dec	Jan	Feb	Winter maximum	Month of maximum
Mute Swan	15	10	12	31	31	Feb
Whooper Swan	.	3	.	2	3	Dec
Pink-footed Goose	250	53	516	585	585	Feb
Greylag Goose	15	10	13	455	455	Feb
Canada Goose	.	4	.	.	4	Dec
Shelduck	119	127	185	205	205	Feb
Wigeon	100	78	31	47	100	Nov
Teal	353	464	402	409	464	Dec
Mallard	316	639	417	279	639	Dec
Pintail	1	.	1	.	1	Nov,Jan
Eider	8674	6692	3102	12667	12667	Feb
Long-tailed Duck	13	102	12	8	102	Dec
Common Scoter	148	350	120	218	350	Dec
Velvet Scoter	6	.	.	5	6	Nov
Goldeneye	.	56	79	59	79	Jan
Red-breasted Merganser	40	62	59	56	62	Dec
Goosander	12	3	.	.	12	Nov
Red-throated Diver	8	2	.	4	8	Nov
Slavonian Grebe	3	4	.	4	4	Dec,Feb
Cormorant	126	85	37	106	126	Nov
Shag	.	1	.	4	4	Feb
Grey Heron	21	28	10	23	28	Dec
Water Rail	1	.	.	.	1	Nov
Oystercatcher	1168	1509	1795	1695	1795	Jan
Ringed Plover	1	7	27	5	27	Jan
Golden Plover	122	10	.	105	122	Nov
Grey Plover	95	57	70	111	111	Feb

Data provided by the British Trust for Ornithology on behalf of The Wetland Bird Survey.
These tabulations are based exclusively on data collected as part of the Low Tide Count scheme.

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Firth of Tay (Low Tide)
WeBS Low Tide Count data for the winter 2012/13

Table 1: Raw monthly totals counted for the whole site

Date for all groups were requested - if data for gulls or terns were available note counting of both is optional (so statistics questionable)

Species	Nov	Dec	Jan	Feb	Winter maximum	Month of maximum
Lapwing	45	69	2	.	69	Dec
Knot	56	46	45	52	56	Nov
Sanderling	107	36	70	54	107	Nov
Dunlin	119	434	572	7	572	Jan
Bar-tailed Godwit	280	589	458	788	788	Feb
Curlew	358	340	357	589	589	Feb
Greenshank	1	2	1	1	2	Dec
Redshank	402	437	250	272	437	Dec
Turnstone	30	47	126	40	126	Jan
Black-headed Gull	146	209	900	792	900	Jan
Common Gull	192	151	560	384	560	Jan
Lesser Black-backed Gull	1	1	.	.	1	Nov,Dec
Herring Gull	200	139	297	193	297	Jan
Great Black-backed Gull	15	14	2	10	15	Nov
unidentified gull	.	.	11	.	11	Jan
unidentified small gull	94	6	.	.	94	Nov

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Firth of Tay (Low Tide)
WeBS Low Tide Count data for the winter 2012/13

Table 2: Overall counted area per month (in hectares) for all sectors counted in 2012/13

Sector code	Intertidal	Sub-tidal	Non-tidal	Total	Months counted
BT001	29	88	0	117	Nov,Dec,Jan,Feb
BT002	62	101	0	163	Nov,Dec,Jan,Feb
BT007	1	0	0	1	Nov,Dec,Jan,Feb
BT015	12	0	0	12	Nov,Dec,Jan,Feb
BT029	1	27	0	28	Nov,Dec,Jan,Feb
BT030	37	75	0	112	Nov,Dec,Jan,Feb
BT031	57	73	0	130	Nov,Dec,Jan,Feb
BT032	63	26	0	89	Nov,Dec,Jan,Feb
BT033	122	0	0	122	Nov,Dec,Jan,Feb
BT034	88	35	0	123	Nov,Dec,Jan,Feb
BT035	93	3	0	96	Nov,Dec,Jan,Feb
BT036	82	18	0	100	Nov,Dec,Jan,Feb
BT037	206	22	0	228	Nov,Dec,Jan,Feb
BT038	193	9	0	202	Nov,Dec,Jan,Feb
BT039	59	0	0	59	Nov
BT043	153	0	0	153	Nov,Dec,Jan,Feb
BT046	113	0	7	120	Jan,Feb
BT047	57	0	9	66	Jan,Feb
BT049	452	114	43	609	Nov,Dec,Jan,Feb
BT051	53	119	0	172	Nov,Dec,Jan,Feb
BT053	58	259	0	317	Nov,Dec,Jan,Feb
BT054	233	102	0	335	Nov,Dec,Jan,Feb
BT055	118	444	0	562	Nov,Dec,Jan,Feb
BT065	21	157	0	178	Nov,Dec,Jan,Feb
BT066	4	144	0	148	Nov,Dec,Jan,Feb
BT068	3	69	0	72	Nov,Dec,Jan,Feb
BT079	100	8	0	108	Nov,Dec,Jan,Feb
BT080	0	35	0	35	Nov,Dec,Jan,Feb

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Firth of Tay (Low Tide)
WeBS Low Tide Count data for the winter 2012/13

Table 2: Overall counted area per month (in hectares) for all sectors counted in 2012/13

Sector code	Intertidal	Sub-tidal	Non-tidal	Total	Months counted
BT081	11	4	0	15	Nov,Dec,Jan,Feb
BT082	1	42	0	43	Nov,Dec,Jan,Feb
BT083	23	8	0	31	Nov,Dec,Jan,Feb
BT084	15	28	0	43	Nov,Dec,Jan,Feb
BT085	3	0	0	3	Nov,Dec,Jan,Feb
BT086	24	1	0	25	Nov,Dec,Jan,Feb
BT087	16	38	0	54	Nov,Dec,Jan,Feb
BT088	34	1	0	35	Nov,Dec,Jan,Feb
BT089	14	54	0	68	Nov,Dec,Jan,Feb
BT090	7	0	0	7	Nov,Dec,Jan,Feb
BT091	16	0	0	16	Nov,Dec,Jan,Feb
BT092	0	31	0	31	Nov,Dec,Jan,Feb
BT093	20	3	0	23	Nov,Dec,Jan,Feb
BT094	0	53	0	53	Nov,Dec,Jan,Feb
BT095	3	31	0	34	Nov,Dec,Jan,Feb
BT096	6	34	0	40	Nov,Dec,Jan,Feb
BT097	5	49	0	54	Nov,Dec,Jan,Feb
BT098	8	57	0	65	Nov,Dec,Jan,Feb
BT099	112	1	0	113	Nov,Dec,Jan,Feb
BT100	170	0	0	170	Nov,Dec,Jan,Feb
BT101	185	0	0	185	Nov,Dec,Jan,Feb
BT102	141	78	0	219	Nov,Dec,Jan,Feb
BT103	92	149	0	241	Nov
BT104	412	160	0	572	Nov,Dec,Feb
BT105	206	99	0	305	Nov,Dec,Feb
BT106	30	69	0	99	Nov,Dec,Feb
BT107	12	52	0	64	Nov,Dec,Feb
BT108	24	81	0	105	Nov,Dec,Feb

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WeBS Low Tide Count data for the winter 2012/13

Table 2: Overall counted area per month (in hectares) for all sectors counted in 2012/13

Sector code	Intertidal	Sub-tidal	Non-tidal	Total	Months counted
BT109	74	390	0	464	Nov,Jan,Feb
BT110	58	49	0	107	Nov,Dec,Jan,Feb
BT111	52	67	0	119	Nov,Dec,Jan,Feb
BT112	57	0	0	57	Nov,Dec,Jan,Feb
BT113	87	0	0	87	Nov,Dec,Jan,Feb
BT114	33	84	0	117	Nov,Dec,Jan,Feb
BT115	393	719	0	1112	Nov,Dec,Jan,Feb
BT116	126	112	0	238	Nov,Dec,Jan,Feb
BT117	135	211	0	346	Nov,Dec,Jan,Feb
BT118	5	46	0	51	Nov,Dec,Jan,Feb
BT119	0	567	0	567	Nov
BT120	172	72	7	251	Dec,Jan,Feb
BT121	172	135	21	328	Nov
Total	5424	5503	87	11014	

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Firth of Tay (Low Tide)
WeBS Low Tide Count data for the winter 2012/13

Table 3: Peak and mean densities for each species on requested count sections only

Areas in hectares, densities in birds per hectare

Sector code	Species	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
BT095	Mute Swan	Sub-tidal	31	7	0.23	5	0.16
	Mallard	All habitats	34	6	0.18	2	0.07
	Eider	Sub-tidal	31	19	0.61	7	0.23
	Red-breasted Merganser	Sub-tidal	31	10	0.32	8	0.25
	Slavonian Grebe	Sub-tidal	31	1	0.03	0	0.01
	Cormorant	All habitats	34	3	0.09	1	0.03
	Grey Heron	Intertidal & non-tidal	3	2	0.67	1	0.42
	Oystercatcher	Intertidal	3	19	6.33	6	1.92
	Curlew	Intertidal & non-tidal	3	2	0.67	2	0.58
	Redshank	Intertidal & non-tidal	3	3	1.00	2	0.58
	Turnstone	Intertidal	3	5	1.67	1	0.42
	Black-headed Gull	All habitats	34	37	1.09	25	0.74
	Common Gull	All habitats	34	4	0.12	3	0.08
	Lesser Black-backed Gull	All habitats	34	1	0.03	0	0.01
	Herring Gull	All habitats	34	43	1.26	20	0.59
	Great Black-backed Gull	All habitats	34	1	0.03	0	0.01
BT096	Mute Swan	Sub-tidal	34	3	0.09	1	0.02
	Eider	Sub-tidal	34	22	0.65	9	0.26
	Common Scoter	Sub-tidal	34	15	0.44	4	0.11
	Red-breasted Merganser	Sub-tidal	34	2	0.06	1	0.04
	Cormorant	All habitats	40	1	0.03	0	0.01
	Grey Heron	Intertidal & non-tidal	6	1	0.17	0	0.04
	Oystercatcher	Intertidal	6	18	3.00	10	1.67
	Curlew	Intertidal & non-tidal	6	4	0.67	2	0.33
	Redshank	Intertidal & non-tidal	6	10	1.67	4	0.67
Turnstone	Intertidal	6	17	2.83	6	1.04	

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Firth of Tay (Low Tide)
WeBS Low Tide Count data for the winter 2012/13

Table 3: Peak and mean densities for each species on requested count sections only

Areas in hectares, densities in birds per hectare

Sector code	Species	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
	Black-headed Gull	All habitats	40	20	0.50	12	0.29
	Common Gull	All habitats	40	5	0.13	3	0.08
	Herring Gull	All habitats	40	6	0.15	5	0.12
BT097	Eider	Sub-tidal	49	2	0.04	1	0.01
	Goldeneye	Sub-tidal	49	1	0.02	0	0.01
	Red-breasted Merganser	Sub-tidal	49	10	0.20	7	0.14
	Cormorant	All habitats	54	1	0.02	0	0.00
	Oystercatcher	Intertidal	5	23	4.60	16	3.10
	Curlew	Intertidal & non-tidal	5	2	0.40	1	0.20
	Redshank	Intertidal & non-tidal	5	3	0.60	3	0.50
	Turnstone	Intertidal	5	2	0.40	1	0.10
	Black-headed Gull	All habitats	54	23	0.43	12	0.23
	Common Gull	All habitats	54	1	0.02	1	0.01
	Herring Gull	All habitats	54	4	0.07	3	0.06
BT098	Mallard	All habitats	65	1	0.02	0	0.00
	Red-breasted Merganser	Sub-tidal	57	33	0.58	15	0.26
	Cormorant	All habitats	65	1	0.02	1	0.01
	Grey Heron	Intertidal & non-tidal	8	1	0.13	1	0.06
	Oystercatcher	Intertidal	8	6	0.75	3	0.34
	Lapwing	Intertidal & non-tidal	8	2	0.25	1	0.06
	Curlew	Intertidal & non-tidal	8	1	0.13	0	0.03
	Redshank	Intertidal & non-tidal	8	5	0.63	2	0.19
	Black-headed Gull	All habitats	65	74	1.14	33	0.50
	Common Gull	All habitats	65	9	0.14	5	0.07
	Herring Gull	All habitats	65	6	0.09	4	0.05

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Firth of Tay (Low Tide)
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Table 4: Mean count and density for each species for the whole site

Densities in birds per hectare

Note these values are the sums of the values from Table 3 and thus take into account monthly variation in coverage

Species	Preferred habitat	Total area of preferred habitat	Mean site count	Mean site density
Mute Swan	Sub-tidal	866.0	22	0.03
Whooper Swan	All habitats	470.0	2	0.00
Pink-footed Goose	All habitats	2008.0	478	0.24
Greylag Goose	All habitats	1916.0	125	0.07
Canada Goose	All habitats	315.0	2	0.01
Shelduck	All habitats	3424.0	163	0.05
Wigeon	All habitats	2053.0	118	0.06
Teal	All habitats	1434.0	407	0.28
Mallard	All habitats	6962.0	424	0.06
Pintail	All habitats	267.0	0	0.00
Eider	Sub-tidal	1885.1	7787	4.13
Long-tailed Duck	Sub-tidal	1198.0	35	0.03
Common Scoter	Sub-tidal	1076.0	210	0.20
Velvet Scoter	Sub-tidal	211.0	3	0.01
Goldeneye	Sub-tidal	2370.0	55	0.02
Red-breasted Merganser	Sub-tidal	2774.1	55	0.02
Goosander	Sub-tidal	419.0	6	0.01
Red-throated Diver	Sub-tidal	1235.0	4	0.00
Slavonian Grebe	Sub-tidal	961.0	2	0.00
Cormorant	All habitats	7536.0	97	0.01
Shag	Sub-tidal	791.0	2	0.00
Grey Heron	Intertidal & non-tidal	2296.1	25	0.01
Water Rail	Intertidal & non-tidal	122.0	0	0.00
Oystercatcher	Intertidal	3630.3	1563	0.43
Ringed Plover	Intertidal	161.1	10	0.06

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Firth of Tay (Low Tide)
WeBS Low Tide Count data for the winter 2012/13

Table 4: Mean count and density for each species for the whole site

Densities in birds per hectare

Note these values are the sums of the values from Table 3 and thus take into account monthly variation in coverage

Species	Preferred habitat	Total area of preferred habitat	Mean site count	Mean site density
Golden Plover	Intertidal & non-tidal	367.0	59	0.16
Grey Plover	Intertidal	945.3	85	0.09
Lapwing	Intertidal & non-tidal	304.0	29	0.10
Knot	Intertidal	646.0	50	0.08
Sanderling	Intertidal	500.2	68	0.14
Dunlin	Intertidal	1160.1	286	0.25
Bar-tailed Godwit	Intertidal	1722.2	537	0.31
Curlew	Intertidal & non-tidal	4222.3	460	0.11
Greenshank	Intertidal & non-tidal	159.0	2	0.01
Redshank	Intertidal & non-tidal	2368.2	352	0.15
Turnstone	Intertidal	906.0	61	0.07
Black-headed Gull	All habitats	7026.0	539	0.08
Common Gull	All habitats	4998.0	340	0.07
Lesser Black-backed Gull	All habitats	156.0	0	0.00
Herring Gull	All habitats	5716.0	213	0.04
Great Black-backed Gull	All habitats	4657.0	11	0.00
unidentified gull	All habitats	335.0	3	0.01
unidentified small gull	All habitats	1214.0	26	0.02

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ANNEX D

DUNDEE CITY COUNCIL PROPOSED FLOOD PROTECTION WORKS BROUGHTY FERRY

COASTAL HYDRODYNAMICS REVIEW OF POTENTIAL EFFECT OF PROPOSALS ON INTER TIDAL AND SUB TIDAL BED AREAS

Dr Ping Dong
Professor of Coastal Engineering
University of Liverpool

January 2018

CONTENTS

(A)/1	CHANGING SHORELINE BOUNDARY CONDITIONS (Douglas Terrace – Fisher Street)
(A)/2	CHANGING SHORELINE BOUNDARY CONDITIONS (Section 3 Beach)
(B)	CONSTRUCTION EFFECTS

REFERENCE DOCUMENTS

- A *Copy of DCC EIA Screening Opinion Letter Dated November 2017 and Associated Tables and Figures.*
- B *Copy of DRAFT HRA prepared by ECOS as passed to SNH in November 2017.*
- C *SNH response to DCC screening opinion (letter dated 4th December 2017) which included at Annex A SNH comments on the draft HRA and a request for further hydrological assessment.*
- D *Mott May 2017 Broughty Ferry Coastal Defence Assessment which included scour and overtopping calculations based on beach sediment sampling.*
- E *Photographs taken during recent (2017) beach trial holes to locate Hatton Main along Douglas Terrace & Fisher Street.*
- F *Photographs of Hatton Main temporary works during installation in the beach.*
- G *Report by Prof R Duck as Incorporated into Hydraulic Study Report for V&A Project.*

Following text is verbatim text per E mail report sent by Dr Ping Dong to Macleod Consulting on 18 January 2018

I am pleased to be asked by Dundee City Council (DCC) to carry out an independent review of the proposed work for Broughty Ferry Flood Protection and thank you for providing me with the relevant information for the review. In carrying out this work I have drawn on the knowledge about the hydrodynamics and morphodynamics of River Tay which I have gained through working with DCC over the past 10 years including advice given in relation to:-

- Atkins 2007 Meteorological and Tide Effects Assessment 2007
- Atkins 2007 Overtopping and Flood Assessment
- Atkins 2007 Erosion Assessment (Stannergate to Dighty)
- Mott 2013: Dundee Coastal Study Stage 2, Hydraulic Modelling Report
- Mac Con 2013: Modelling V&A Offshore Site Formation
- United Utilities Hatton Rising Main and Storm Culvert Beach Sections Stannergate to Fisher Street.
- Mac Con: Broughty Ferry Dunes: Review of Dune Replenishment Proposals
- Mott 2017: Broughty Ferry Dunes: Establishing Design Criteria for Flood Protection Measures

In the process of undertaking this review I have been briefed by Macleod Consulting (MC) on the DCC proposed flood protection measures and associated construction methods along with the following relevant documents which are referenced in this report as appropriate:-

- A. Copy of DCC EIA Screening Opinion letter dated November 2017 and associated tables and figures.
- B. Copy of DRAFT HRA prepared by ECOS as passed to SNH in November 2017.
- C. SNH response to DCC screening opinion (letter dated 4th December 2017) which included at Annex A SNH comments on the draft HRA and a request for further hydrological assessment.
- D. Mott May 2017 Broughty Ferry Coastal Defence Assessment which included scour and overtopping calculations based on beach sediment sampling.
- E. Photographs taken during recent (2017) beach trial holes to locate Hatton Main along Douglas Terrace & Fisher Street.
- F. Photographs of Hatton Main temporary works during installation in the beach.
- G. Report by Prof R Duck's report related to V&A project.

