



Department of
**Agriculture,
Food and the Marine**

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**Talmhaíochta,
Bia agus Mara**

Department of Agriculture, Food and the Marine
Cork South Regional Office
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BirdWatchIreland
protecting birds and biodiversity

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Patron
Michael D. Higgins
President of Ireland

Éarlámh
Micheál D Ó hUigínn
Uachtarán Na hÉireann

Jonathan Cooper

JBA Consulting Ltd.

24 Grove Island

Corbally

Limerick

Ireland

Re: Clonakilty Flood Relief Scheme.

Your Ref. CG/2014s0971-I-L001-1.doc

Our Ref. 27.03.14CK

Dear Mr Cooper,

Thank you for the opportunity to comment on the Clonakilty Flood Relief Scheme. BirdWatch Ireland understands the necessity for flood alleviation works in Clonakilty and would like to be involved in the design of a sustainable solution to the flooding problem. This scheme may potentially have significant impacts on the conservation interests of the Clonakilty Bay SPA/SAC and on other protected bird species in the area. We therefore would appreciate it if you would keep us informed and engage with us in further consultation throughout all stages of this project going forward. We trust that appropriate and due consideration will be given to the Clonakilty Bay SPA and SAC and that appropriate detailed investigations into the impacts of the scheme on the designated sites will be carried out. It would be very useful if you could send us copies of the Appropriate Assessment Screening and the EIA document as and when they become available.

Birdwatch Ireland would have concerns about options that include a tidal barrage given the importance of the inner Clonakilty Bay estuary for wading birds and the potential significant impacts that the barrage could cause. Alternative solutions to a tidal barrage would be welcomed by Birdwatch Ireland as would any solutions that would result in the least impacts upon the SPA site and its conservation interests.

In addition, Birdwatch Ireland would have some concerns with regard to the tidal defences option as the provision of higher sea walls around the inner estuary may impact on known roost sites. Waterbirds are known to roost on sea walls around the Model Railway Village, and if these are developed into tidal defences (e.g. raised sea walls), then roost sites may be lost. Furthermore, given the man-made nature of the inner estuary, there are already limited roosting options for birds; therefore any impacts upon roosts may be highly significant. We would therefore



Directors: K O'Byrne (Chairman), J Cromie, J O'Halloran, B Lavery, P. Moore, JB Peart, E Sides, J Wilson

Registered charity no. 5703. BirdWatch Ireland is the trading name of the Irish Wildbird Conservancy, Cairde Éanlaith Éireann, a company limited by guarantee.
Registered in Ireland, no. 116468. Registered office: Unit 20, Block D, Bullford Business Campus, Kilcoole, Co. Wicklow, Ireland.



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recommend that appropriate bird surveys are carried out on sites proposed for development of sea walls to inform on the nature and level of impact that may arise and that appropriate mitigation measures be put in place should this option be chosen.

In addition, the lands at Deasy's Quay, in the inner estuary, although outside the SPA boundary, are a known important roost site. This area is often used for materials storage and other purposes with little consideration given to its proximity to the estuary or use by birds. This area, which is reclaimed land, should be protected during works and its importance given due consideration during the impact assessment phase.

We would welcome the opportunity to discuss this scheme and our comments further with you.

Yours sincerely,

Deborah D'Arcy

Casework Officer

Policy and Advocacy Team



Directors: K O'Byrne (Chairman), J Cromie, J O'Halloran, B Lavery, P. Moore, JB Peart, E Sides, J Wilson

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20131104-XX-Clonakilty

JBA Consulting
24 Grove Island
Corbally Limerick
Ireland

11.04.13

Re: Clonakilty Flood Relief Scheme – Environment Constraints Consultation

Dear Sir/Madam,

As required under the EU Floods Directive (2007/60/EC), Ireland is currently developing a catchment based approach to flood risk management. An integral part of this process, as directed by European best practise guidance, is the identification of strategies to improve water retention within the catchment. The National Flood Policy Review of 2004 and the EU Floods Directive of 2007 are prescribing that a more proactive, sustainable flood risk management approach with increased use of non-structural and flood impact mitigation measures. An Taisce has previously demonstrated our commitment to sustainable flood risk management in our report “The use of wetlands for flood attenuation” by Williams et al., 2012.

