

Technical Report

# Ecology Desk Study

Fairbourne Outfall

Waterco Ltd

March 2019



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# 1 Introduction

## 1.1 Terms of reference

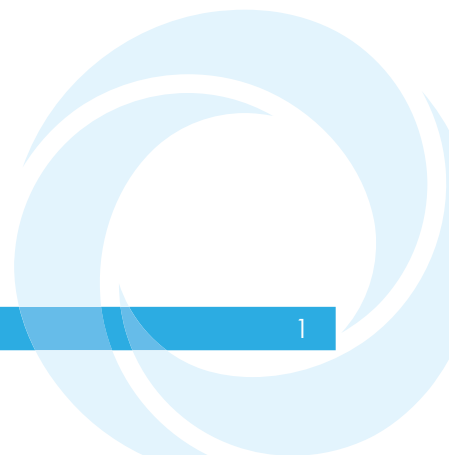
In January 2019 Atmos Consulting Ltd (Atmos) were commissioned by Waterco Ltd to undertake an ecology desk study on the area around Fairbourne Outfall in Gwynedd which is in need of repair. A Marine Licence Band 2 is needed for these works and so an ecological assessment of the area is required. This desk study is to inform this ecological assessment.

## 1.2 Site location and description

Fairbourne Outfall is a short marine outfall on the coast of Barmouth Bay and to the north of the village of Fairbourne in Gwynedd. The outfall has an approximate central national grid reference (NGR) of SH 61047 13619.

## 1.3 Objectives

The objective of the desk study is to compile and review ecology data relevant to the site and local area, notably for statutory and non-statutory nature conservation sites and records of protected or otherwise notable species.



## 2 Methodology

### 2.1 Nature conversation sites

A review of online resources<sup>1</sup> was undertaken in February 2019 to gather details of statutory nature conservation designations within 5 km of the site, e.g. Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Ramsar Sites, Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs) and Local Nature Reserves (LNRs).

In addition, Cofnod, the North Wales Environmental Information Service, was contacted in February 2019 for details on any non-statutory nature conservation designations within 5 km of the site, e.g. Ancient Woodland Inventory (AWI), Sites of Nature Conservation Interest (SNCIs) and Local Wildlife Sites (LWSs).

### 2.2 Species

Cofnod was also contacted for species records to obtain details of any legally protected species or otherwise notable<sup>2</sup> species within 5 km of the site. A time limit of 25 years was applied to the search.

In concert with the search for data records, a review of Ordnance Survey maps and aerial images was undertaken to identify the presence of waterbodies within 500 m of the site. Great crested newts *Triturus cristatus*, which are protected together with their habitats, can travel relatively large distances between breeding ponds and terrestrial habitat. Following guidance issued by Natural England (English Nature, 2001), land within 500 m of a great crested newt breeding pond should be treated as potential great crested newt terrestrial habitat and evaluated accordingly.

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<sup>1</sup> Using the MAGIC website ([www.Magic.gov.uk](http://www.Magic.gov.uk)) which provides authoritative geographic information about the natural environment from across government.

<sup>2</sup> Species listed within published red data lists or within national and local policies as being of conservation concern. These include species listed under the Natur Gwynedd Biodiversity Action Plan and Species of Principal Importance in Wales (NERC Act 2006)

## 3 Designated Nature Conservation Sites

### 3.1 Statutory designated sites

The Fairbourne Outfall lies within two statutory designated sites; Pen Llyn a`r Sarnau/ Llyn Peninsula and the Sarnau SAC (Marine) and Aber Mawddach/Mawddach Estuary SSSI. Details of further statutory sites within 5 km of the outfall can also be found below in Table 1.

#### 3.1.1 Special Area of Conservation (Marine)

##### Pen Llyn a`r Sarnau/ Llyn Peninsula and the Sarnau

The Fairbourne Outfall lies within the Pen Llyn a`r Sarnau/ Llyn Peninsula SAC which encompasses areas of sea, coast and estuary that support a wide range of marine habitats and species. It has been selected as an SAC for the presence of 9 marine habitat types and associated species (Habitats Directive Annex I habitat types) and 3 mammal species (Habitats Directive Annex II species). For the qualifying habitats and species, this designated site is considered to be one of the best areas in the UK for:

- Reefs
- Large shallow inlets and bays
- Sandbanks which are slightly covered by seawater all the time
- Estuaries
- Coastal lagoons

They are also considered to support a significant presence of:

- Mudflats and sandflats not covered by seawater at low tide
- Atlantic salt meadows (*Glauco-Puccinellietalia maritima*)
- *Salicornia* and other annuals colonising mud and sand
- Submerged and partially submerged sea caves
- Grey seal *Halichoerus grypus*
- Bottlenose dolphin *Tursiops truncatus*
- Otter *Lutra lutra*

These features are distributed throughout the SAC with no single feature occupying the entire SAC and with features overlapping in some locations. The SAC habitats understood to be present around the outfall location are intertidal mudflats and sandflats, and estuaries.

A number of the habitats and species listed within the SAC are also listed in the Section 7 list of habitats and Species of Principal Importance in Wales (NERC Act 2006) and in the OSPAR List of Threatened and/or Declining Species and Habitats.