In response to the SNH requirements and guidance (Reference Document C) I have focused on providing a qualitative assessment of likely changes in beach morphology during and post construction and the nature of these changes, i.e. whether they are reversible or irreversible, long or short term, particularly at areas which are important in relation to maintaining the integrity of EC designated areas for the qualifying interests and have given my views under two headings:

- A. Change shoreline boundary conditions Douglas Terrace to Fisher Street and Section 3 (Beach)
- B. Construction effects.

(A)/1 CHANGING SHORELINE BOUNDARY CONDITIONS (Douglas Terrace – Fisher Street)

1. The design involves replacing the existing sloping concrete revetment by a vertical wall. This change involves no loss of the beach material although the local beach profile immediately adjacent to the wall is likely to be lowered due to wave-induced scour. The XBeach modelling results (Reference Document D: Mott Scour report (2017)) indicate that the lateral extent for the profile changes under a range of design storm and water level conditions is less than ten metres except for Profile 4 which shows a value around twenty metres. The beach sediment materials within the potentially affected zone and scour depth are similar (based on sample analysis information within Mott Scour report and images from

trial holes) and therefore would not lead to any significant selected transport of smaller size fractions. No areas within or significantly remote from the affected zones are therefore expected to change from sand to silt or silty sand to gravel. It should be noted that the simulated profile changes are for extreme wave and water conditions and thus represent the worst conditions. The extent of the scour zone will therefore vary and is expected to reduce markedly as sediments tend to fill up the holes during normal weather conditions. This infill process can happen over days or weeks.

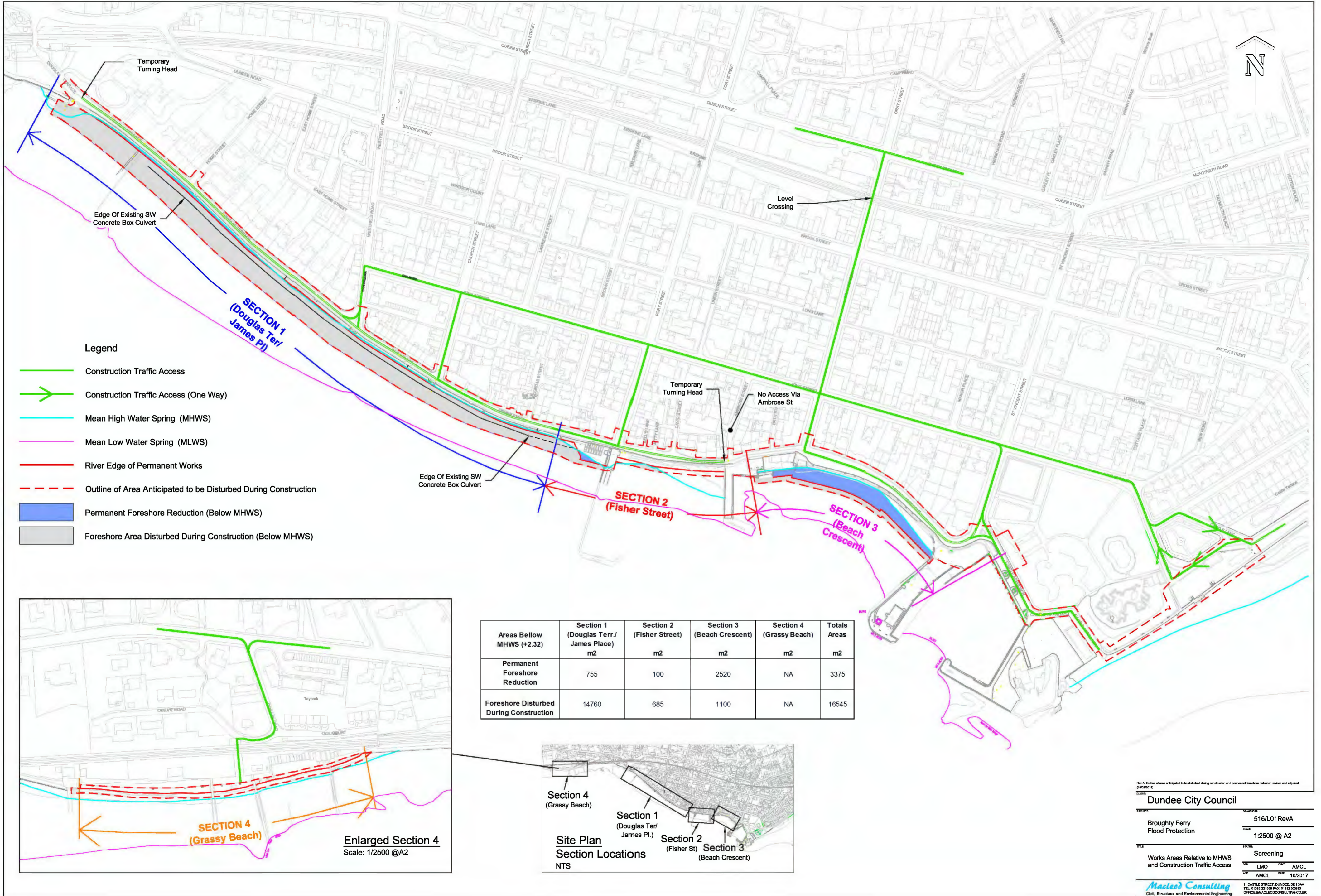
2. The design proposes to replace the existing sloping revetment to a vertical seawall. This amounts to a change in the boundary condition for the hydrodynamic processes in the Tay. However, since the proposed vertical sea wall is in very shallow water (above MLWS) and nearly at the toe of the existing revetment, it is considered that its introduction will only affect the waves, flows, sediment transport and beach morphology in the immediate area near the seawall, see Section 3 below. The waves tend to break close to the beach and whilst the cross-shore distribution of the longshore transport may be affected by the presence of the wall the total longshore drift rate are expected to be close to that of the existing conditions. The hydrodynamic or morphological processes in the far-field (40-50m approx. away from the wall) are therefore considered unlikely to be affected by the proposed work and certainly no impact is expected on coastal zone beyond Broughty Ferry Harbour.
3. The studies undertaken in relation to the site selection for the V&A @ Dundee Museum included an appraisal of the hydrodynamic and sediment transport characteristics of the River Tay (Reference Document G: Prof Rob Duck (2010)) covering tides, flows, winds, waves and sediment suspension and tidal flat morphology within the estuary. The main points made are that the suspended sediments in the Tay Estuary can migrate up and down estuary with the tidal waters, but also receive additions from the waters draining the extensive inter-tidal flats on the north side of the upper reach. The report indicates that suspension concentrations generally vary with tidal level and, whilst at mid-tide, are independent of tidal range. Turbidity levels have been found to be strongly linked to wind conditions. Both wind speed and direction are known to be of importance with the stronger storm winds at lower tides creating greater wave-induced erosion of the surface of the inter-tidal flats with erosion which is at its greatest when winds are blowing from the south-east. The modelling work indicates that the proposed work will lead to a limited area of change / scour in the cross-shore direction. The volume of sediments affected both during construction and post-construction through beach adjustment is therefore very small compared with the variation in the volume of suspended sediments being moved in the Tay during seasonal storm conditions. I am fully aware that any coastal structure that reduces the inter-tidal flat area and volume will decrease the estuary tidal prism and channel and may decrease the ebb-tidal delta areas and volumes. The total estuary area is constrained at high water and any changes in plan area must be balanced by changes in channel (section) area for the estuary to evolve towards a new equilibrium. The proposed flood protection works at Broughty Ferry involve a change from a sloping revetment to a vertical wall with a reduction to the overall estuary (section) area being very small which is considered unlikely to cause any appreciable changes to the tidal flow field or sediment transport patterns within the Estuary. This conclusion is also supported by the Mott beach characterisation and beach profile change modelling.

(A)/2 CHANGING SHORELINE BOUNDARY CONDITIONS (Section 3 Beach)

For Section 3 where the beach is being replaced by stepped concrete with sheet piled toe, the effect on the existing conditions and extent of any disturbance is considered likely to be even smaller.

(B) CONSTRUCTION EFFECTS

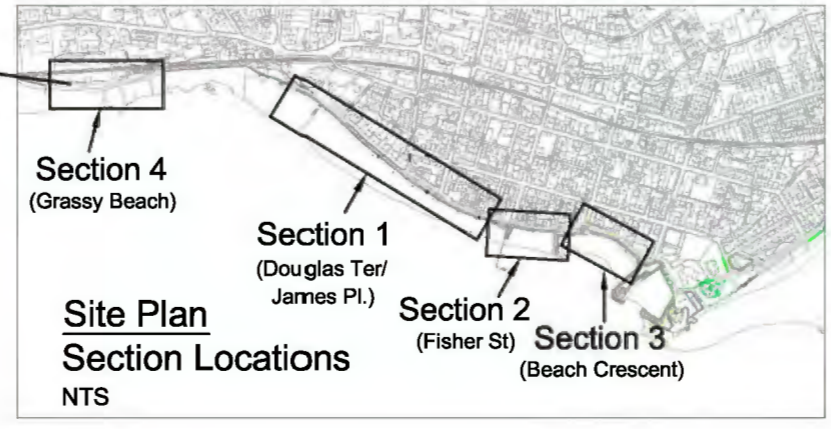
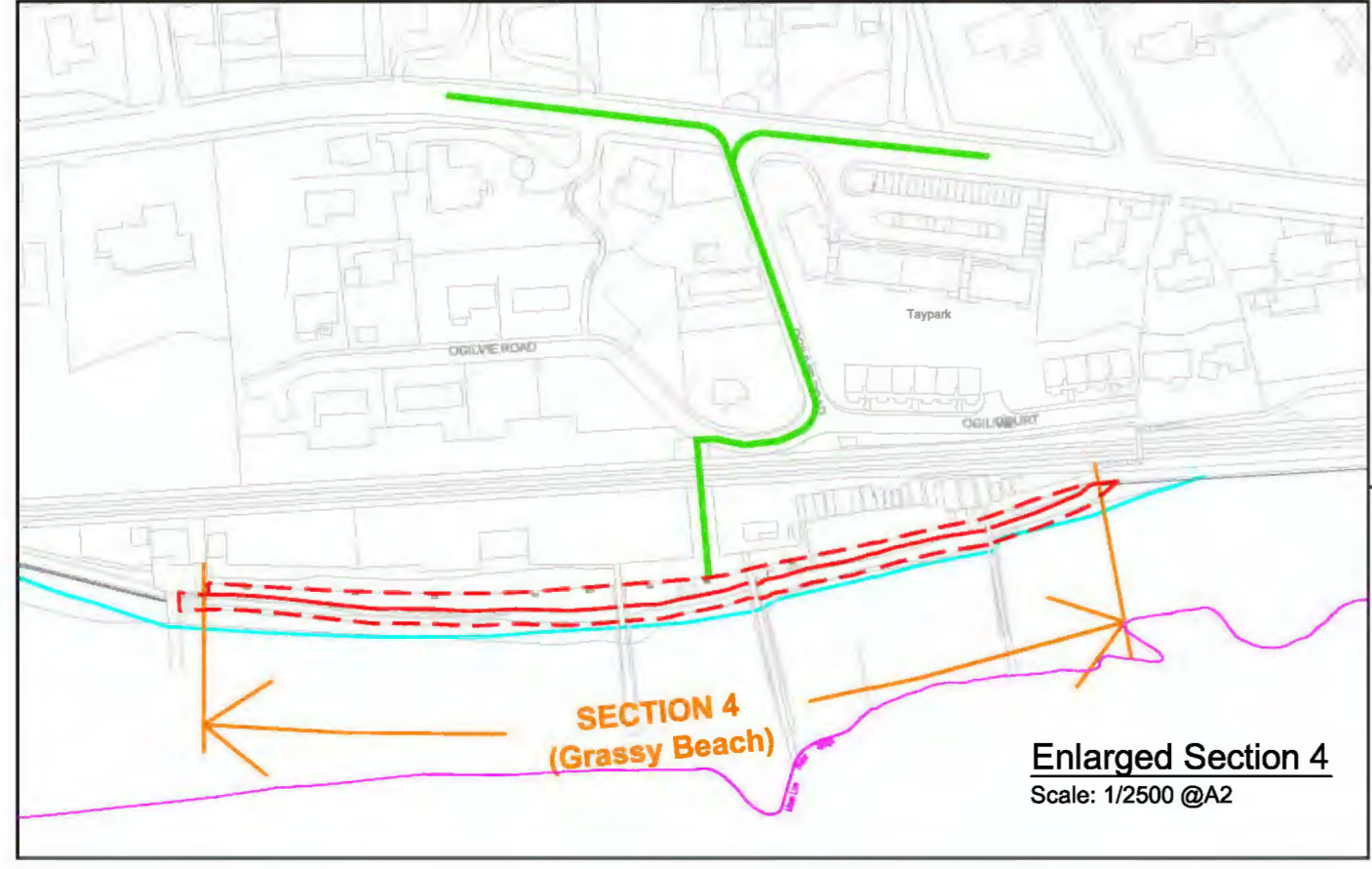
- 1.** Construction effects seaward of the permanent gravity wall MAY include a temporary sheet pile wall and low tide construction access by tracked plant but will, if consented, include the temporary side casting of material excavated to form the wall foundations onto the inter tidal area of the beach. It is noted that all sheet piling installation and removal will be undertaken above tide level and the side cast material will, on completion of the wall, be placed as back fill material with larger stone from the existing revetment placed as toe protection. It is understood that this measure is proposed to avoid double handling of material and reduce the volume of aggregate required to be imported to the site. The period between excavation and replacement is unlikely to be more than two weeks. No notable changes to beach morphological evolution is anticipated from this work.
- 2.** The sediments that are being worked on during construction are similar to that moving normally along and across the beach; however, the volume of sediment involved is much smaller than the background level of sediment transport in the river Tay, see A/1 and A/2 above. The changes to the longshore drift and cross-shore transport both during and after construction are largely confined to the vicinity of the working area and are not expected to extend to the east of Broughty Ferry Castle.
- 3.** The beach is highly dynamic and the process of re-working of sediments from the scheduled construction works is expected to lead rapidly to a new equilibrium beach within one year of completion of all the works. The construction effects here are taken to be the construction period plus one year during which the normal scour profile is formed.
- 4.** During construction there will be no removal of sediment from below the existing beach level and therefore there will not be a general lowering of the area in front of the wall except the localised scour holes that are expected to be a permanent if varying feature near the seawall toe.