In recent years there has been shift away from ‘hard’ engineering flood defence solutions, such as channel alteration and river embankment construction, towards encouraging more natural flood management (NFM) solutions within catchments. The UK’s ‘Making Space for Water’ and Netherland’s ‘Room for Rivers’ approaches, for example, promote spatial rather than purely technical flood management solutions by the provision of more room for Peak River discharges. In this context, wetlands are increasingly seen as providing a potential valuable ecosystem service of flood attenuation. This is additional to their purported role as ‘buffers’ to prevent excess sediment and nutrient inputs into waterways and as conservation and biodiversity hotspots within intensively-used landscapes.

Ireland’s present Catchment Flood Risk Assessment and Management (CFRAM) approach indicates that policy is in place that recognises catchment scale processes in flood generation and management. An Taisce would like to see an option in the Clonakilty Flood Relief Scheme which embodies the sustainable flood risk management approach with increased use of non-structural and flood impact mitigation measures. Two possible measures to enhance the flood attenuation potential of floodplains along the Feagle River are: (1) restoring the natural hydrological connectivity between river and floodplain so allowing land to inundate more frequently; and, (2) retaining or restoring ‘rough’ floodplain surfaces, in the form of walls, hedges, coarse and woody vegetation, relict channels and depressions.

In addition An Taisce would like to note that this development has the capacity to have a significant negative impact on the Clonakilty Bay SAC and pNHA (Site Code: 000091) and the Clonakilty Bay SPA (Site Code: 00408). The Clonakilty Bay SAC has been designated because it contains a good diversity of coastal habitats. These habitats show a succession from salt to freshwater influences and include six which are listed on Annex I of the EU Habitats Directive. The dune types, as well as the intertidal sand and mud flats, are habitats that are listed on Annex I of the E.U. Habitats Directive. The Clonakilty Bay SPA was designated under the EU Birds Directive, of special conservation interest for the following species: Shelduck, Dunlin,

The Tailors’ Hall, Back Lane, Dublin 8, Ireland | Telephone: 01 454 1786 | Fax: 01 453 3255
www.antaisce.org

Company Registration No: 12469 | Charity Reference No: CHY 4741

Directors : J Harnett | J Leahy | M Mehigan | D Murphy | B Rickwood (British) | P Howley | C Stanley Smith (British) | A Uí Bhroin

Black-tailed Godwit and Curlew. It is of high ornithological importance, particularly for its internationally important population of Black-tailed Godwit. In addition, there are four species with populations of national importance. The presence of the E.U. Birds Directive Annex I species, Golden Plover, Bar-tailed Godwit, Little Egret and Short-eared Owl is of note.

The proposed tidal flood defences may impact on the substantial areas of sand and mud flats which are found in Clonakilty harbour. The intertidal flats have a typical diversity of macro-invertebrates, including Lugworm (*Arenicola marina*), Peppery Furrow -shell (*Scrobicularia plana*), Ragworm (*Hediste diversicolor*), the marine bristle worms *Nephtys hombergii* and *N. cirrosa*, Laver Spire-shell (*Hydrobia ulvae*) and Common Cockle (*Cerastoderma edule*). These intertidal sand and mud flats provide an important food resource for the wintering waterfowl.

Yours sincerely,

Fintan Kelly
Natural Environment Office
naturalenvironment@antaisce.org

Tom Sampson

From: Elizabeth Russell
Sent: 13 May 2014 11:56
To: Jonathan Cooper; Declan Egan; Tom Sampson
Cc: Ross Bryant
Subject: FW: Clonakilty Flood Relief Scheme- Environmental Constraints Consultation-Revised Study Area

FYI

Elizabeth Russell
Operations Manager (Ireland)

061 345463
JBA Consulting, Unit 24 Grove Island, Corbally, Limerick

From: Michael OKane [<mailto:Michael.OKane@teagasc.ie>]
Sent: 13 May 2014 11:29
To: Information (Ireland)
Cc: Billy Kelleher; Keith Kennedy
Subject: Clonakilty Flood Relief Scheme- Environmental Constraints Consultation-Revised Study Area

Jonathan, further to the above and your recent letters to Teagasc, I would confirm that Teagasc will not be making any submission and that we waive our right to be consulted on the proposed scheme on any derivative thereof.