#### 3.1.2 Site of Special Scientific Interest

##### Aber Mawddach/Mawddach Estuary

The outfall site lies within this SSSI and is of special interest for its biological features. It includes the Mawddach estuary, which is a large shallow estuary draining into Cardigan Bay, as well as adjacent habitats. The estuary is wide with extensive sandflats,

areas of muddy sediments and large areas of saltmarsh. The mouth of the estuary is protected to the south by Fairbourne Spit, a sand and shingle spit, and on the north side of the small town of Barmouth. The special features of the site are the estuarine habitats, particularly muddy sediments and saltmarshes, reed beds and raised mire. There are also substantial species interest, including breeding waders, scarce vascular plants, bryophytes and invertebrates.

There is one plant on the site, *Eleocharis parvula*, which is listed under Schedule 8 species under the Wildlife & Countryside Act 1981 (as amended). There are two Wildlife & Countryside Act Schedule 5 animal species occurring within the SSSI, otter and allis shad *Alosa alosa* (non-spawning population). These species are both also listed under Annex II of the European Habitat & Species Directive and three other Annex II species also occur, twaite shad *Alosa fallax*, sea lamprey *Petromyzon marinus* and Atlantic salmon *Salmo salar*.

### 3.1.1 Further statutory sites within 5 km

There are a further ten statutory nature conservation sites within 5 km of the outfall site. These include SSSIs, SPAs, SACs and an RSPB nature reserve.

**Table 1: Designated features of the statutory sites within 5 km of the site**

Site Name	Designation	Distance and Direction from Site	Designated Features	
Glannau Tonfanau I Friog	SSSI	1.6 km (S)	Habitats	Habitats that are the primary reason for the selection of this site: <ul style="list-style-type: none"> <li>Honeycomb worm <i>Sabellaria alveolata</i> biogenic reefs</li> <li>Specialised coralline rock pools</li> <li>Extensive, natural, mixed substrata shore</li> </ul>
Mawddach Woodlands	RSPB	2.0 km (E)	General	Woodland and heathland nature reserve which is intentionally important for rare mosses, liverworts and lichens. Pied flycatcher <i>Ficedula hypoleuca</i> , redstart <i>Phoenicurus phoenicurus</i> , wood warbler <i>Phylloscopus sibilatrix</i> and lesser horseshoe bats <i>Rhinolophus hipposideros</i> are also present and the reserve supports migrant tree pipit <i>Anthus trivialis</i> and nightjar <i>Caprimulgus europaeus</i> in the summer.
Barmouth Hillside	SSSI	2.0 km (N)	Geology	Nationally important geological site.
Ty Bach Ystlumod	SSSI	2.7 km (E)	Species	Species that are the primary reason for the selection of this site: <ul style="list-style-type: none"> <li>Breeding roost of lesser horseshoe bats <i>Rhinolophus hipposideros</i></li> </ul>
Northern Cardigan Bay / Gogledd Bae Ceredigion	SPA (marine components)	3.0 km (W)	Species	Article 4.1 qualification: <ul style="list-style-type: none"> <li>Wintering populations of red-throated diver <i>Gavia stellata</i></li> </ul> Article 4.2 qualification: <ul style="list-style-type: none"> <li>Assemblage of at least 20,000 waterfowl or seabirds in any season</li> </ul>

Site Name	Designation	Distance and Direction from Site	Designated Features	
Arthog Hall Woods	SSSI	3.5 km (E)	Habitats	Habitats that are the primary reason for the selection of this site: <ul style="list-style-type: none"> <li>Bryophyte-rich woodland with several rare and uncommon species</li> </ul>
Coedydd Derw a Safleoedd Ystlumod Meirion / Meirionnydd Oakwoods and Bat Sites	SAC	3.5 km (E)	Habitats	Annex I habitats for which the site is designated: <ul style="list-style-type: none"> <li>Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i>, <i>Alnion incanae</i>, <i>Salicion albae</i>)</li> <li>Bog woodland</li> <li>Old sessile oak woods with <i>Ilex</i> and <i>Blechnum</i> in the British Isles</li> <li>Watercourses of plain to montane levels with the <i>Ranunculion fluitantis</i> and <i>Callitricho-Batrachion</i> vegetation</li> <li><i>Tilio-Acerion</i> forests of slopes, screes and ravines</li> <li>European dry heaths</li> <li>Northern Atlantic wet heaths with <i>Erica tetralix</i></li> </ul>
			Species	Annex II species for which the site is designated: <ul style="list-style-type: none"> <li>Lesser horseshoe bats <i>Rhinolophus hipposideros</i></li> </ul>
Cadair Idris	SSSI	4.0 km (E)	Habitats	Habitats that are the primary reason for the selection of this site: <ul style="list-style-type: none"> <li>Blanket bog</li> <li>Wet and dry heaths</li> <li>Lichen/bryophyte heath</li> <li>Tall herb and fern ledges</li> <li>Vegetated natural rock exposures</li> <li>Standing water</li> <li>Broadleaved woodland</li> <li>Calcareous, acid and marshy grassland</li> <li>Flushes and springs</li> </ul>
			Species	Species that are the primary reason for the selection of this site: <ul style="list-style-type: none"> <li>Assemblage of higher plants, lichens, bryophytes and montane invertebrates</li> <li>Nine higher plants are of special interest in their own right as is the slender green feather moss <i>Hamatocaulis vernicosus</i> and an edge of range lichen species.</li> <li>Marsh fritillary butterfly <i>Eurodryas aurinia</i></li> <li>Welsh clearwing moth <i>Sinathedon scoliaeformis</i></li> <li>Lesser horseshoe bat <i>Rhinolophus hipposideros</i></li> </ul>