Legend

- Construction Traffic Access
- ➔ Construction Traffic Access (One Way)
- Mean High Water Spring (MHWS)
- Mean Low Water Spring (MLWS)
- River Edge of Permanent Works
- - - Outline of Area Anticipated to be Disturbed During Construction
- Permanent Foreshore Reduction (Below MHWS)
- Foreshore Area Disturbed During Construction (Below MHWS)

Areas Below MHWS (+2.32)	Section 1 (Douglas Terr./ James Place) m2	Section 2 (Fisher Street) m2	Section 3 (Beach Crescent) m2	Section 4 (Grassy Beach) m2	Totals Areas m2
Permanent Foreshore Reduction	755	100	2520	NA	3375
Foreshore Disturbed During Construction	14760	685	1100	NA	16545

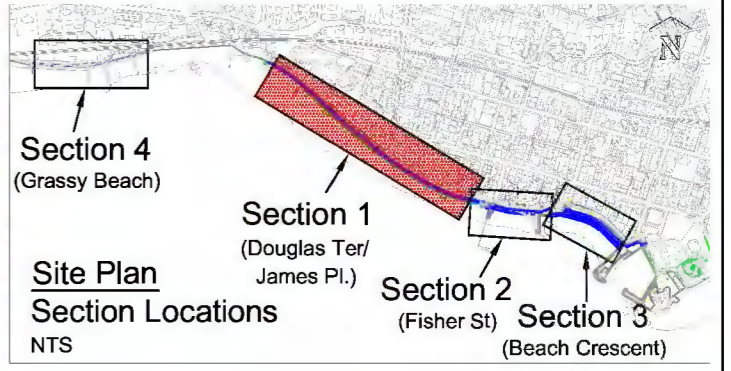
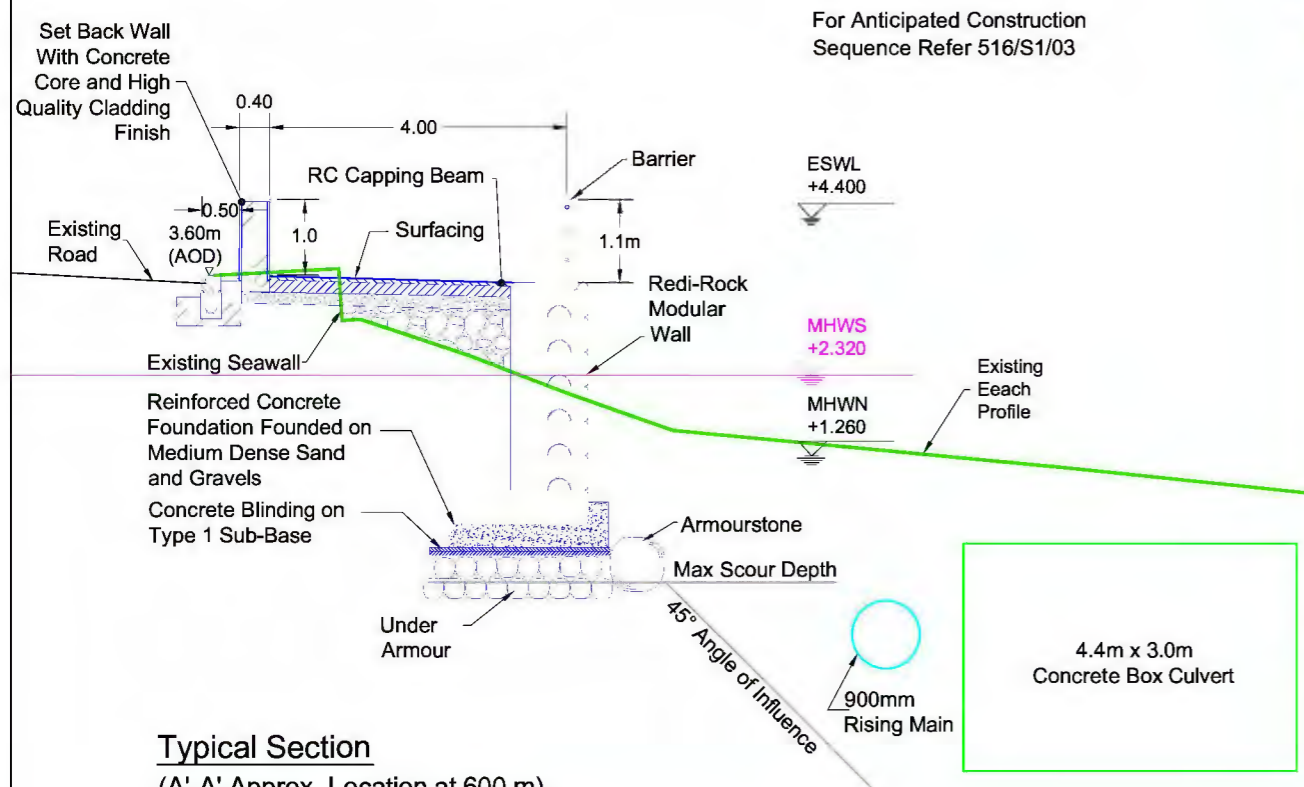
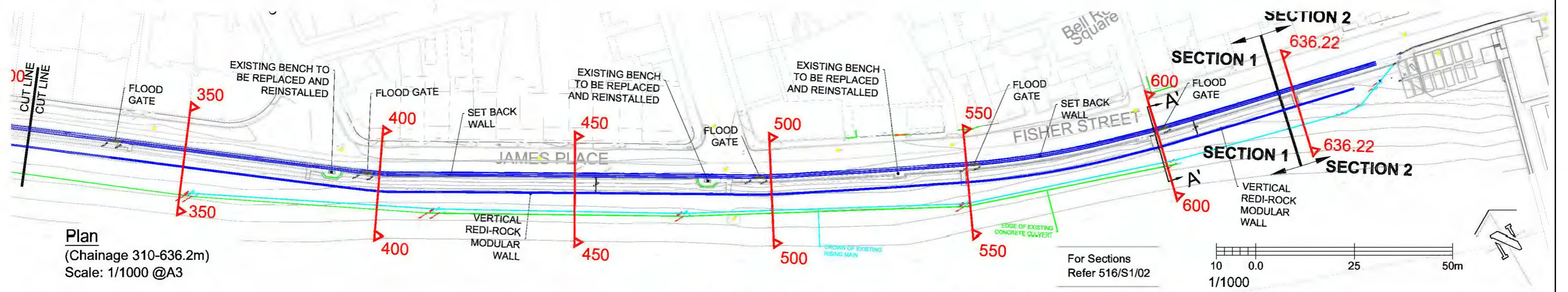
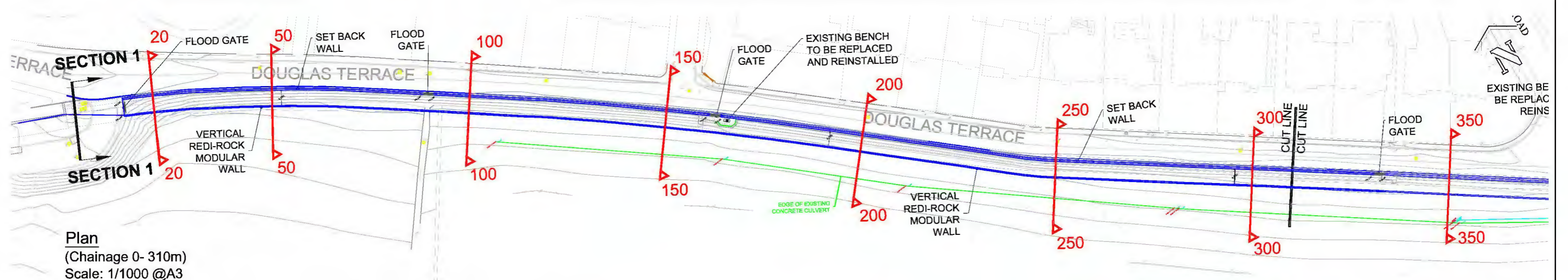


Rev A: Outline of area anticipated to be disturbed during construction and permanent foreshore reduction revised and adjusted, 03/2018

Dundee City Council

PROJECT:	Broughty Ferry Flood Protection	DRAWN BY:	LMO	CHECKED BY:	AMCL
CLIENT:	Dundee City Council	SCALE:	1:2500 @ A2		
TITLE:	Works Areas Relative to MHWS and Construction Traffic Access	STATUS:	Screening		
DATE:	10/2017	OFFICE:	11 CASTLE STREET, DUNDEE, DD1 3AA		

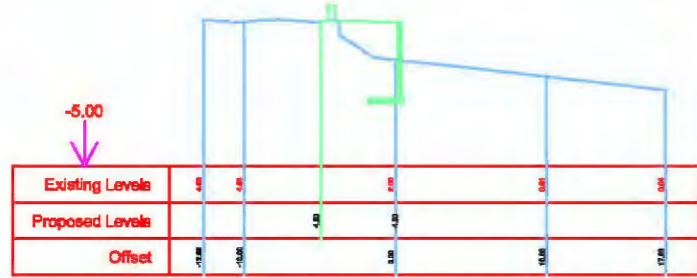
Maclead Consulting
 Civil, Structural and Environmental Engineering
 TEL: 01382 221999 FAX: 01382 203283
 OFFICE@MACLEADCONSULTING.CO.UK



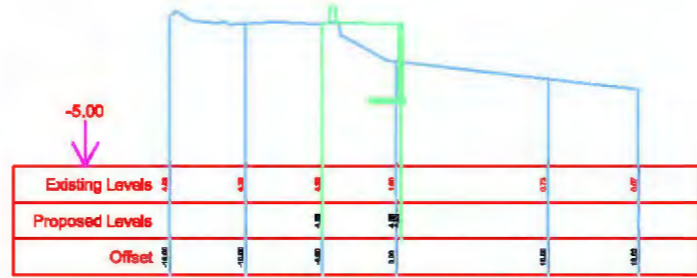
Note:
- Section A'-A' Location as per Macleod Consulting With Current Beach Levels at Chainage 600m Approx.

CLIENT:	Dundee City Council	DRN:	LMO
TITLE:	Broughty Ferry Flood Protection Section 1: Douglas Ter/James Pl	CHKD:	AMCL
DESCRIPTION:	Section 1 - Plan Proposal Outline	APP:	AMCL
STATUS:	Screening	DATE:	10/17
DRAWING No.:	516/S1/01	SCALE:	Varies @ A3
		11 Castle Street, DUNDEE, DD1 3AA TEL: 01382 221999 FAX: 01382 203383 OFFICE@MACLEODCONSULTING.CO.UK	

200.000
 Horiz. 1:200
 Vert. 1:200

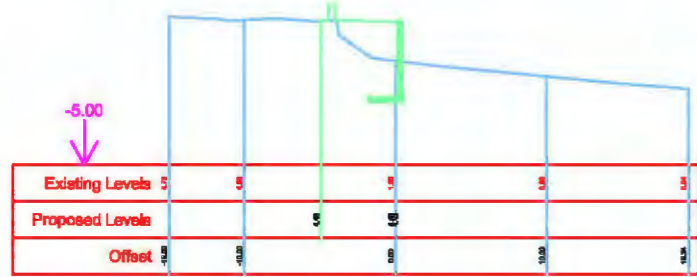


450.000
 Horiz. 1:200
 Vert. 1:200



For Sections Locations Refer 516/S1/01
 For Proposed Construction Sequence Refer 516/S1/03

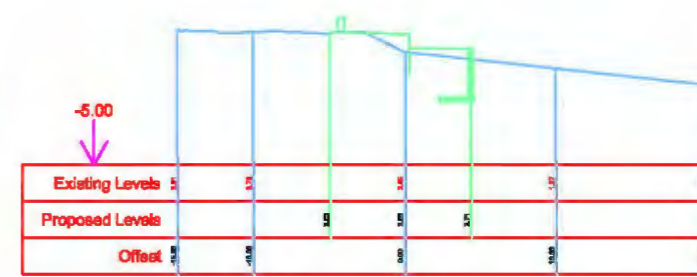
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 Horiz. 1:200
 Vert. 1:200



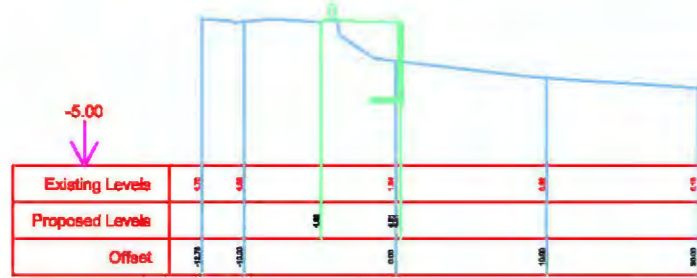
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 Vert. 1:200



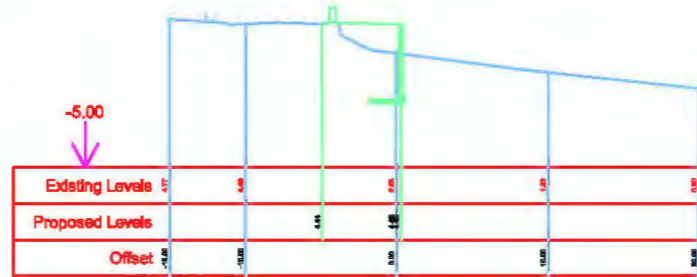
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 Vert. 1:200



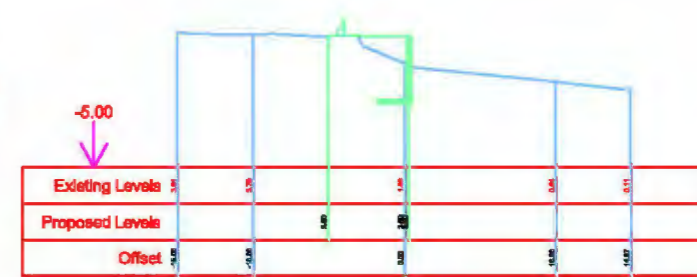
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 Vert. 1:200



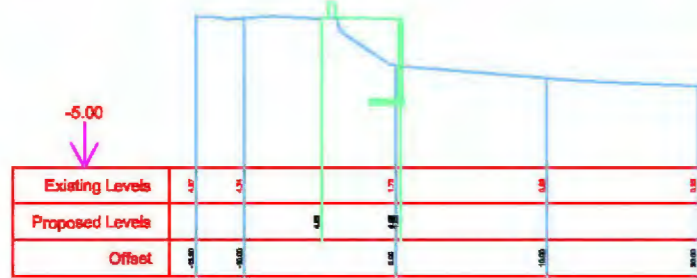
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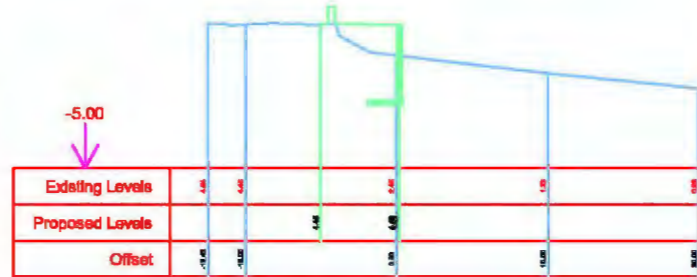
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 Horiz. 1:200
 Vert. 1:200



50.000
 Horiz. 1:200
 Vert. 1:200



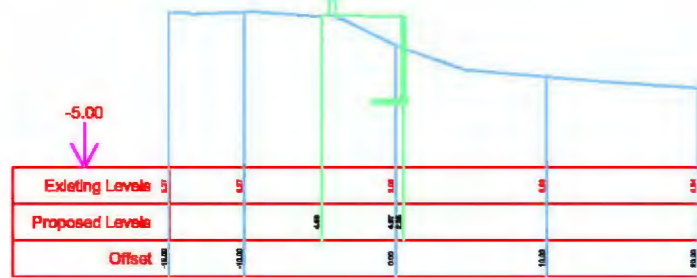
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 Horiz. 1:200
 Vert. 1:200



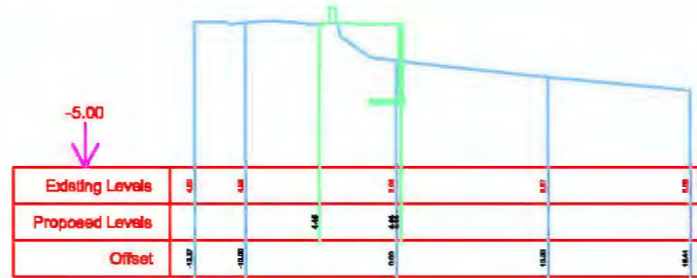
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 Vert. 1:200



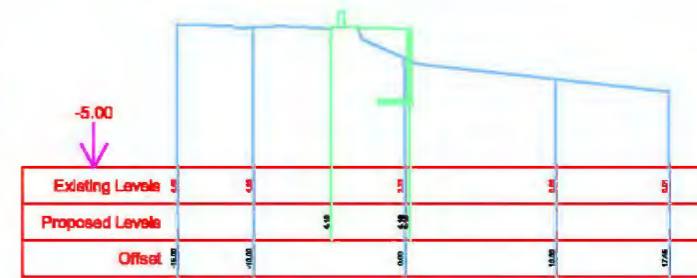
20.000
 Horiz. 1:200
 Vert. 1:200



250.000
 Horiz. 1:200
 Vert. 1:200



500.000
 Horiz. 1:200
 Vert. 1:200



CLIENT: Dundee City Council

TITLE: Broughty Ferry Flood Protection
 Section 1: Douglas Ter / James Pl

DESCRIPTION: Section 1
 Profiles 20 to 636.22-

STATUS: Screening

DATE: 10/17

DESIGNED BY: LMO
 CHECKED BY: AMCL
 APPROVED BY: AMCL

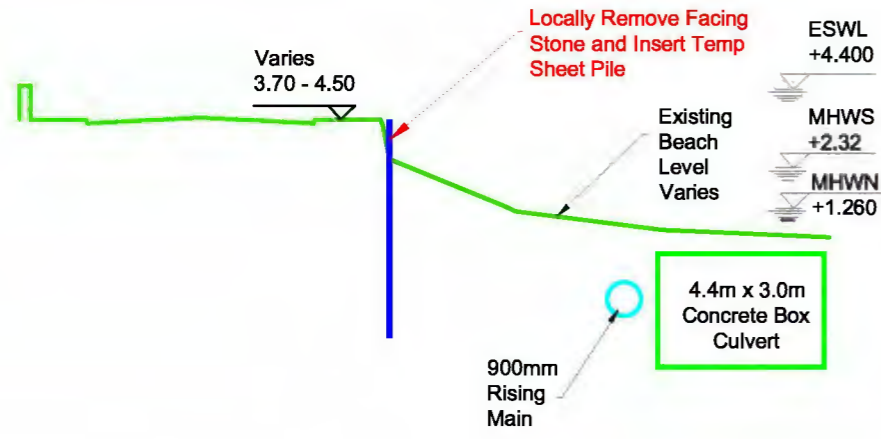
DRAWING NO.: 516/S1/02

SCALE: Varies @ A3

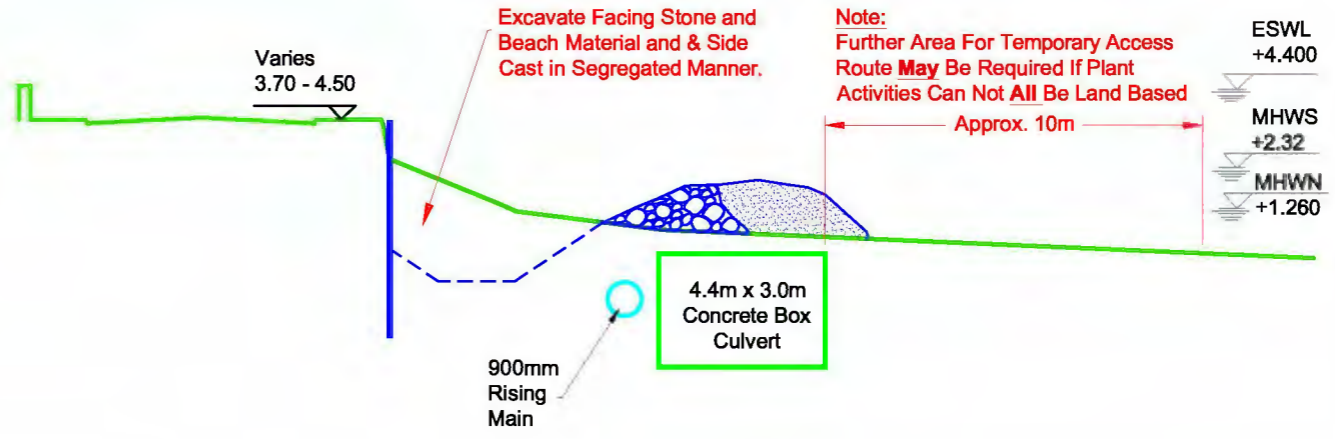
Macleod Consulting
 Civil, Structural and Environmental Engineering