Michael O'Kane C. Eng
Teagasc
Moorepark
Fermoy
PH 025 42307
E michael.okane@teagasc.ie

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Tabhair aire:

Tá an r-phost seo faoi phribhléid agus faoi rún. Mura tusa an duine a bhí beartaithe leis an teachtaireacht seo a fháil, scrios é le do thoil agus cuir an seoltóir ar an eolas. Is leis an údar amháin aon dearcaí nó tuairimí a léirítear. Scanadh an r-phost seo le Teagasc agus deimhníodh go raibh sé saor ó víoras leis an bpatrúnchomhad atá in úsáid faoi láthair. Ní féidir a ráthú leis seo áfach nach bhfuil ábhar mailíseach ann.

JBA first internal send 11:56 Tue 13 May 2014

Appendix 4E - River Fealge (Clonakilty) Drainage Scheme PCD 02 July 2014

River Fealge (Clonakilty) Drainage Scheme Public Consultation Day 2nd July 2014

Final Report

October 2014



JBA Project Manager

Declan Egan
24 Grove Island
Corbally
Limerick
Ireland

Revision History

Revision Ref / Date Issued	Amendments	Issued to
V1.0 / December 2014		Patrick McAlinney (OPW)

Contract

This report describes work commissioned by Liam Basquille, on behalf of the Office of Public Works, by a letter dated 27th February 2014. The Office of Public Works representative for the contract was Patrick McAlinney. Laura Thomas and Declan Egan of JBA Consulting carried out this work.

Prepared by Declan Egan
Project Manager

Reviewed by Anne Murray BSc CIEEM
Senior Ecologist

..... Jonathan Cooper BEng MSc DipCD CEng MICE
MCIWEM C.WEM MIOd
Director

Purpose

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JBA Consulting has no liability regarding the use of this report except to the Office of Public Works.

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JBA is aiming to reduce its per capita carbon emissions.

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1 Introduction

This report details the outcomes of the Public Consultation Day held in the Parish Centre, Clonakilty on the 2nd July, 2014

The flood events that occurred in Clonakilty in the summer of 2012 and in 2013 prompted the programme for flood relief works to be accelerated. A Public Information Day was held in Clonakilty in November 2012.

1.1 Clonakilty Public Consultation Day

A Public Consultation Day (PCD) was held in the Parish Centre, Clonakilty on the 2nd July, 2014. The programme for the PCD was:

- A presentation to the Elected Representatives from Cork County Council and Clonakilty Town Council. The presentation describing the preferred drainage scheme option was given by JBA Consulting and Mott McDonald Ireland
- Public information session where the public viewed information on the preferred option. JBA Consulting and MMI personnel were available to answer any queries from the public. Cork County Council and OPW personnel were also available throughout the day
- Feedback forms were made available to the public for comment. Members of the public were invited to comment either at the event or were requested to return their comments by post in a stamped addressed envelope. The closing date for submissions was the 2nd August. A copy of the feedback form is given in this appendix to the EIS.

A brochure on the scheme was made available to the public. A copy of the brochure is given in this appendix to the EIS.

2 Submissions for the Public

2.1 Introduction

Feedback forms were available at the Public Consultation Day in order to collate opinions on the preferred drainage scheme option presented at the PCD. In summary the feedback form sought to gather information on:

- The preferred option
- Comments or suggestions for the design of the Tidal Defence walls, the fluvial embankment and storage, river walls through the town and any other further information
- How useful the PCD was to them.

58 people attended the PCD and a total of 9 people returned completed feedback forms. 2 other people submitted comments by letter and email.

2.2 Summary of Submissions

A breakdown of the submissions given in the feedback forms is discussed below.