Site Name	Designation	Distance and Direction from Site	Designated Features	
	SAC	4.0 km (E)	Habitats	Annex I habitats for which the site is designated: <ul style="list-style-type: none"> <li>Blanket bogs</li> <li>Alkaline fens</li> <li>Calcareous rocky slopes with chasmophytic vegetation</li> <li>European dry heaths</li> <li>Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels</li> <li><i>Molinia</i> meadows on calcareous, peaty or clayey-silt-laden soils (<i>Molinion caeruleae</i>)</li> <li>Northern Atlantic wet heaths with <i>Erica tetralix</i></li> <li>Old sessile oak woods with <i>Ilex</i> and <i>Blechnum</i> in the British Isles</li> <li>Oligotrophic to mesotrophic standing waters with vegetation of the <i>Littorelletea uniflorae</i></li> <li>Siliceous rocky slopes with chasmophytic vegetation</li> <li>Siliceous scree of the montane to snow levels</li> </ul>
			Species	Annex II species for which the site is designated: <ul style="list-style-type: none"> <li>Marsh fritillary butterfly <i>Euphydryas aurinia</i></li> <li>Slender green feather-moss <i>Drepanocladus vernicosus</i></li> </ul>
Cregennen A Pared Y Cefn Hir	SSSI	4.4 km (E)	Geology	Nationally important geological site.

### 3.2 Non-statutory designated sites

The outfall site does not lie directly within any non-statutory designated sites. 106 Ancient Woodland Sites (AWS) are located within 5 km of the site with the closest of these an ancient semi-natural woodland site lying approximately 1 km from the outfall site. These AWS sites range from ancient semi natural woodland, restored semi natural woodland, restored ancient woodland and ancient woodland sites of unknown category. There are also seven Local Wildlife Sites (LWS) within 5 km of the outfall site. Details of these can be seen below (Table 2).

**Table 2: Local Wildlife Sites within 5 km of the site**

Site Name	Distance and Direction from Site	Features
Dinas Oleu	2.0 km (N)	<ul style="list-style-type: none"> <li>Dry dwarf shrub heath</li> </ul>
Garn (candidate site)	2.2 km (N)	<ul style="list-style-type: none"> <li>Dry heath/acid grassland mosaic</li> <li>Acid grassland</li> </ul>
Orielton Wood (candidate site)	2.3 km (N)	<ul style="list-style-type: none"> <li>Broadleaved woodland</li> <li>Dry dwarf shrub heath</li> </ul>
Wern Mynach	2.7 km (N)	<ul style="list-style-type: none"> <li>Wet woodland</li> <li>Marshy grassland</li> </ul>
Ceilwart-ganol	3.3 km (N)	<ul style="list-style-type: none"> <li>Acid grassland</li> </ul>

Site Name	Distance and Direction from Site	Features
		<ul style="list-style-type: none"> <li>• Bracken</li> </ul>
Ffridd y Graig & south of Garn	3.2 km (N)	<ul style="list-style-type: none"> <li>• Acid grassland</li> <li>• Dry dwarf shrub heath</li> </ul>
Tyddyn-y-nant	5.5 km (N)	<ul style="list-style-type: none"> <li>• Acid grassland</li> <li>• Marshy grassland</li> </ul>

### 3.3 Protected and notable species

#### 3.3.1 Algae

There is also a single record of a *Porphyra* spp which is a non-native alga that is listed under Schedule 9 of the wildlife and Countryside Act (1981). This record dates from 2005 and is located on the coast approximately 2.1 km south of the outfall site.

#### 3.3.2 Lichens

There are four records of *Lobaria pulmonaria*, which is a lichen species listed under Schedule 8 of the Wildlife and Countryside Act (1981). The closest record to the outfall site is 2.4 km away and all records date from 2002.

#### 3.3.3 Plants

There are records of numerous vascular plant species from within the search area, with bluebell *Hyacinthoides non-scripta* the only species protected under Schedule 8 (Wildlife and Countryside Act, 1981). There are numerous records of bluebell, with the closest being located 3.0 km from the site and the most recent record dating from 2016. A list of all plant species with records obtained during the data search is provided in Appendix A.

There are also records of a number of non-native invasive plant species listed on Schedule 9 (Wildlife and Countryside Act, 1981) from within 5 km of the site (Table 3).

**Table 3: Non-native invasive plant records from within 5 km of the site**

Species	No. of records	Most recent record	Closest record to site
Himalayan balsam <i>Impatiens glandulifera</i>	7	2018	2.0 km
Himalayan cotoneaster <i>Cotoneaster simonsii</i>	1	2015	3.0 km
Japanese knotweed <i>Fallopia japonica</i>	72	2018	1.1 km
Japanese rose <i>Rosa rugosa</i>	6	2015	0.5 km
Montbretia <i>Crocasmia crocosmiiflora</i>	15	2017	0.5 km
Rhododendron <i>Rhododendron ponticum</i>	76	2016	1.4 km
Small-leaved cotoneaster <i>Cotoneaster microphyllus</i>	1	2015	4.3 km
Wall cotoneaster <i>Cotoneaster horizontalis</i>	4	2015	1.1 km

### 3.3.4 Invertebrates

There are records of many invertebrate species from within 5 km of the outfall site and a full list of these species can be found in Appendix B. The white letter hairstreak butterfly *Satyrion w-album* is the only Schedule 5 species with records obtained during the data search. There are two records of this species with the nearest located 2.8 km from the site and the most recent dating from 2008.