11 Castle Street, DUNDEE, DD1 3AA
 TEL: 01382 221990 FAX: 01382 223885
 OFFICES@MACLEODCONSULTING.CO.UK

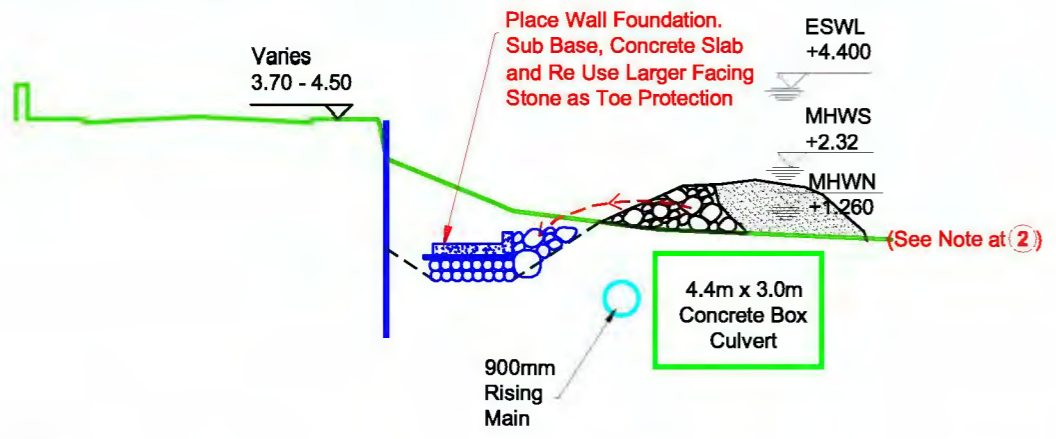
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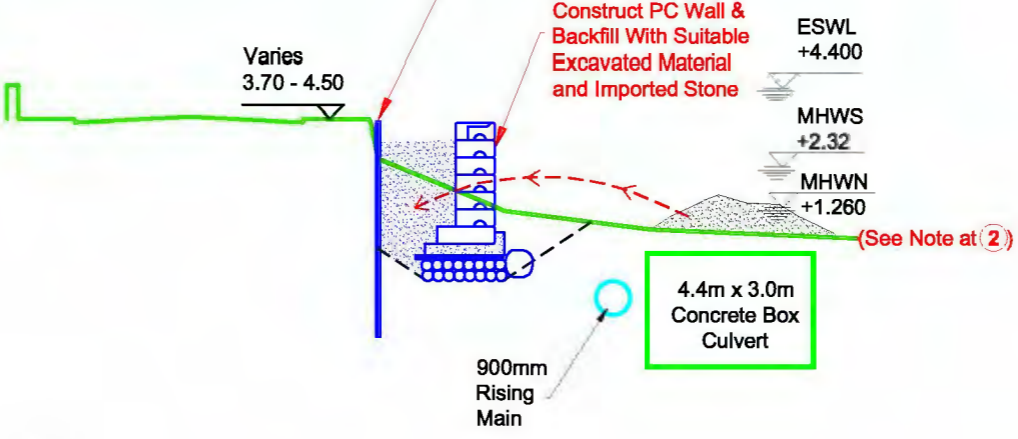
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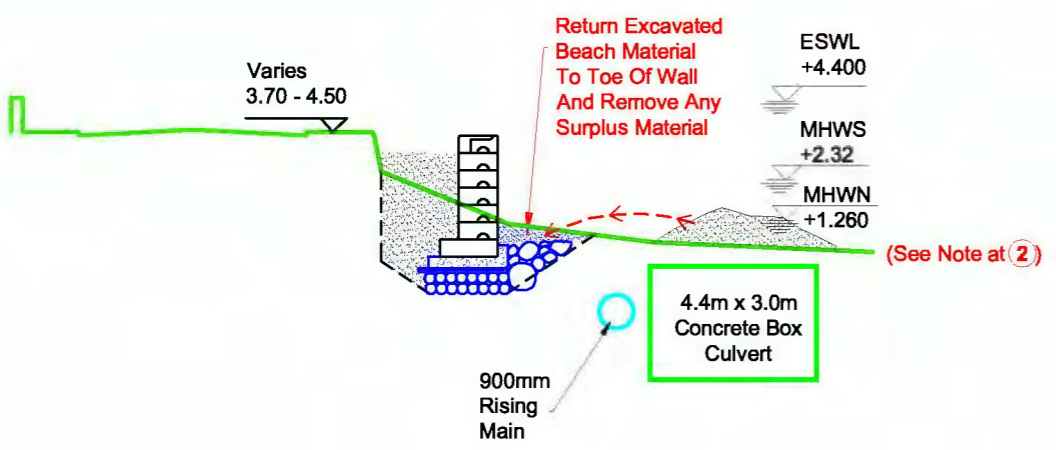
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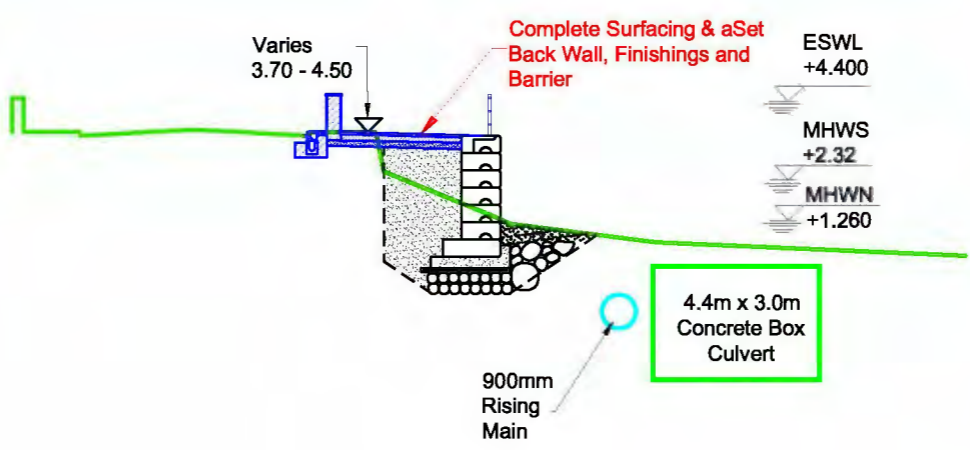
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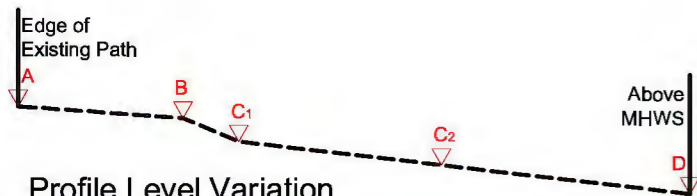
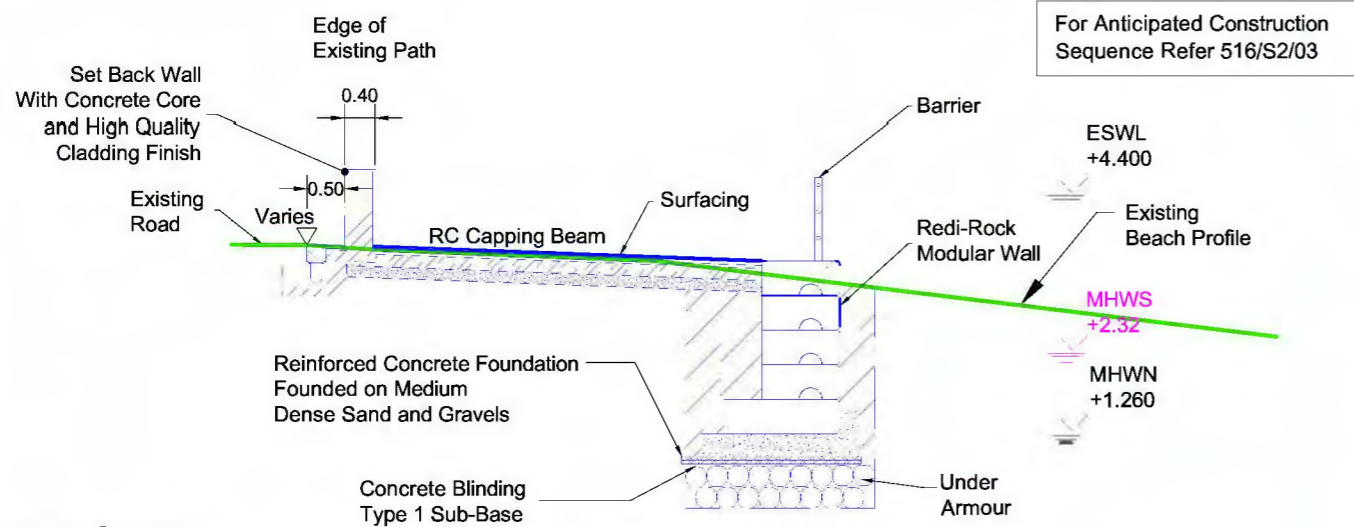
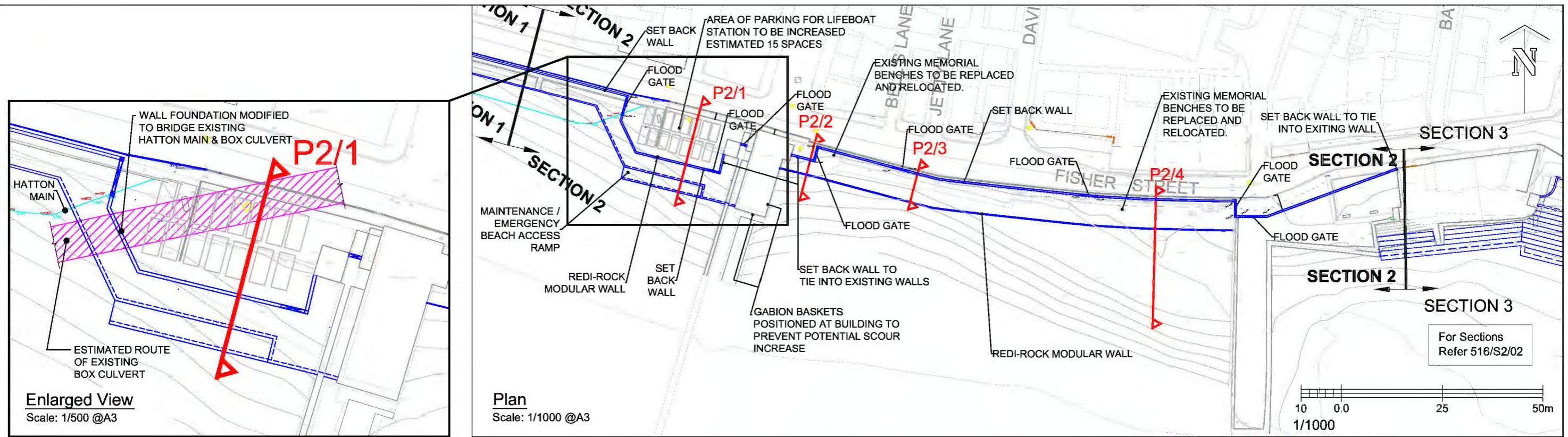
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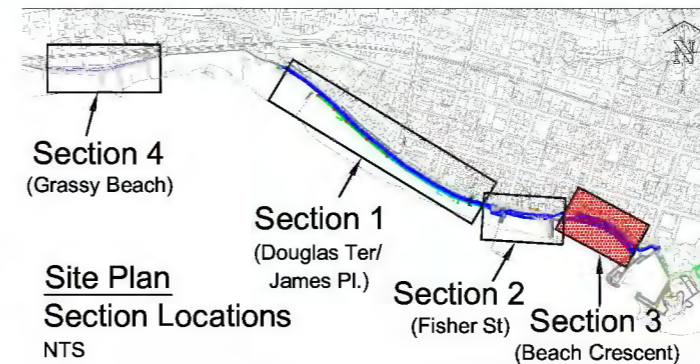
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CLIENT: Dundee City Council		DRN: LMO
TITLE: Broughty Ferry Flood Protection		CHKD: AMCL
Section 1: Douglas Ter./James Pl.		APP: AMCL
		DATE: 10/17
DESCRIPTION: Section 1	DRAWING NO.: 516/S103	
STATUS: Outline Construction Sequence	SCALE: 1:200 @ A3	
<small>11 Castle Street, DUNDEE, DD1 3AA TEL: 01382 221999 FAX: 01382 203383 OFFICE@MACLEODCONSULTING.CO.UK</small>		

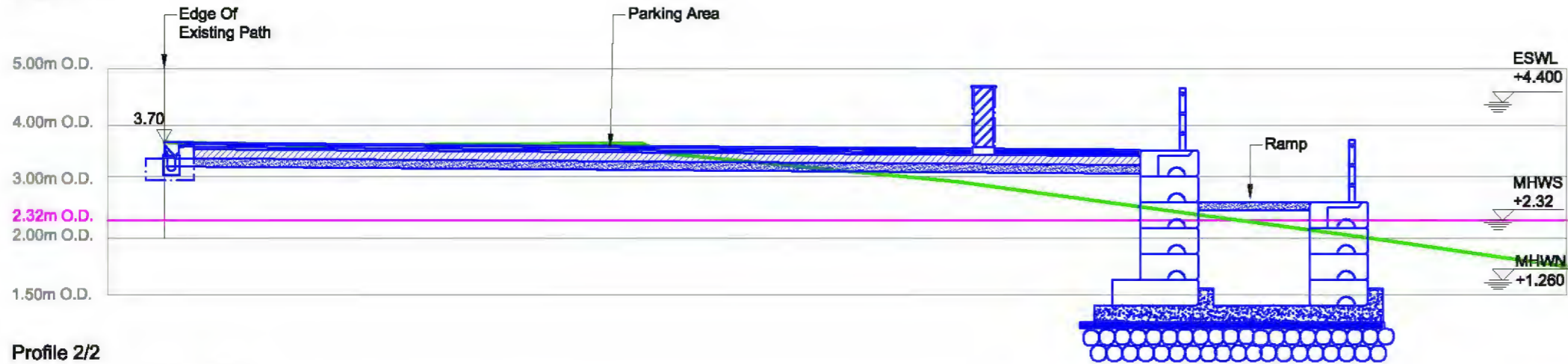


	SECTION 2 (Fisher Street)					
	P2/2		P2/3		P2/4	
	Level (m O.D)	Distance (m)	Level (m O.D)	Distance (m)	Level (m O.D)	Distance (m)
A	3.71	0.00	3.70	0.00	3.70	0.00
B	3.65	0.89	3.64	1.05	3.72	0.90
C1	3.50	4.62	3.18	2.88	3.71	2.01
C2	-	-	-	-	3.37	16.37
D	2.50	12.80	2.50	8.24	2.5	30.83