2.2.1 Comments on the Preferred Option

- 3 of the 9 submissions commented that a tidal barrage would be their preferred option
- 2 submissions agreed that the chosen preferred option was the best option
- 2 respondents were concerned about flooding in Weston Lodge
- 1 respondent requested further information on the operation of the sluice gate on the fluvial storage embankment.

2.2.2 Comments on the Tidal Defence Walls

- 2 respondents were concerned about the visual impacts of the tidal defence walls
- 1 respondent was concerned about the strength of the foundations to withstand increased flood levels heights due to global warming
- 2 respondents were concerned about the impacts of flooding on Weston Lodge.

2.2.3 Comments on Fluvial Embankment and Storage

- 3 respondents favoured the embankment and storage
- 1 respondent was concerned about the stability of the embankment
- 1 respondent suggested smaller holding areas further upstream.

2.2.4 Comments on the River Walls through the Town

- 1 respondent favoured with the walls
- 1 respondent felt that the walls would lessen the amenity value of the river
- 1 respondent stated that the walls alongside the church should be removed or other walls in the area raised
- 1 respondent stated that the walls at the western side of the town must be repaired or replaced
- 1 respondent requested more information about the bridge and walls at the Credit Union.

2.2.5 Additional Information Requested

- 2 respondents requested further information on an engineer's report prepared prior to the construction of the defence wall at the church
- 1 respondent asked if the river could be dredged.
- 1 respondent requested the Council to lay a drain through the archway into Hartes Courtyard

2.2.6 How useful was the Event?

- 5 respondents said that it was about right
- 2 respondents said that it was OK
- 1 respondent requested more information.

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and Scientists Limited**

Registration number 444752



**Visit our website
www.jbaconsulting.ie**



River Fealge (Clonakilty) Drainage Scheme

Public Consultation Day

Parish Centre, Clonakilty
2nd July 2014
4pm to 8pm



RIVER FEALGE (CLONAKILTY) DRAINAGE SCHEME

PUBLIC CONSULTATION DAY – 2ND JULY 2014

FEEDBACK FORM

(Please complete this questionnaire and hand it in at the Public Consultation Day or place in the stamped addressed envelope provided, and return by 2nd August 2014 or e-mail to clonakiltyfrs@mottmac.com)

1. Name (*optional*): _____

Address: _____

Phone (*optional*): _____

Email (*optional*): _____

Do you have any comments on the preferred option?

If so, please describe:

Do you have any comments or suggestions for the design of the following elements of the preferred option?

Tidal Defence Walls

Comment:

Fluvial Embankment and Storage upstream (west) of Clonakilty

Comment:

River walls through the town

Comment:

Is there any further information you would like?

Comment:

How useful have you found this public event?

Above expectations ☐

About right ☐

OK ☐

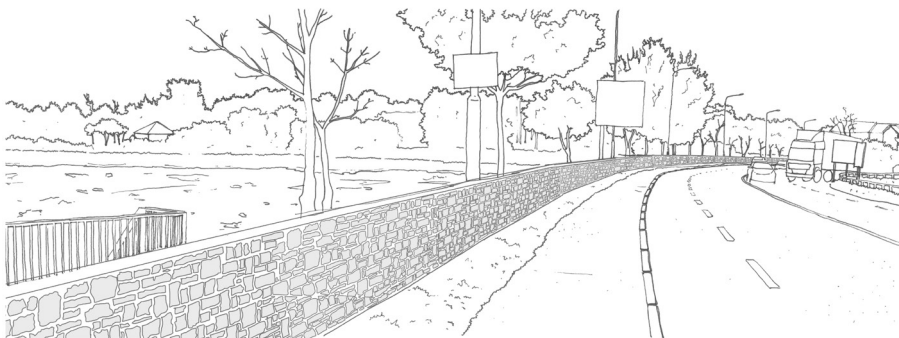
Partially OK ☐

Need more information ☐

Freedom of Information Act

The Office of Public Works (OPW) undertakes to hold any information provided to it by individuals or others on a confidential basis, subject to the OPW's obligations under law, including the Freedom of Information Act. If, for any reason, it is intended that information provided to the OPW should not be disclosed due to the sensitive nature of such information, it is incumbent on the person or body supplying the information to make clear this wish and to specify the reasons for the information's sensitivity. The OPW will consult with any individual or body so supplying sensitive information before making a decision on any freedom of information request received.