### 3.3.5 Fish

There were no records of any fish species obtained during the data search. However, the Aber Mawddach/Mawddach Estuary SSSI is known to support twaite shad, sea lamprey, Atlantic salmon and non-spawning allis shad.

### 3.3.6 Reptiles

Four reptile species have been recorded within 5 km of the outfall; slow-worm, grass snake *Natrix helvetica*, adder *Vipera berus* and common lizard *Zootoca vivipara*. There is a single adder record approximately 4.6 km from the outfall site which dates from 2013. There are 13 common lizard records with the most recent dating from 2015 and the closest record during this year being located 0.2 km from the outfall in the sand dunes around Fairbourne. There three records of grass snake with the most recent dating from 2013 and the nearest located 0.5 km from the outfall. There are 15 records of slow worm with the closest located 0.5 km from the outfall and the most recent dating from 2016.

### 3.3.7 Amphibians

Two amphibian species have been recorded within 5 km of the outfall site; common frog *Rana temporaria* and common toad *Bufo bufo*. There are four records of common toad dating from between 2004 and 2018 with the closest record located approximately 0.9 km to the south of the outfall. There are two records of common frog from between 2005 and 2006 with the closest located approximately 2.7 km north.

### 3.3.8 Birds

There were records of a number of bird species obtained during the data search. A full list of these species can be found in Appendix C. Further details on records of Schedule 1 (Wildlife and Countryside Act, 1981) bird species can be found below (Table 4).

**Table 4: Schedule 1 bird species records from within 5 km of the site**

Species	No. of records	Most recent record	Closest record to site
Avocet <i>Recurvirostra avosetta</i>	1	2011	0.5 km
Barn owl <i>Tyto alba</i>	8	2016	1.1 km
Black tern <i>Chlidonias niger</i>	1	2015	4.3 km
Chough <i>Pyrhocorax pyrrhocorax</i>	13	2017	0.9 km
Common crossbill <i>Loxia curvirostra</i>	2	2011	3.4 km
Common scoter <i>Melanitta nigra</i>	7	2017	3.0 km

Species	No. of records	Most recent record	Closest record to site
Fieldfare <i>Turdus pilaris</i>	1	1996	1.8 km
Goshawk <i>Accipiter gentilis</i>	4	2008	2.7 km
Great northern diver <i>Gavia immer</i>	1	2008	5.0 km
Hobby <i>Falco subbuteo</i>	2	2010	2.2 km
Kingfisher <i>Alcedo atthis</i>	1	2015	3.8 km
Little gull <i>Hydrocoloeus minutus</i>	1	2014	4.0 km
Long-tailed duck <i>Clangula hyemalis</i>	1	2008	5.0 km
Mediterranean gull <i>Larus melanocephalus</i>	1	2013	0.5 km
Merlin <i>Falco columbarius</i>	1	2014	3.5 km
Osprey <i>Pandion haliaetus</i>	2	2016	1.1 km
Peregrine <i>Falco peregrinus</i>	10	2017	0.5 km
Red kite <i>Milvus milvus</i>	14	2018	1.5 km
Red-throated diver <i>Gavia stellata</i>	1	2008	5.0 km
Redwing <i>Turdus iliacus</i>	1	1994	2.5 km
Scaup <i>Aythya marila</i>	1	2010	1.2 km
Slavonian grebe <i>Podiceps auritus</i>	11	2008	5.0 km
Spoonbill <i>Platalea leucorodia</i>	2	2008	2.0 km
Velvet scoter <i>Melanitta fusca</i>	1	2008	5.0 km
Whimbrel <i>Numenius phaeopus</i>	2	2016	1.9 km

### 3.3.9 Bats

There were records of eight bat species identified during the data search, along with further records of *Myotis* and *Pipistrellus* that were not identified down to species level and records of unidentified bats. Details of these records can be found below (Table 5).

**Table 5: Bat species recorded within 5 km of the site**

Species	No. of records	Most recent record	Closest record to site	Roost records within 5 km of site
Brown long-eared <i>Plecotus auritus</i>	4	2011	1.0 km	Yes
Common pipistrelle <i>Pipistrellus pipistrellus</i>	10	2018	1.5 km	Yes
Daubentons <i>Myotis daubentonii</i>	6	2008	2.1 km	Yes
Greater horseshoe <i>Rhinolophus ferrumequinum</i>	6	2011	2.8 km	Yes
Lesser horseshoe <i>Rhinolophus hipposideros</i>	62	2018	1.0 km	Yes
<i>Myotis brandtii/mystacinus</i> Brandts/Whiskered	3	2010	3.3 km	Yes

Species	No. of records	Most recent record	Closest record to site	Roost records within 5 km of site
<i>Myotis</i> spp	4	2015	3.3 km	Yes
Natterers <i>Myotis nattereri</i>	4	2010	3.1 km	Yes
Pipistrelle <i>Pipistrellus</i> spp	1	2017	1.1 km	Yes
Soprano pipistrelle <i>Pipistrellus pygmaeus</i>	8	2018	2.8 km	Yes
Unidentified bat	21	2017	1.1 km	Yes

### 3.3.10 Badger

There are 27 records of badger *Meles meles* dating from between 1994 and 2016. The closest of these is located approximately 1.4 km from the site and dates from 1994. The most recent record is a road kill record located approximately 3.9 km from the site.