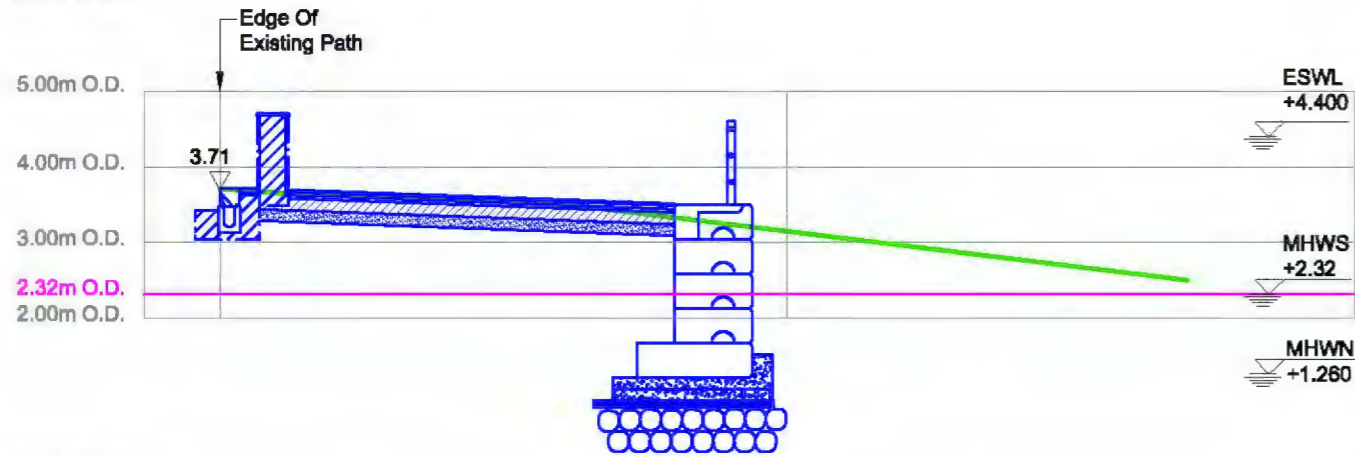


CLIENT:	Dundee City Council	DRN:	LMO
TITLE:	Broughty Ferry Flood Protection Section 2: Fisher Street	CHKD:	AMCL
		APP:	AMCL
		DATE:	10/17
DESCRIPTION:	Section 2 - Plan Proposal Outline	DRAWING No.:	516/S2/01
STATUS:	Screening	SCALE:	Varies @ A3
Macleod Consulting Civil, Structural and Environmental Engineering		11 Castle Street, DUNDEE, DD1 3AA TEL: 01382 221999 FAX: 01382 203383 OFFICE@MACLEODCONSULTING.CO.UK	

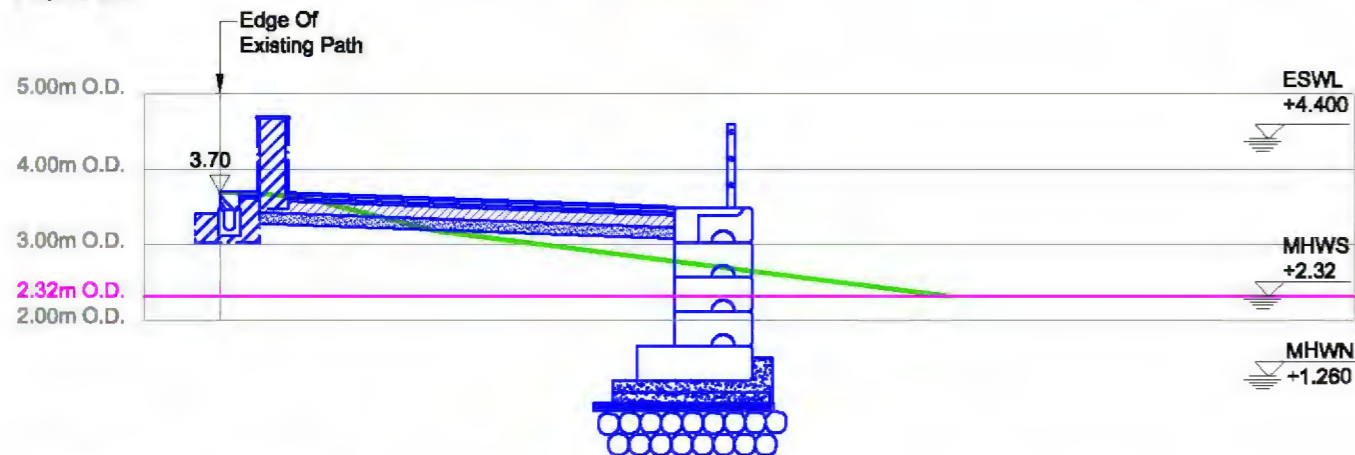
Profile 2/1



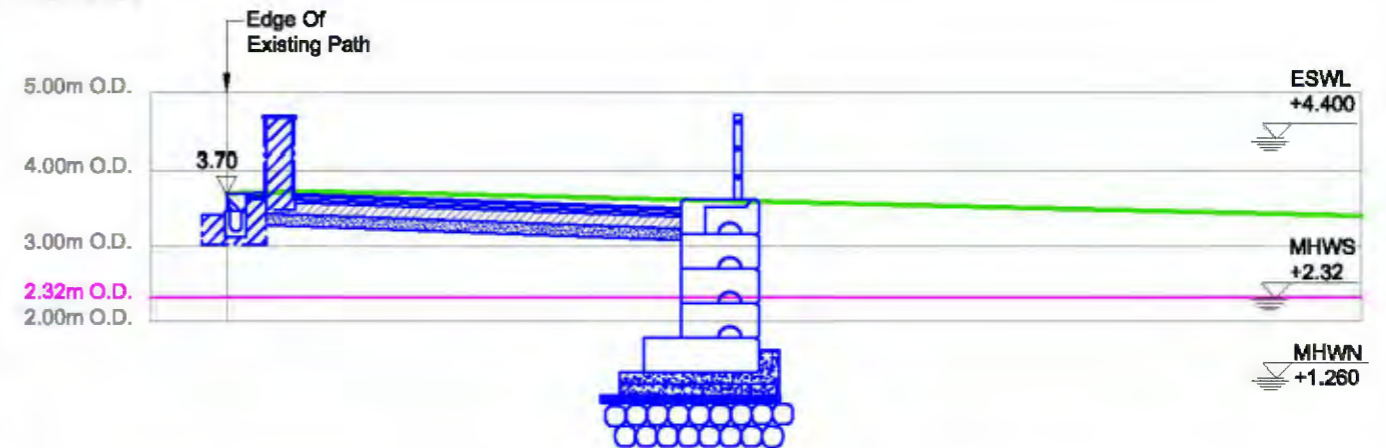
Profile 2/2



Profile 2/3

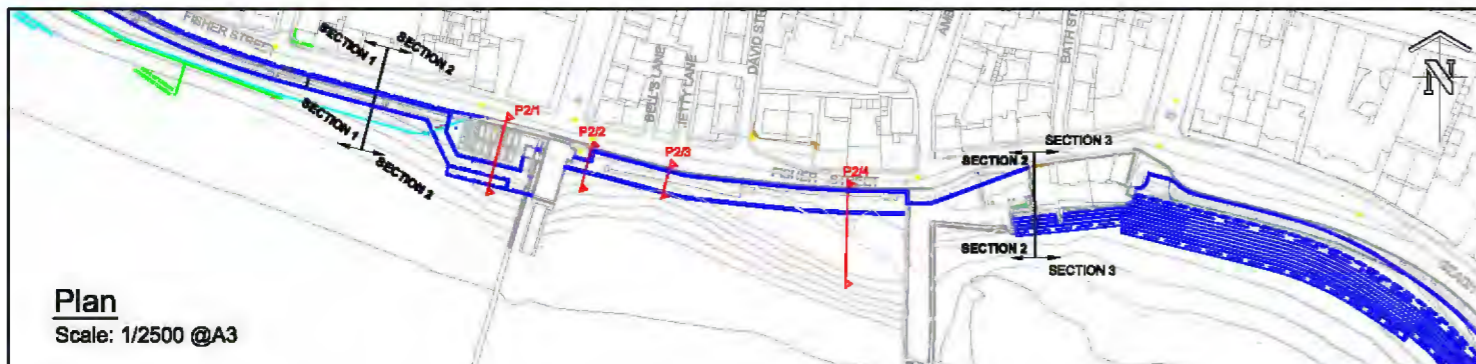


Profile 2/4



Profiles Section 2 (1-4)

Scale: 1/100 @A3



Plan

Scale: 1/2500 @A3

For Sections Locations Refer 516/S2/01
For Proposed Construction Sequence Refer 516/S2/03

CLIENT: Dundee City Council

TITLE: Broughty Ferry Flood Protection
Section 2: Fisher Street

DESCRIPTION: Section 2
Profiles 1 to 4

DATE: 10/17

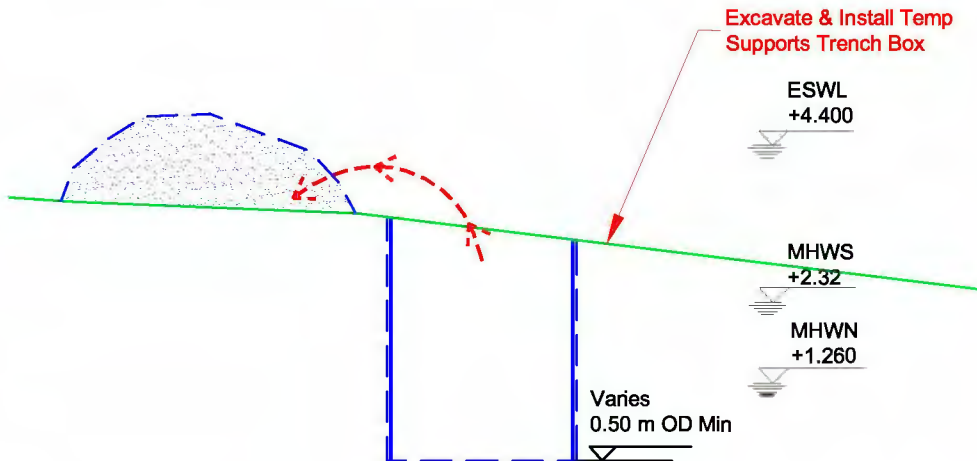
STATUS: Screening

SCALE: Varies @ A3

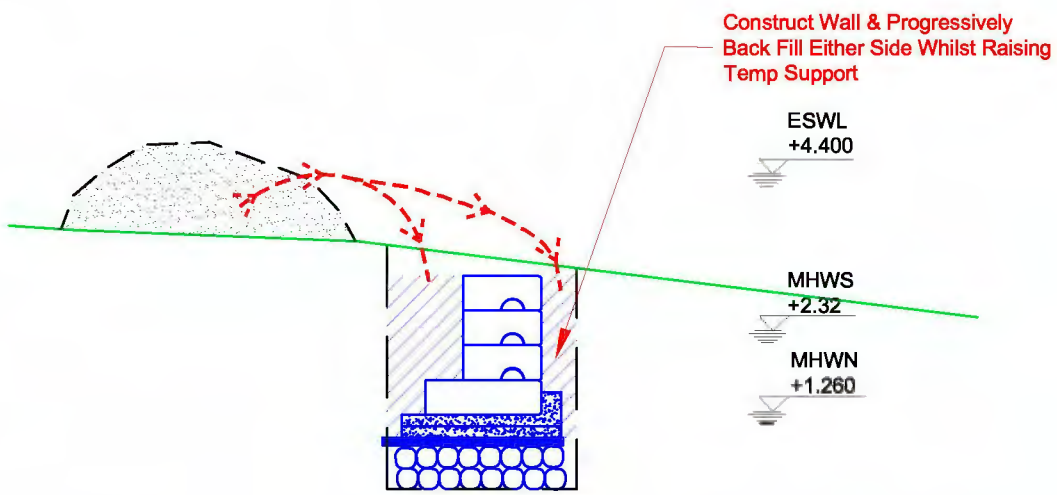
Macleod Consulting
Civil, Structural and Environmental Engineering

11 Castle Street, DUNDEE, DD1 3AA
TEL: 01382 221600 FAX: 01382 220085
OFFICE@MACLEODCONSULTING.CO.UK

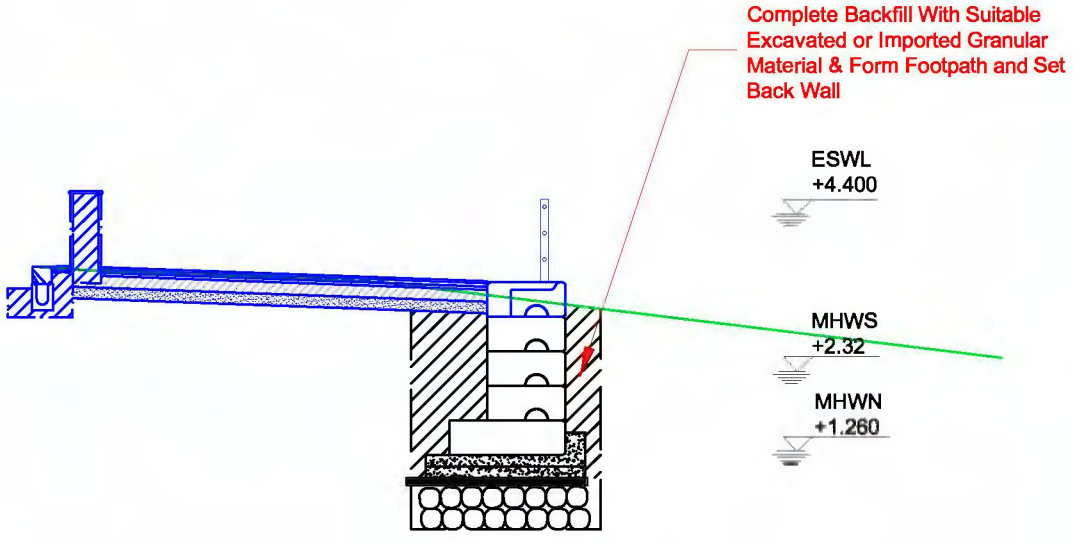
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2



3



CLIENT: Dundee City Council

PROJECT: Broughty Ferry Flood Protection - Section 2

STATUS: Screening

DRAWING No.: 516/S2/03

SCALE: 1:100@A4

TITLE: Section 2 Outline Construction Sequence

DRN: LMO

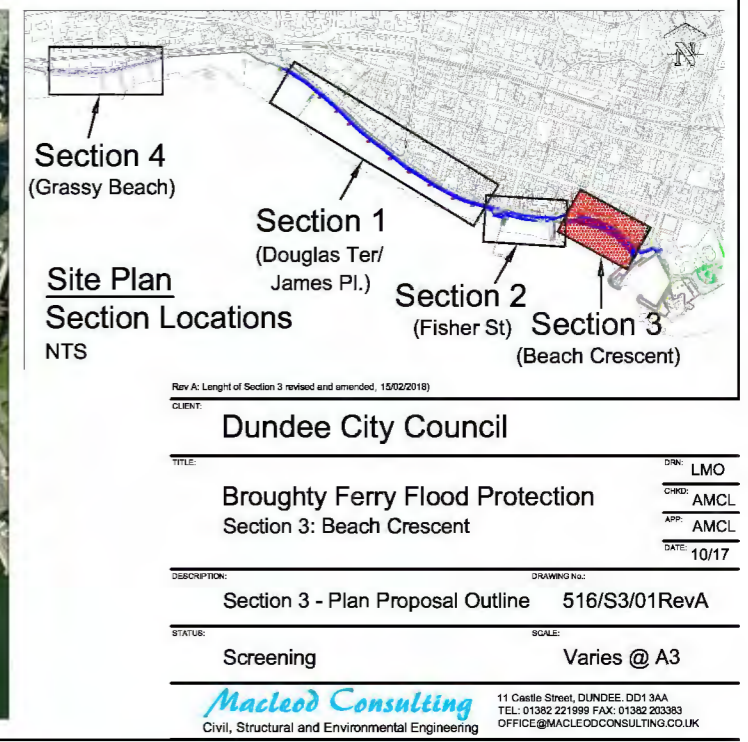
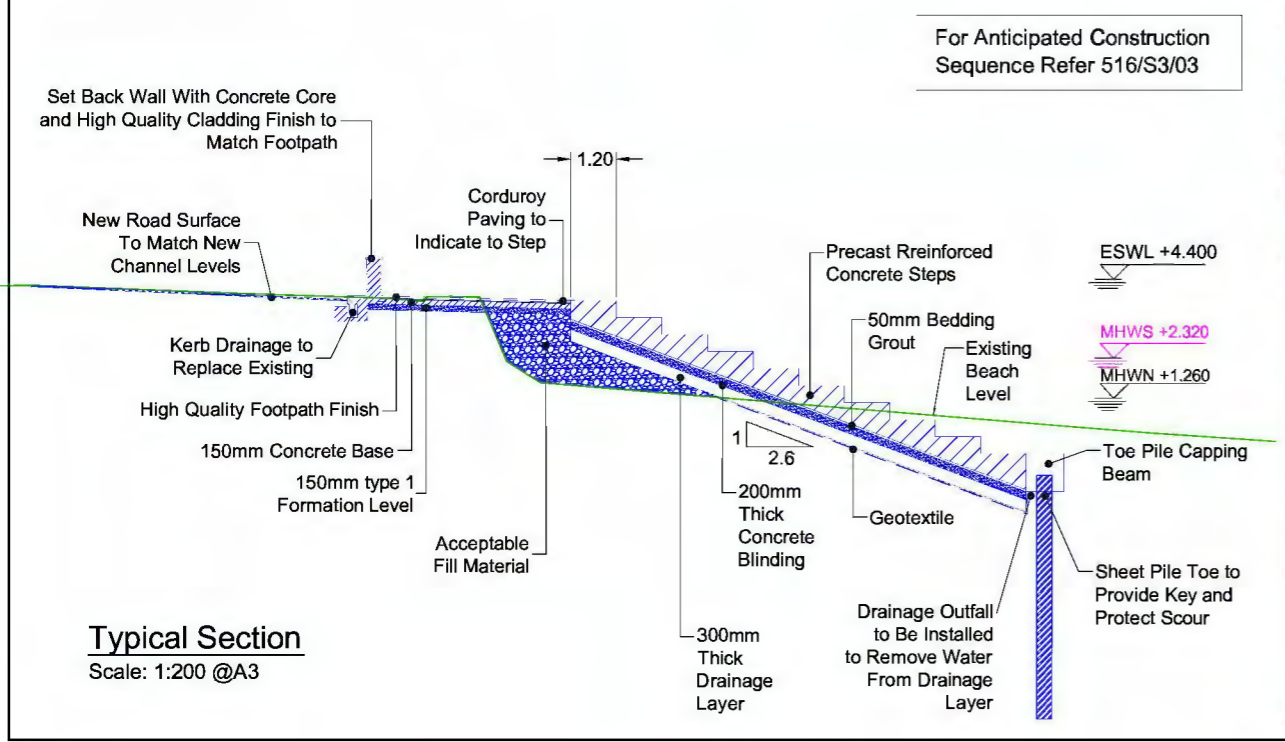
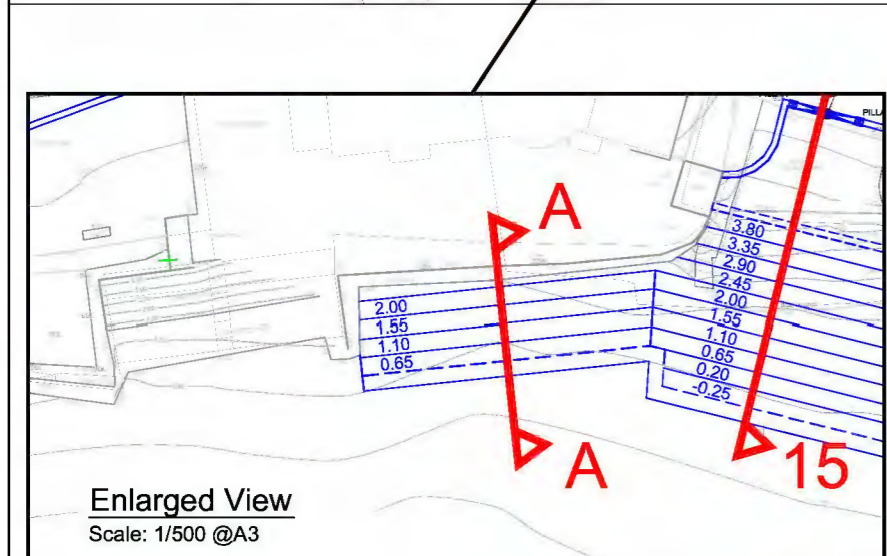
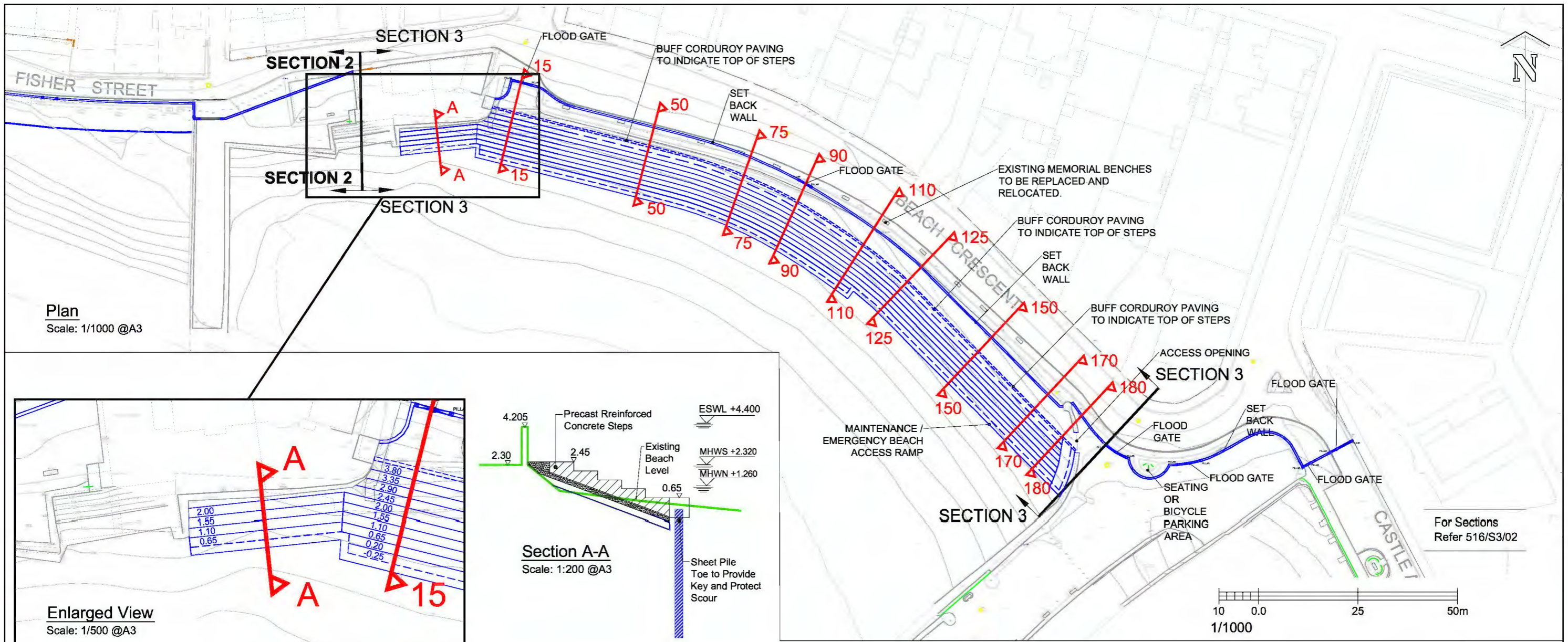
CHKD: AMCL

APP: AMCL

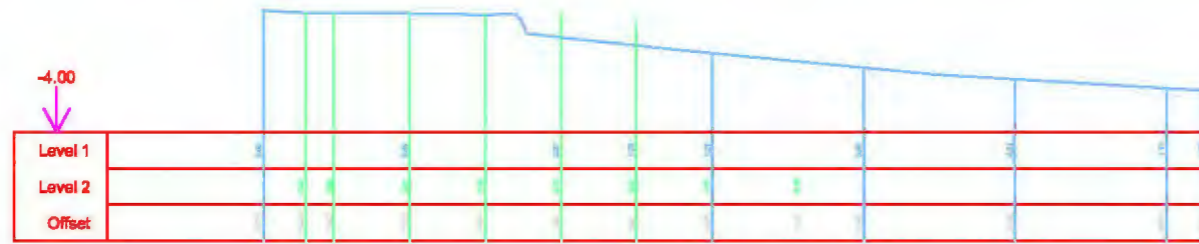
DATE: 10/17

Macleod Consulting
Civil, Structural and Environmental Engineering

11 Castle Street, DUNDEE, DD1 3AA
TEL: 01382 221999 FAX: 01382 203383
OFFICE@MACLEODCONSULTING.CO.UK

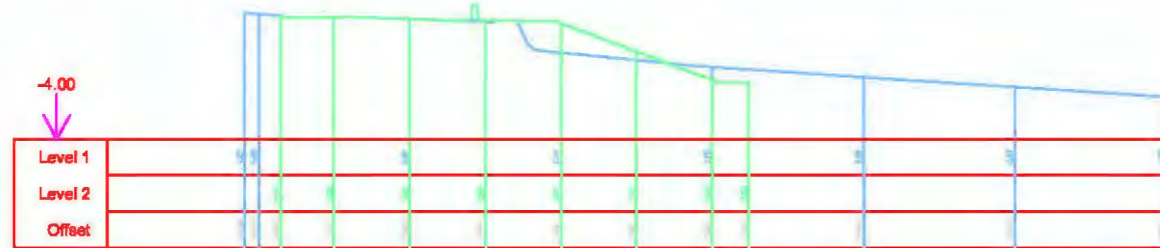


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 Horiz. 1:200
 Vert. 1:200

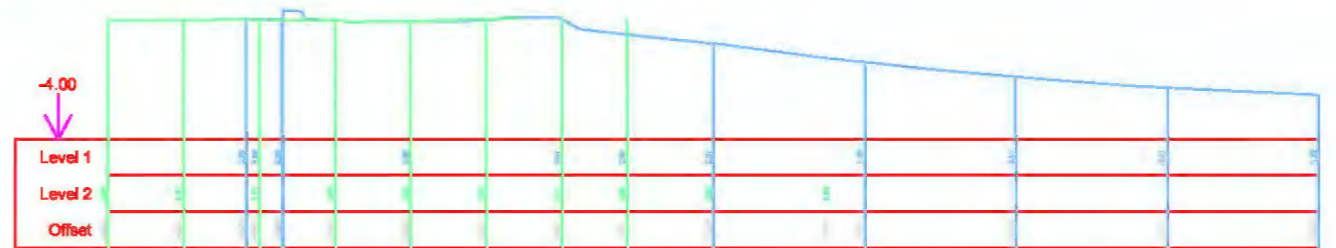


For Sections Locations Refer 516/S3/01
 For Proposed Construction Sequence Refer 516/S3/03

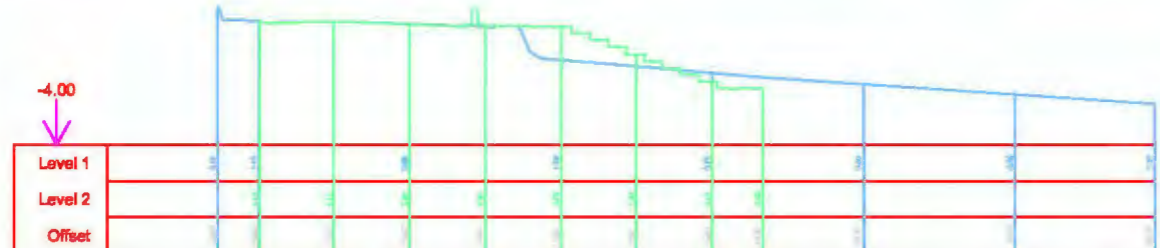
90.000
 Horiz. 1:200
 Vert. 1:200



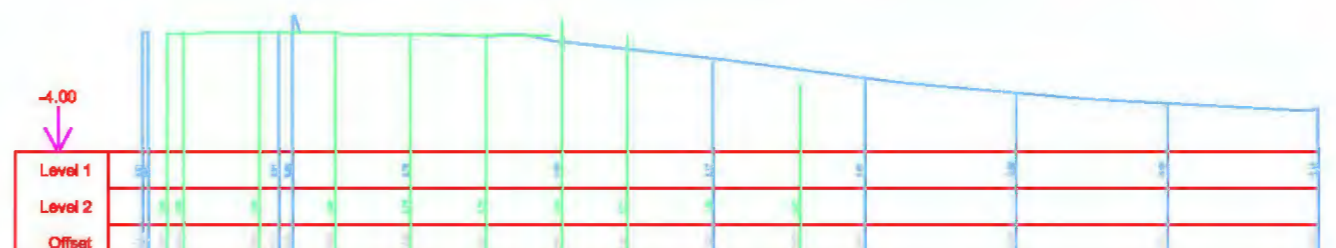
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 Horiz. 1:200
 Vert. 1:200



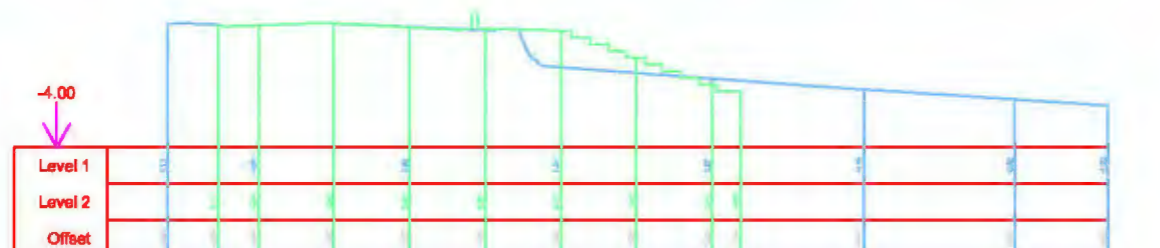
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 Vert. 1:200



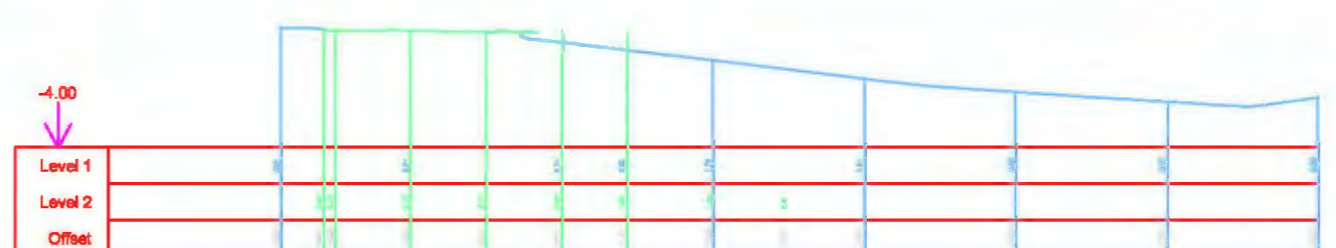
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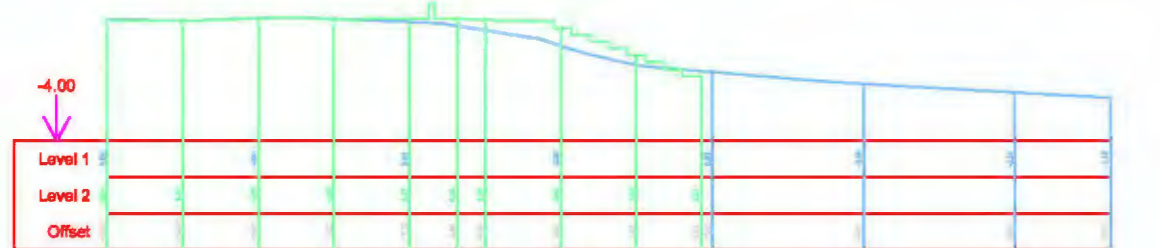
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 Vert. 1:200



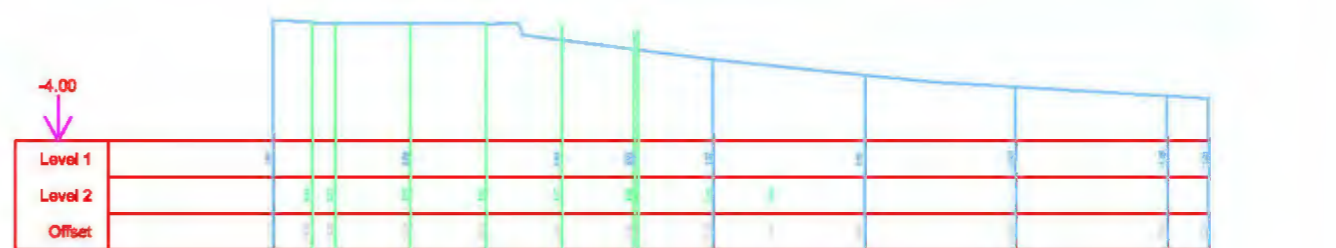
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15.000
 Horiz. 1:200
 Vert. 1:200