### 3.3.11 Otter

There are 37 records of otter *Lutra lutra* dating from between 1998 and 2018. The closest of these is located approximately 0.5 km to the south of the outfall site and is a record of a spraint beneath a bridge that dates from 2019. The most recent record is a spraint containing crab remains, which indicates intertidal foraging, located approximately 1.4 km from the site.

### 3.3.12 Grey seals

There were no grey seal records obtained during the data search, however the species is known to be present within the area. The Pen Llyn a'r Sarnau/ Llyn Peninsula SAC supports the species but the area immediately around outfall site is not noted as being a pupping, moulting, or resting haul out site (CCW, 2009).

### 3.3.13 Other mammal species

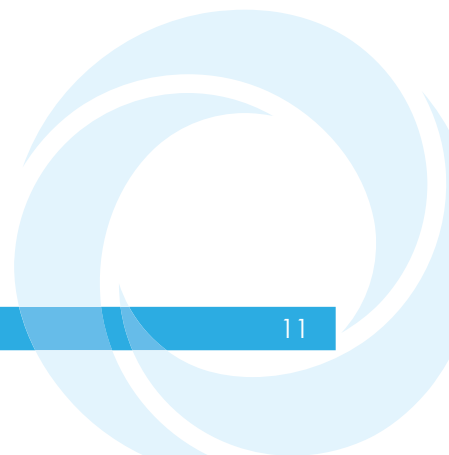
A number of other mammal species have been recorded within 2 km of the site, including three mammals of conservation significance (Table 6).

**Table 6: Further mammal species of conservation significance recorded within 5 km of the site**

Species	No. of records	Most recent record	Closest record to site	Species of Principal Importance in Wales	Gwynedd BAP
Hare <i>Lepus europaeus</i>	19	2015	1.1 km	Yes	Yes
Hedgehog <i>Erinaceus europaeus</i>	10	2018	0.4 km	Yes	No
Polecat <i>Mustela putorius</i>	4	2015	2.2 km	Yes	Yes

American mink *Neovison vison*, a non-native invasive mammal species, has also been recorded in the area and there are nine records of dating from 2005 to 2009. The

closest of these is a record from approximately 1.1 km east of the outfall dating from 2005.



## 4 References

Countryside Council for Wales (2009). Pen Llyn a'r Sarnau/ Llyn Peninsula SAC Regulation 33 Advice.

## Appendices

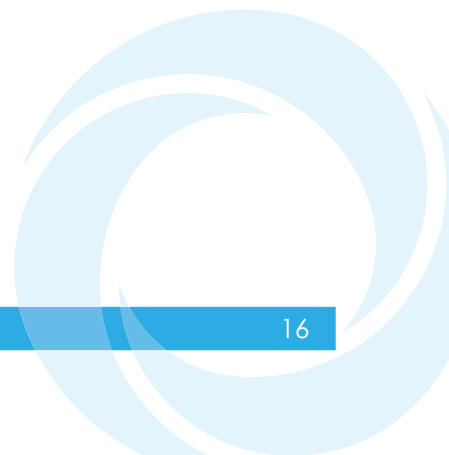
### Appendix A. Records of plant species within 5 km of the site

Latin name	Common name
<i>Acer campestre</i>	Field Maple
<i>Aethusa cynapium</i>	Fool's Parsley
<i>Agrimonia procera</i>	Fragrant Agrimony
<i>Agrostis gigantea</i>	Black Bent
<i>Allium vineale</i>	Wild Onion
<i>Anacamptis pyramidalis</i>	Pyramidal Orchid
<i>Andromeda polifolia</i>	Bog-rosemary
<i>Anthyllis vulneraria</i>	Kidney Vetch
<i>Asplenium marinum</i>	Sea Spleenwort
<i>Asplenium obovatum</i>	Lanceolate Spleenwort
<i>Atriplex portulacoides</i>	Sea-purslane
<i>Azolla filiculoides</i>	Water Fern
<i>Beta vulgaris</i> subsp. <i>maritima</i>	Sea Beet
<i>Brassica nigra</i>	Black Mustard
<i>Bromus hordeaceus</i> subsp. <i>thominei</i>	Sand Soft-brome
<i>Calystegia sepium</i> subsp. <i>roseata</i>	Bindweed
<i>Campylopus pillifer</i>	Stiff Swan-neck Moss
<i>Carduus nutans</i>	Musk Thistle
<i>Carduus tenuiflorus</i>	Slender Thistle
<i>Catapodium marinum</i>	Sea Fern-grass
<i>Cephalanthera longifolia</i>	Narrow-leaved Helleborine
<i>Chaenorhinum minus</i>	Small Toadflax
<i>Chenopodium ficifolium</i>	Fig-leaved Goosefoot
<i>Cortaderia selloana</i>	Pampas-grass
<i>Cotoneaster horizontalis</i>	Wall Cotoneaster
<i>Cotoneaster microphyllus</i>	Small-leaved Cotoneaster
<i>Cotoneaster simonsii</i>	Himalayan Cotoneaster
<i>Crithmum maritimum</i>	Rock Samphire
<i>Crocasmia pottsii</i> x <i>aurea</i> = <i>C. x crocosmiiflora</i>	Montbretia