125.000
 Horiz. 1:200
 Vert. 1:200

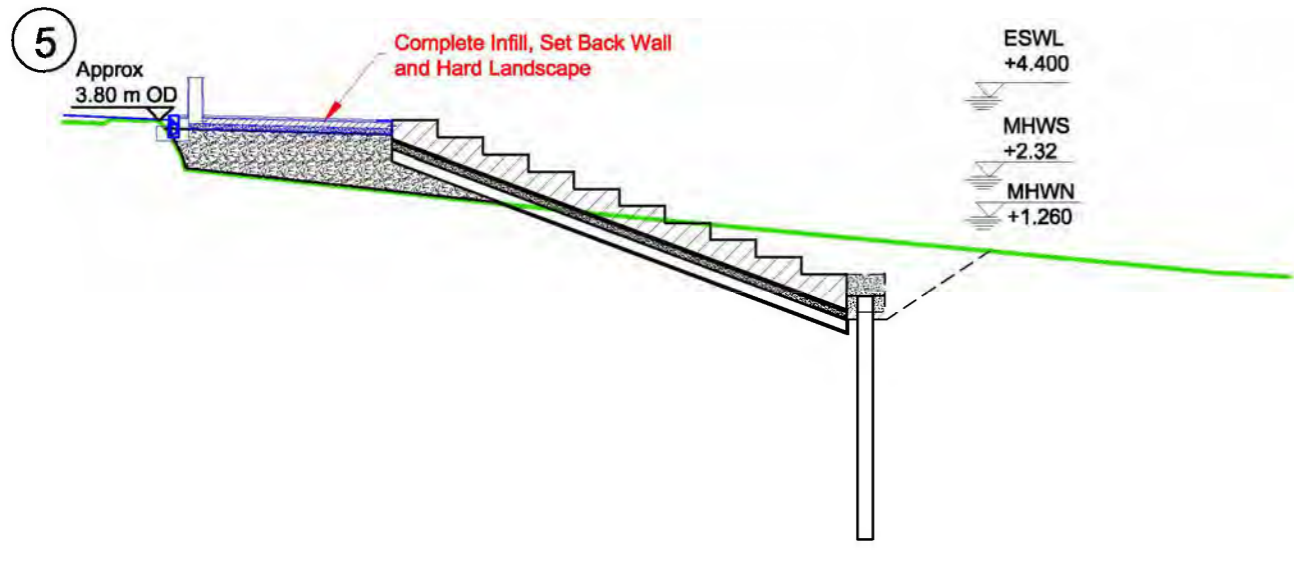
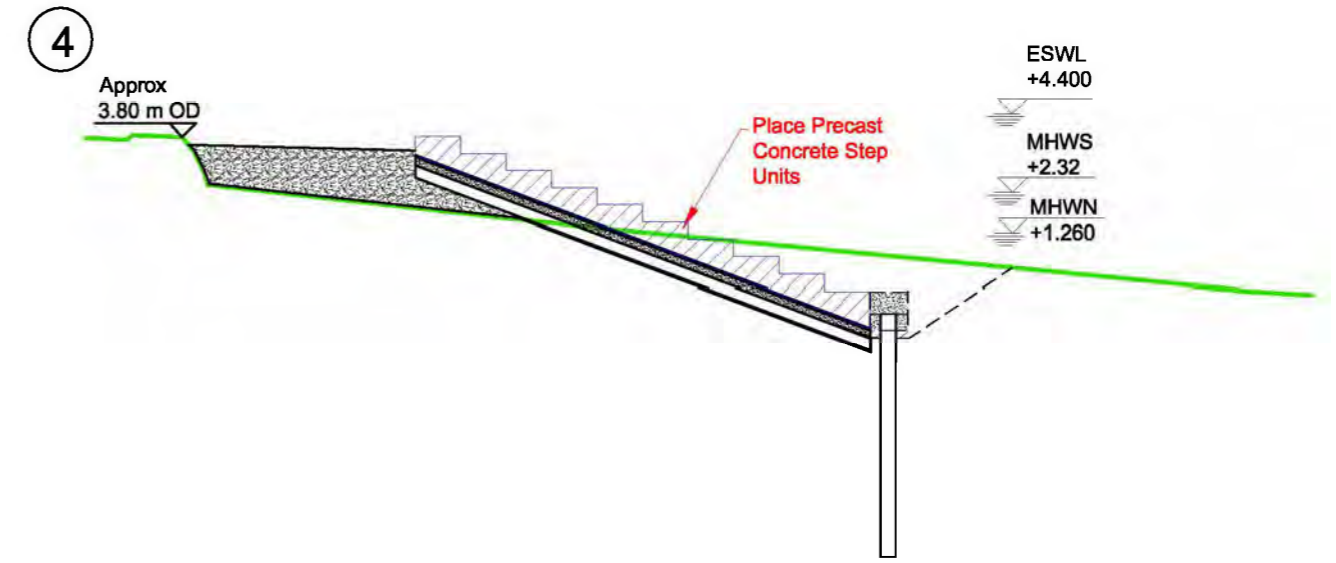
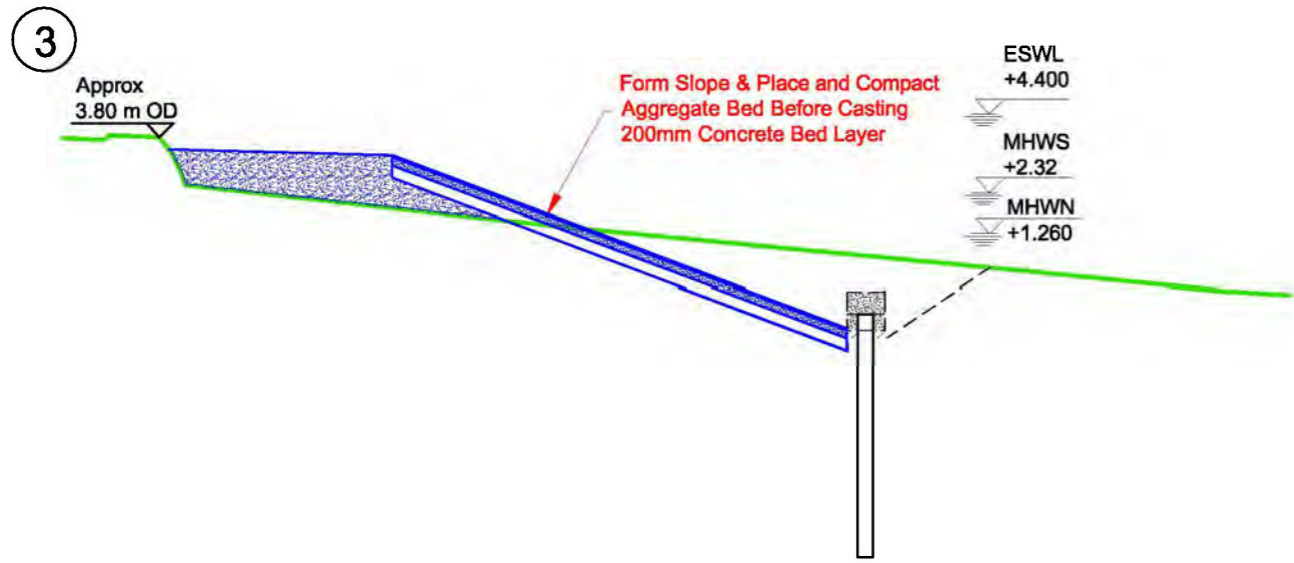
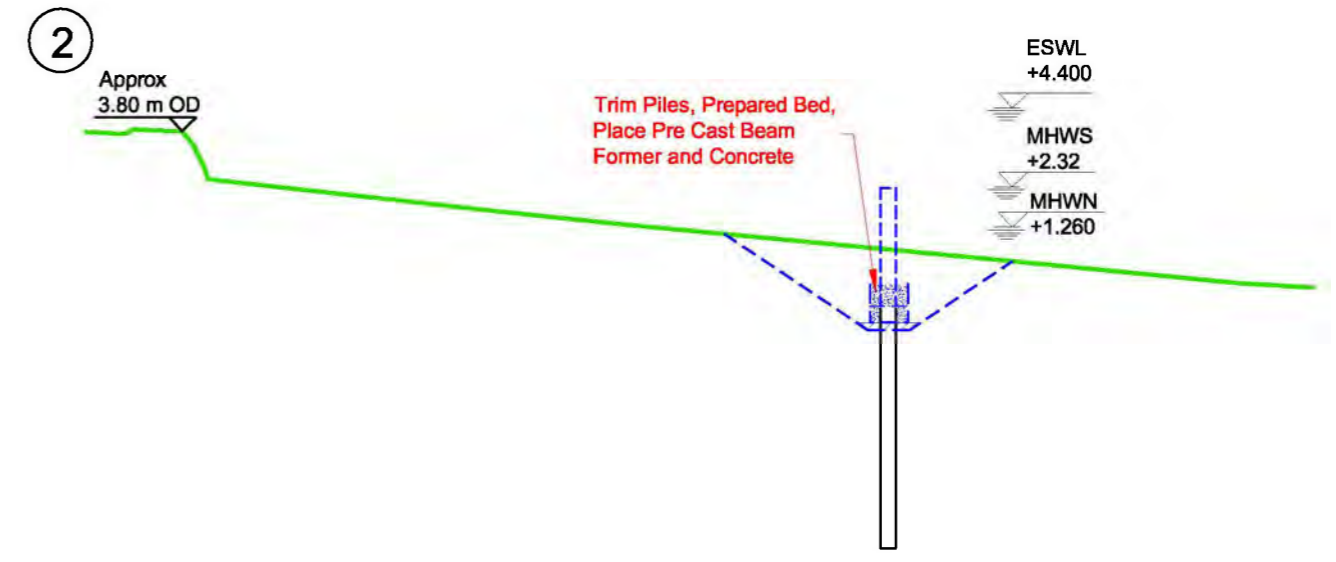
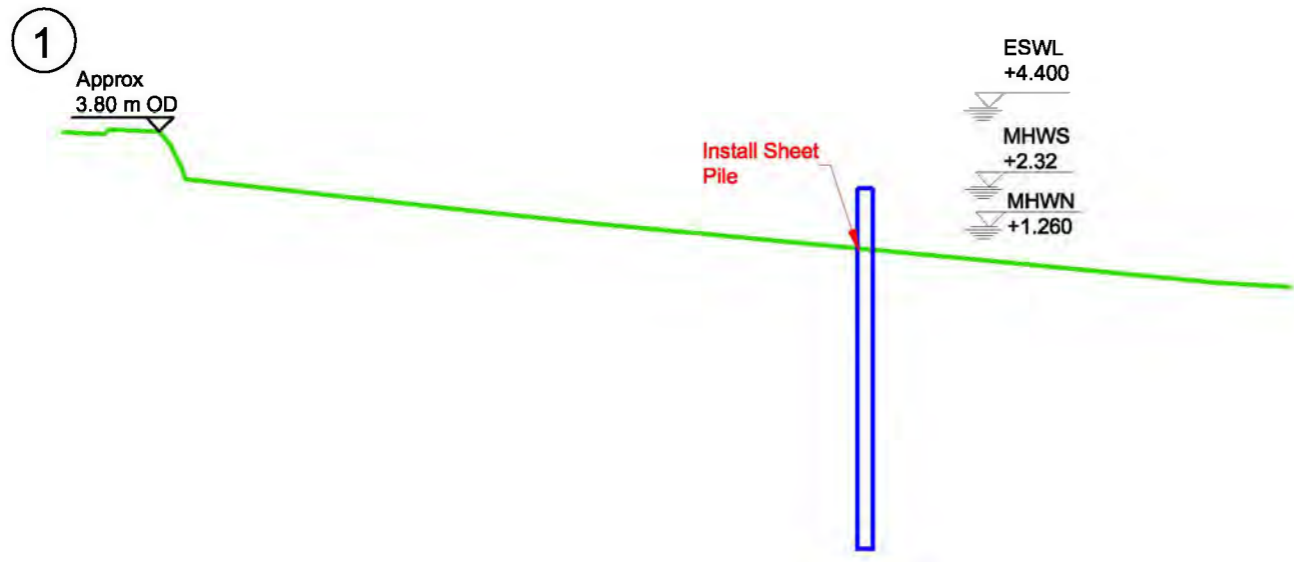


Plan
 Scale: 1/2500 @A3

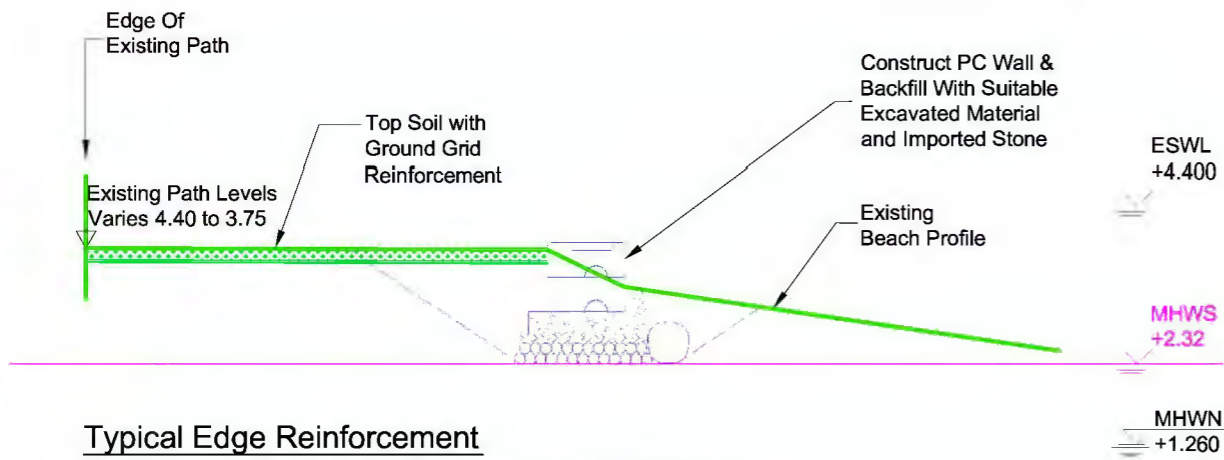
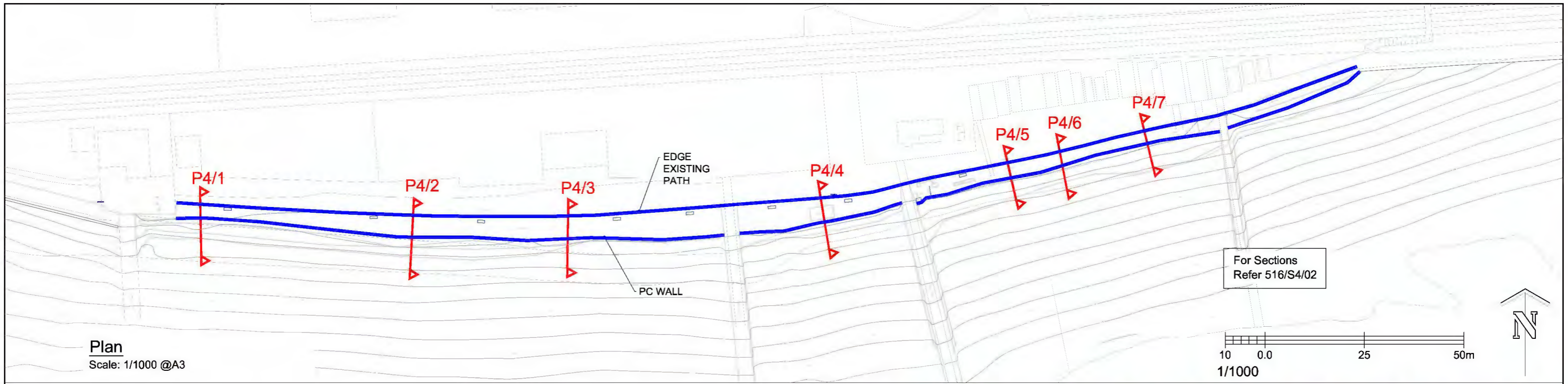
Rev A: Length of Section 3 revised and extended, (16/02/2018)

CLIENT:	Dundee City Council	DRN:	LMO
TITLE:	Broughty Ferry Flood Protection Section 3: Beach Crescent	CHKD:	AMCL
DESCRIPTION:	Section 3 Profiles 15 to 180m	APP:	AMCL
STATUS:	Screening	DATE:	10/17
ENGINEER NO.:	516/S3/02RevA	SCALE:	Varies @ A3

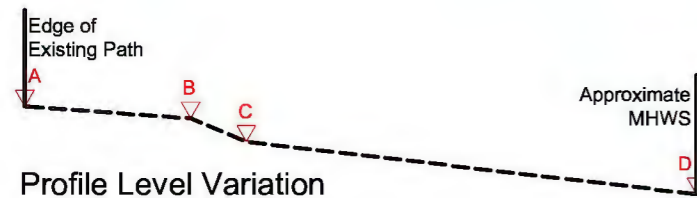
Macleod Consulting
 Civil, Structural and Environmental Engineering
 11 Castle Street, DUNDEE, DD1 3AA
 TEL: 01392 221599 FAX: 01392 223385
 OFFICE@MACLEODCONSULTING.CO.UK



CLIENT:	Dundee City Council		
TITLE:	Broughty Ferry Flood Protection Section 3: Beach Crescent		
DESCRIPTION:	Section 3 Outline Construction Sequence	DRAWING No.:	516/S3/03
STATUS:	Screening	SCALE:	1:200 @ A3
DATE:	10/17	DIR:	LMO
		CHKD:	AMCL
		APP:	AMCL
Macleod Consulting Civil, Structural and Environmental Engineering		11 Castle Street, DUNDEE, DD1 3AA TEL: 01382 221999 FAX: 01382 233393 OFFICE@MACLEODCONSULTING.CO.UK	

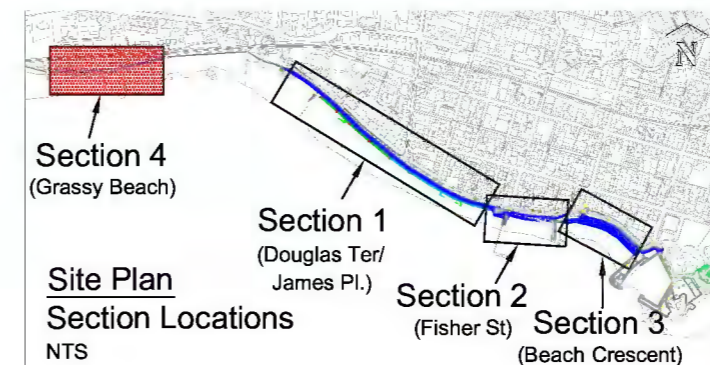


Typical Edge Reinforcement
For Proposed Construction Sequence Refer 516/S4/03
Scale: 1:100 @A3



Profile Level Variation
For Sections Refer 516/S4/02
NTS

		SECTION 4 (Grassy Beach)													
		P4/1		P4/2		P4/3		P4/4		P4/5		P4/6		P4/7	
		Level (m O.D)	Distance (m)	Level (m O.D)	Distance (m)	Level (m O.D)	Distance (m)	Level (m O.D)	Distance (m)	Level (m O.D)	Distance (m)	Level (m O.D)	Distance (m)	Level (m O.D)	Distance (m)
A		4.34	0.00	3.97	0.00	3.92	0.00	3.85	0.00	3.85	0.00	3.89	0.00	3.72	0.00
B		4.09	3.46	3.75	5.50	3.92	5.35	3.83	6.09	3.83	2.69	3.79	2.36	3.85	3.11
C		3.60	4.63	*	*	3.48	6.54	3.34	7.10	3.57	4.04	3.58	3.42	3.28	4.84
D		2.50	14.06	2.50	12.85	2.50	12.96	2.50	12.82	2.50	10.34	2.50	9.76	2.50	10.56