Latin name	Common name
<i>Cynoglossum officinale</i>	Hound's-tongue
<i>Didymodon vinealis</i>	Soft-tufted Beard-moss
<i>Dipsacus fullonum</i>	Wild Teasel
<i>Drepanocladus polygamus</i>	Fertile Feather-moss
<i>Dryopteris carthusiana</i> x <i>dilatata</i> = <i>D. x deweveri</i>	Buckler-Fern
<i>Echium vulgare</i>	Viper's-bugloss
<i>Eleocharis uniglumis</i>	Slender Spike-rush
<i>Epilobium brunnescens</i>	New Zealand Willowherb
<i>Erodium maritimum</i>	Sea Stork's-bill
<i>Euphrasia officinalis</i> subsp. <i>pratensis</i>	Eyebright
<i>Fallopia convolvulus</i>	Black-bindweed
<i>Fallopia japonica</i>	Japanese Knotweed
<i>Festuca longifolia</i>	Blue Fescue
<i>Fissidens rivularis</i>	River Pocket-moss
<i>Fumaria bastardii</i>	Tall Ramping-fumitory
<i>Galium mollugo</i> subsp. <i>erectum</i>	Upright Hedge Bedstraw
<i>Geranium sanguineum</i>	Bloody Crane's-bill
<i>Glaucium flavum</i>	Yellow Horned-poppy
<i>Grimmia decipiens</i>	Great Grimmia
<i>Hyacinthoides hispanica</i>	Spanish Bluebell
<i>Hyacinthoides non-scripta</i>	Bluebell
<i>Hyacinthoides non-scripta</i> x <i>hispanica</i> = <i>H. x massartiana</i>	Bluebell
<i>Hypericum perforatum</i> x <i>maculatum</i> = <i>H. x desetangii</i>	Des Etangs' St John's-wort
<i>Hypericum undulatum</i>	Wavy St John's-wort
<i>Impatiens glandulifera</i>	Himalayan Balsam
<i>Impatiens noli-tangere</i>	Touch-me-not Balsam
<i>Isolepis cernua</i>	Slender Club-rush
<i>Koeleria macrantha</i>	Crested Hair-grass
<i>Leycesteria formosa</i>	Himalayan Honeysuckle
<i>Limonium humile</i>	Lax-flowered Sea-lavender
<i>Limonium vulgare</i>	Common Sea-lavender
<i>Malva neglecta</i>	Dwarf Mallow
<i>Matricaria chamomilla</i>	Scented Mayweed

Latin name	Common name
<i>Meconopsis cambrica</i>	Welsh Poppy
<i>Melilotus altissimus</i>	Tall Melilot
<i>Oenanthe lachenalii</i>	Parsley Water-dropwort
<i>Orthotrichum rupestre</i>	Rock Bristle-moss
<i>Pallavicinia lyellii</i>	Ribbonwort
<i>Parapholis strigosa</i>	Hard-grass
<i>Persicaria lapathifolia</i>	Pale Persicaria
<i>Petasites hybridus</i>	Butterbur
<i>Polygonum oxyspermum</i>	Ray's Knotgrass
<i>Populus nigra</i> subsp. <i>betulifolia</i>	Black Poplar
<i>Porphyra</i>	
<i>Potamogeton perfoliatus</i>	Perfoliate Pondweed
<i>Potentilla anglica</i> x <i>reptans</i> = <i>P. x mixta</i>	Hybrid Cinquefoil
<i>Prunus laurocerasus</i>	Cherry Laurel
<i>Pulicaria dysenterica</i>	Common Fleabane
<i>Ranunculus lingua</i>	Greater Spearwort
<i>Ranunculus sceleratus</i>	Celery-leaved Buttercup
<i>Rhododendron ponticum</i>	
<i>Rhynchostegium megapolitanum</i>	Megapolitan Feather-moss
<i>Riccardia latifrons</i>	Bog Germanderwort
<i>Riccia crozalsii</i>	Ciliate Crystalwort
<i>Riccia nigrella</i>	Black Crystalwort
<i>Rosa rugosa</i>	Japanese Rose
<i>Rumex crispus</i> subsp. <i>littoreus</i>	Curled Dock
<i>Rumex crispus</i> x <i>obtusifolius</i> = <i>R. x pratensis</i>	Dock
<i>Rumex hydrolapathum</i>	Water Dock
<i>Sagina maritima</i>	Sea Pearlwort
<i>Salicornia dolichostachya</i>	Long-spiked Glasswort
<i>Salicornia ramosissima</i>	Purple Glasswort
<i>Salsola kali</i> subsp. <i>kali</i>	Prickly Saltwort
<i>Sarcocornia perennis</i>	Perennial Glasswort
<i>Schoenoplectus lacustris</i>	Common Club-rush
<i>Scrophularia auriculata</i>	Water Figwort
<i>Sedum album</i>	White Stonecrop

Latin name	Common name
<i>Silene uniflora</i>	Sea Campion
<i>Smyrniolus olusatrum</i>	Alexanders
<i>Sparganium erectum subsp. neglectum</i>	Branched Bur-Reed
<i>Spartina anglica</i>	Common Cord-grass
<i>Spergula arvensis</i>	Corn Spurrey
<i>Spergularia media</i>	Greater Sea-spurrey
<i>Spergularia rupicola</i>	Rock Sea-spurrey
<i>Splachnum ampullaceum</i>	Cruet Collar-moss
<i>Stachys arvensis</i>	Field Woundwort
<i>Stellaria neglecta</i>	Greater Chickweed
<i>Stellaria nemorum subsp. montana</i>	Wood Stitchwort
<i>Tanacetum vulgare</i>	Tansy
<i>Tragopogon pratensis</i>	Goat's-beard
<i>Trifolium scabrum</i>	Rough Clover
<i>Tripleurospermum inodorum</i>	Scentless Mayweed
<i>Ulex gallii</i>	Western Gorse
<i>Utricularia minor</i>	Lesser Bladderwort
<i>Veronica agrestis</i>	Green Field-speedwell
<i>Viola canina</i>	Heath Dog-violet
<i>Viola odorata</i>	Sweet Violet
<i>Vulpia myuros</i>	Rat's-tail Fescue



## Appendix B. Invertebrate records

### Moth and butterfly species recorded within 5 km of the outfall site

Latin name	Common name
<i>Acronicta psi</i>	Grey dagger
<i>Acronicta rumicis</i>	Knot grass
<i>Amphipoea oculea</i>	Ear moth
<i>Apamea remissa</i>	Dusky brocade
<i>Arctia caja</i>	Garden tiger
<i>Atethmia centrago</i>	Centre-barred sallow
<i>Boloria selene</i>	Small pearl-bordered fritillary
<i>Brachylomia viminalis</i>	Minor shoulder-knot
<i>Caradrina morpheus</i>	Mottled rustic
<i>Ceramica pisi</i>	Broom moth
<i>Coenonympha pamphilus</i>	Small heath
<i>Cossus cossus</i>	Goat moth
<i>Diarsia rubi</i>	Small square-spot
<i>Ecliptopera silaceata</i>	Small phoenix
<i>Eugnorisma glareosa</i>	Autumnal rustic
<i>Hepialus humuli</i>	Ghost moth
<i>Hipparchia semele</i>	Grayling
<i>Hoplodrina blanda</i>	Rustic
<i>Hydraecia micacea</i>	Rosy rustic
<i>Lasiommata megera</i>	Wall
<i>Litologia literosa</i>	Rosy minor
<i>Malacosoma neustria</i>	Lackey
<i>Melanchra persicariae</i>	Dot moth
<i>Melanthia procellata</i>	Pretty chalk carpet
<i>Mniotype adusta</i>	Dark brocade
<i>Polia bombycina</i>	Pale shining brown
<i>Satyrion w-album</i>	White-letter hairstreak
<i>Scopula marginepunctata</i>	Mullein wave
<i>Spilosoma lubricipeda</i>	White ermine
<i>Spilosoma lutea</i>	Buff ermine
<i>Tholera cespitis</i>	Hedge rustic
<i>Tyria jacobaeae</i>	Cinnabar
<i>Watsonalla binaria</i>	Oak hook-tip
<i>Xanthorhoe ferrugata</i>	Dark-barred twin-spot carpet

**Further invertebrate species recorded within 5 km of the outfall site**

Latin name	Common name
<i>Aizobius sedi</i>	
<i>Aromia moschata</i>	Musk beetle
<i>Austrominius modestus</i>	
<i>Brachygluta waterhousei</i>	
<i>Calopteryx virgo</i>	beautiful demoiselle
<i>Carpelimus halophilus</i>	
<i>Cordulegaster boltonii</i>	golden-ringed dragonfly
<i>Donacia thalassina</i>	
<i>Enallagma cyathigerum</i>	Common blue damselfly
<i>Formica rufa</i>	Red wood ant
<i>Larinus planus</i>	
<i>Mecinus collaris</i>	
<i>Melieria cana</i>	
<i>Orthetrum coerulescens</i>	Keeled skimmer
<i>Pelenomus waltoni</i>	Beetles (Weevils)
<i>Pelenomus zumpti</i>	
<i>Pentastiridius leporinus</i>	
<i>Phaleria cadaverina</i>	
<i>Pyrrhosoma nymphula</i>	Large red damselfly
<i>Thinophilus ruficornis</i>	