CLIENT: Dundee City Council

TITLE: Broughty Ferry Flood Protection
Section 4: Grassy Beach

DESIGNER: LMO
CHECKED: AMCL
APPROVED: AMCL
DATE: 10/17

DESCRIPTION: Section 4
Sections for Edge Protection

DRAWING No.: 516/S4/01

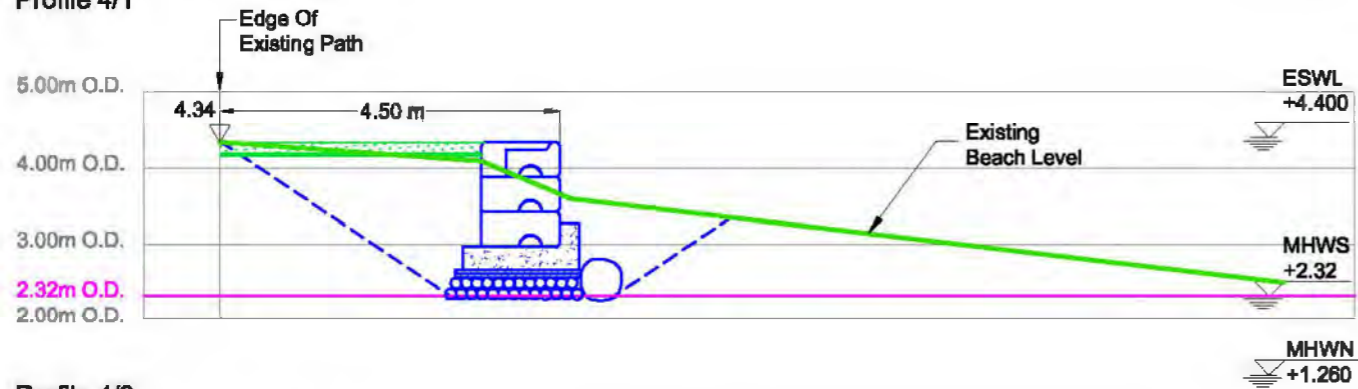
STATUS: Screening

SCALE: Varies @ A3

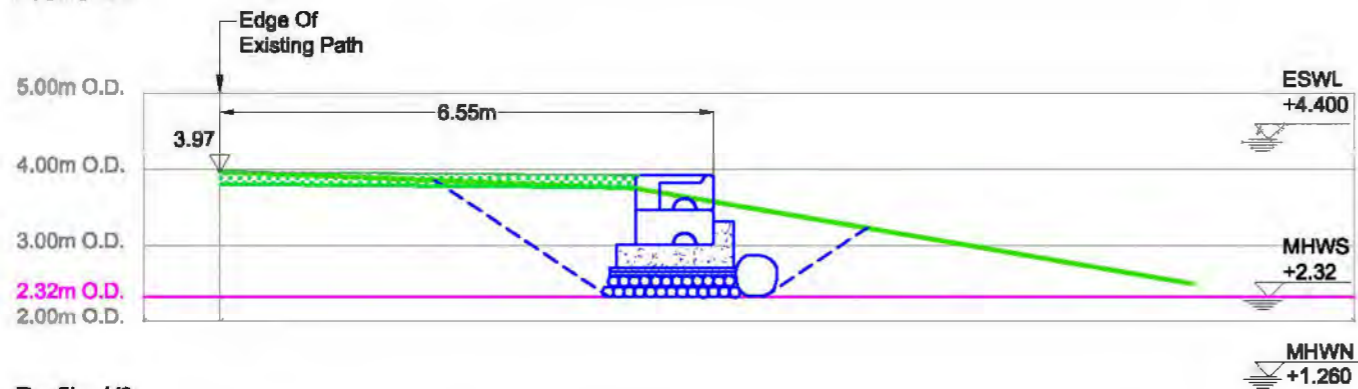
Macleod Consulting
Civil, Structural and Environmental Engineering

11 Castle Street, DUNDEE, DD1 3AA
TEL: 01382 221995 FAX: 01382 203383
OFFICE@MACLEODCONSULTING.CO.UK

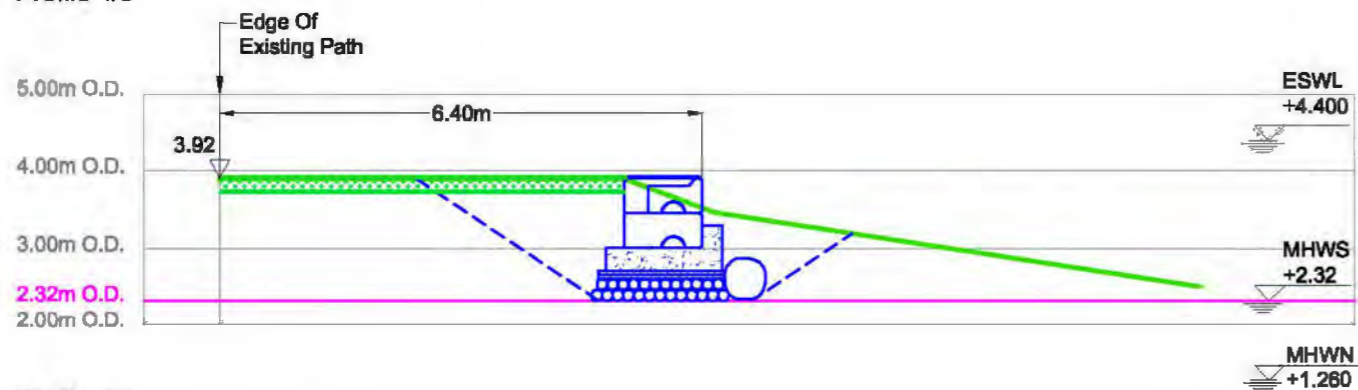
Profile 4/1



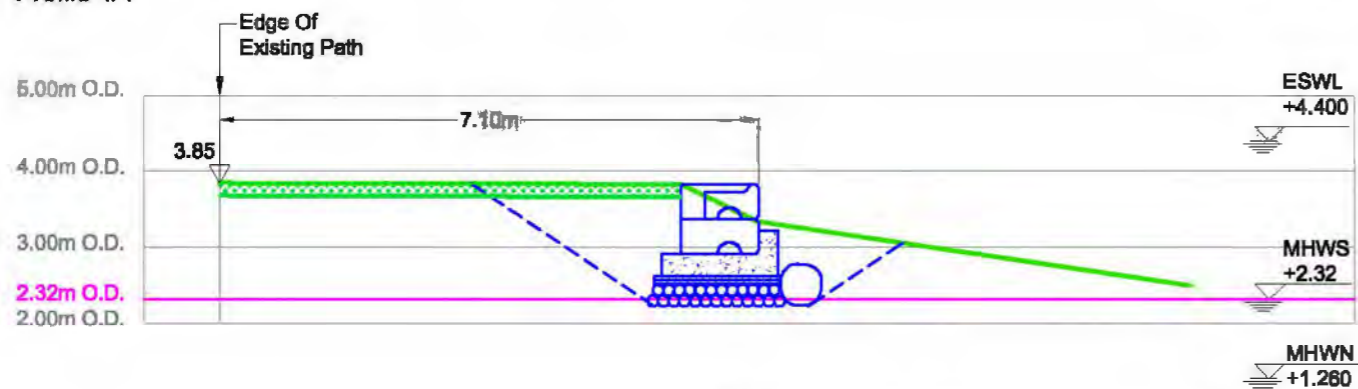
Profile 4/2



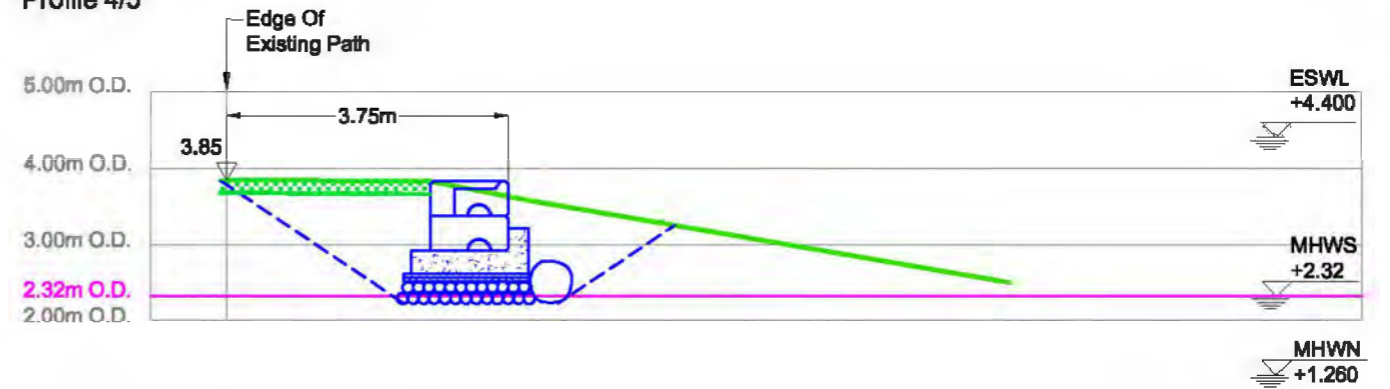
Profile 4/3



Profile 4/4



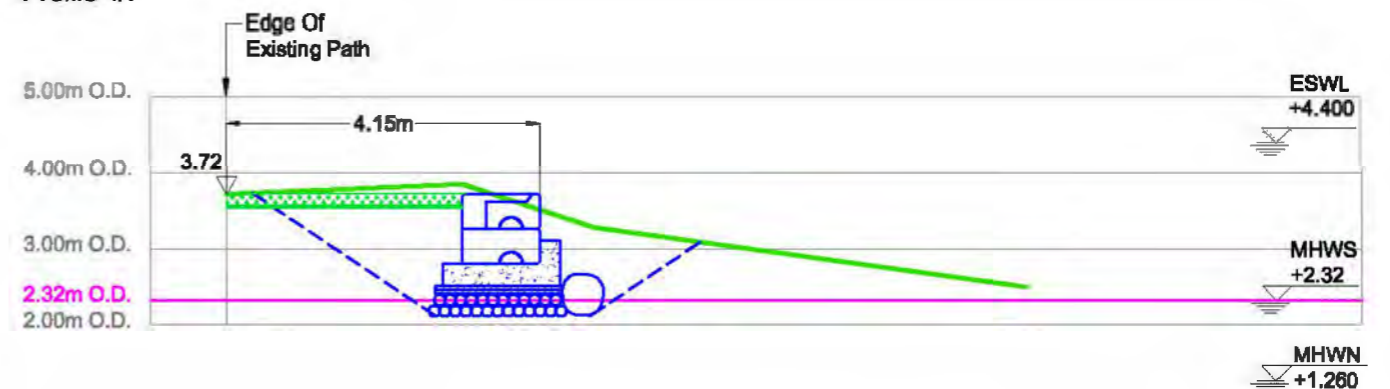
Profile 4/5



Profile 4/6

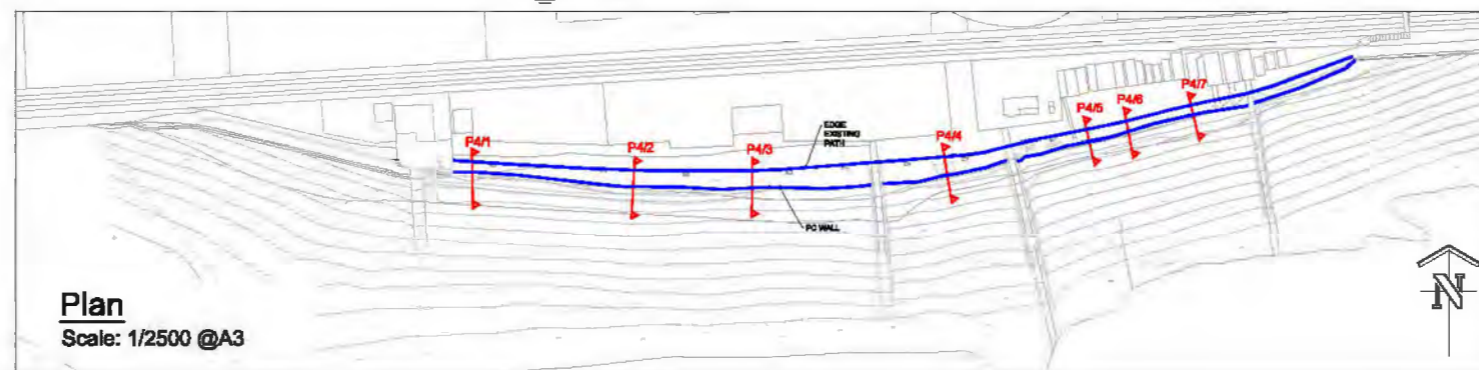


Profile 4/7



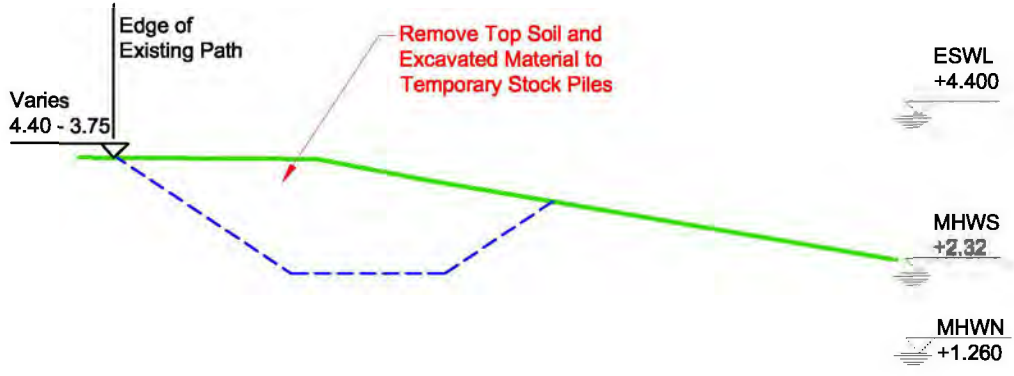
For Sections Locations Refer 516/S4/01
For Proposed Construction Sequence Refer 516/S4/03

Profiles Section 4 (1-7)
Scale: 1/100 @A3

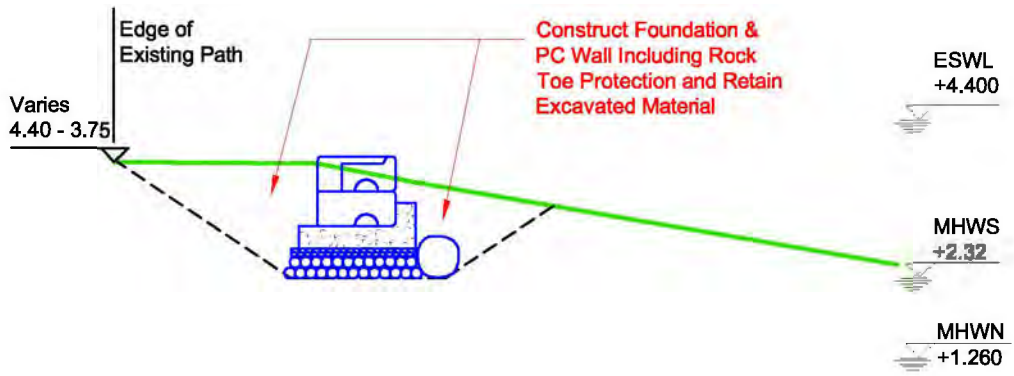


CLIENT:	Dundee City Council	DRW:	LMO
TITLE:	Broughty Ferry Flood Protection Section 4: Grassy Beach	CHEK:	AMCL
DESCRIPTION:	Section 4 Profiles 1 to 7	APP:	AMCL
STATUS:	Screening	DATE:	10/17
DRAWING No.:	516/S4/02	SCALE:	Varies @ A3
		11 Castle Street, DUNDEE, DD1 3AA TEL: 01382 221600 FAX: 01382 220088 OFFICE@MACLEODCONSULTING.CO.UK	

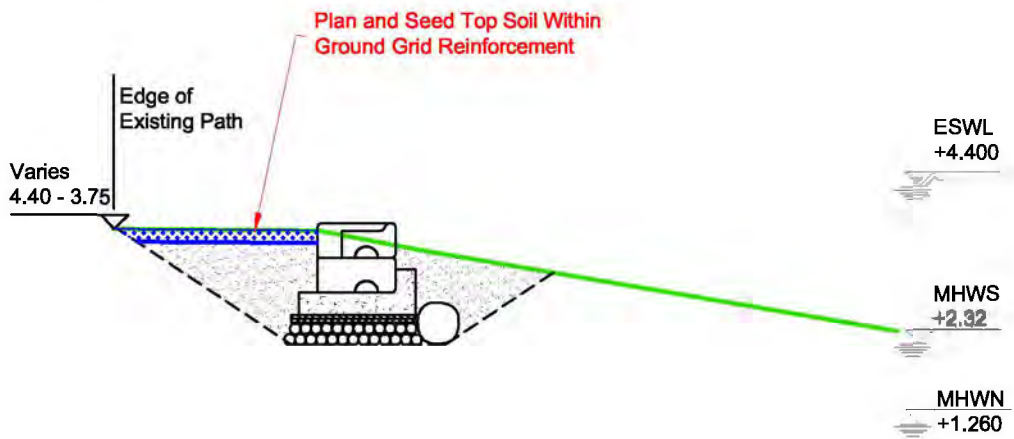
1



2



3



CLIENT: Dundee City Council

PROJECT: Broughty Ferry Flood Protection - Section 4

STATUS: Screening

DRAWING No.: 516/S4/03

SCALE: 1:100@A4

TITLE: Section 4 Outline Construction Sequence

DRN: LMO

CHKD: AMCL

APP: AMCL

DATE: 10/17

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