## Appendix C. Bird species recorded within 5 km of the outfall site

Latin name	Common name
<i>Acanthis cabaret</i>	Lesser Redpoll
<i>Accipiter gentilis</i>	Goshawk
<i>Actitis hypoleucos</i>	Common Sandpiper
<i>Aegithalos caudatus</i>	Long-tailed Tit
<i>Alauda arvensis</i>	Skylark
<i>Alcedo atthis</i>	Kingfisher
<i>Anas crecca</i>	Teal
<i>Anas penelope</i>	Wigeon
<i>Anas platyrhynchos</i>	Mallard
<i>Anas strepera</i>	Gadwall
<i>Anthus pratensis</i>	Meadow Pipit
<i>Anthus trivialis</i>	Tree Pipit
<i>Apus apus</i>	Swift
<i>Arenaria interpres</i>	Turnstone
<i>Asio flammeus</i>	Short-eared Owl
<i>Aythya marila</i>	Scaup
<i>Branta canadensis</i>	Canada Goose
<i>Branta leucopsis</i>	Barnacle Goose
<i>Calidris alba</i>	Sanderling
<i>Calidris alpina</i>	Dunlin
<i>Calidris canutus</i>	Knot
<i>Cephus grylle</i>	Black Guillemot
<i>Charadrius hiaticula</i>	Ringed Plover
<i>Chlidonias niger</i>	Black Tern
<i>Chroicocephalus ridibundus</i>	Black-headed Gull
<i>Cinclus cinclus</i>	Dipper
<i>Clangula hyemalis</i>	Long-tailed Duck
<i>Cuculus canorus</i>	Cuckoo
<i>Cygnus olor</i>	Mute Swan
<i>Delichon urbicum</i>	House Martin
<i>Dendrocopos minor</i>	Lesser Spotted Woodpecker
<i>Egretta garzetta</i>	Little Egret
<i>Emberiza citrinella</i>	Yellowhammer
<i>Emberiza schoeniclus</i>	Reed Bunting

Latin name	Common name
<i>Falco columbarius</i>	Merlin
<i>Falco peregrinus</i>	Peregrine
<i>Falco subbuteo</i>	Hobby
<i>Falco tinnunculus</i>	Kestrel
<i>Ficedula hypoleuca</i>	Pied Flycatcher
<i>Gallinago gallinago</i>	Snipe
<i>Gavia arctica</i>	Black-throated Diver
<i>Gavia immer</i>	Great Northern Diver
<i>Gavia stellata</i>	Red-throated Diver
<i>Haematopus ostralegus</i>	Oystercatcher
<i>Hirundo rustica</i>	Swallow
<i>Hydrobates pelagicus</i>	Storm Petrel
<i>Hydrocoloeus minutus</i>	Little Gull
<i>Larus argentatus</i>	Herring Gull
<i>Larus canus</i>	Common Gull
<i>Larus fuscus</i>	Lesser Black-backed Gull
<i>Larus marinus</i>	Great Black-backed Gull
<i>Larus melanocephalus</i>	Mediterranean Gull
<i>Limosa lapponica</i>	Bar-tailed Godwit
<i>Linaria cannabina</i>	Linnet
<i>Locustella naevia</i>	Grasshopper Warbler
<i>Loxia curvirostra</i>	Common Crossbill
<i>Melanitta fusca</i>	Velvet Scoter
<i>Melanitta nigra</i>	Common Scoter
<i>Mergus serrator</i>	Red-breasted Merganser
<i>Milvus milvus</i>	Red Kite
<i>Morus bassanus</i>	Gannet
<i>Muscicapa striata</i>	Spotted Flycatcher
<i>Numenius arquata</i>	Curlew
<i>Numenius phaeopus</i>	Whimbrel
<i>Oenanthe oenanthe</i>	Wheatear
<i>Pandion haliaetus</i>	Osprey
<i>Passer domesticus</i>	House Sparrow
<i>Periparus ater</i>	Coal Tit
<i>Phalacrocorax aristotelis</i>	Shag
<i>Phalacrocorax carbo</i>	Cormorant

Latin name	Common name
<i>Phoenicurus phoenicurus</i>	Redstart
<i>Phylloscopus sibilatrix</i>	Wood Warbler
<i>Phylloscopus trochilus</i>	Willow Warbler
<i>Picus viridis</i>	Green Woodpecker
<i>Platalea leucorodia</i>	Spoonbill
<i>Podiceps auritus</i>	Slavonian Grebe
<i>Poecile montana</i>	Willow Tit
<i>Prunella modularis</i>	Dunnock
<i>Puffinus mauretanicus</i>	Balearic Shearwater
<i>Puffinus puffinus</i>	Manx Shearwater
<i>Pyrhacorax pyrrhacorax</i>	Chough
<i>Pyrrhula pyrrhula</i>	Bullfinch
<i>Recurvirostra avosetta</i>	Avocet
<i>Regulus regulus</i>	Goldcrest
<i>Rissa tridactyla</i>	Kittiwake
<i>Saxicola rubetra</i>	Whinchat
<i>Saxicola rubicola</i>	Stonechat
<i>Scolopax rusticola</i>	Woodcock
<i>Stercorarius longicaudus</i>	Long-tailed Skua
<i>Stercorarius parasiticus</i>	Arctic Skua
<i>Sterna sandvicensis</i>	Sandwich Tern
<i>Streptopelia turtur</i>	Turtle Dove
<i>Sturnus vulgaris</i>	Starling
<i>Sylvia borin</i>	Garden Warbler
<i>Sylvia communis</i>	Whitethroat
<i>Tadorna tadorna</i>	Shelduck
<i>Tringa totanus</i>	Redshank
<i>Turdus iliacus</i>	Redwing
<i>Turdus philomelos</i>	Song Thrush
<i>Turdus pilaris</i>	Fieldfare
<i>Turdus torquatus</i>	Ring Ouzel
<i>Tyto alba</i>	Barn Owl
<i>Uria aalge</i>	Guillemot
<i>Vanellus vanellus</i>	Lapwing