THANK YOU FOR YOUR CO-OPERATION



What Next?

All comments received from this public consultation day will be considered by the OPW in the final design of the Scheme. Comments can be made by way of the Feedback Form available at the meeting or on the scheme website listed below.

The next stage (Stage II) is the preparation of an Environmental Impact Statement. A Public Exhibition of the Scheme will be given in November 2014. Stage III of the Scheme will include detailed design tenders. Then the Scheme will then be subject to confirmation by the Minister of Public Expenditure and Reform (stage IV). The final stage (stage V) involves the construction of the Scheme. The stages are shown in the table below.

Stage No.	Stage
I	Feasibility Study
II	Environmental Impact Statement and Public Exhibition. Public Exhibition in November 2014
III	Detailed Design
IV	Confirmation of Scheme
V	Construction

When will it be built?

It is expected that construction will commence in October 2015 and be completed in early 2018.

For more information contact us or visit the website:

clonakiltyfrs@mottmac.com
www.clonakiltyfrs.ie

Clonakilty FRS Communications
Coordinator
Mott MacDonald Ireland Limited
5 Eastgate Avenue, Eastgate,
Little Island, Co. Cork



River Fealge (Clonakilty) Drainage Scheme

Public Consultation Day

July 2nd 2014



Introduction

The purpose of the River Fealge (Clonakilty) Drainage Scheme is to alleviate tidal and fluvial flooding in Clonakilty. The Office of Public Works (OPW) has appointed consultants to carry out both an Engineering Study and an Environmental Study in order to determine an appropriate scheme on the basis of technical, social and environmental criteria.

Current Position

An Environmental Constraints Study was carried out to inform the Design Engineers.

Summary of the Constraints Study

- The biggest constraint within the Study Area is Clonakilty Bay. This site is protected under the EU Habitats Directive and is of international importance for its intertidal and estuarine habitats and wader and wildfowl populations.
- Clonakilty has been designated an Architectural Conservation Area. There are 207 listed structures in the Record of Protected Structures (RPS) within the study area of Clonakilty. There are 42 Record of Monument and Places (RMPs) incorporated by the study area.

Scheme Options

Six options were considered for the Drainage Scheme, namely:

1. Flow Diversion & Tidal Barrage
2. Flow Diversion & Tidal Defences
3. Fluvial Defences & Tidal Barrage
4. Fluvial Defences & Tidal Defences
5. Fluvial Storage & Tidal Barrage
6. Fluvial Storage & Tidal Defences

The Preferred Scheme Option

Option 6 (fluvial storage and tidal defences) is the Preferred Scheme Option. This consists of a number elements.

Fluvial Flood Storage Area

- Designed to limit flow in the River Fealge to bank-full level.
- Excess flood flow retained in storage area.
- Embankment to store c.400,000 m³ of flood water.
- The embankment will have a single sluice, a spillway and a fish pass to accommodate the movement of fish.

Tidal Defences

- Floodwalls (typically 1.1m high) from Bridge Street to Croppy Road.
- 1.6m high wall at Facksbridge.
- Raise Ring Road for a length of 200m to a height of 1.7m.
- Tidal flood embankments at the old Timoleague Road (1.4m high) and beside the Wastewater Treatment Plant (0.75m high).

Stormwater Pumping

Pumping stations will be constructed to ensure that rainwater that falls behind the defences does not cause a flood risk. These will be located at:

- Croppy Road (Cork County Council)
- Rossa Street
- Kent Street
- Former GAA grounds (Cork County Council)

Area between Fluvial Storage and Tidal Defences

Works to be carried out to strengthen river banks where required. Locations where banks are low to be raised to permit design flow to be contained within the river banks.

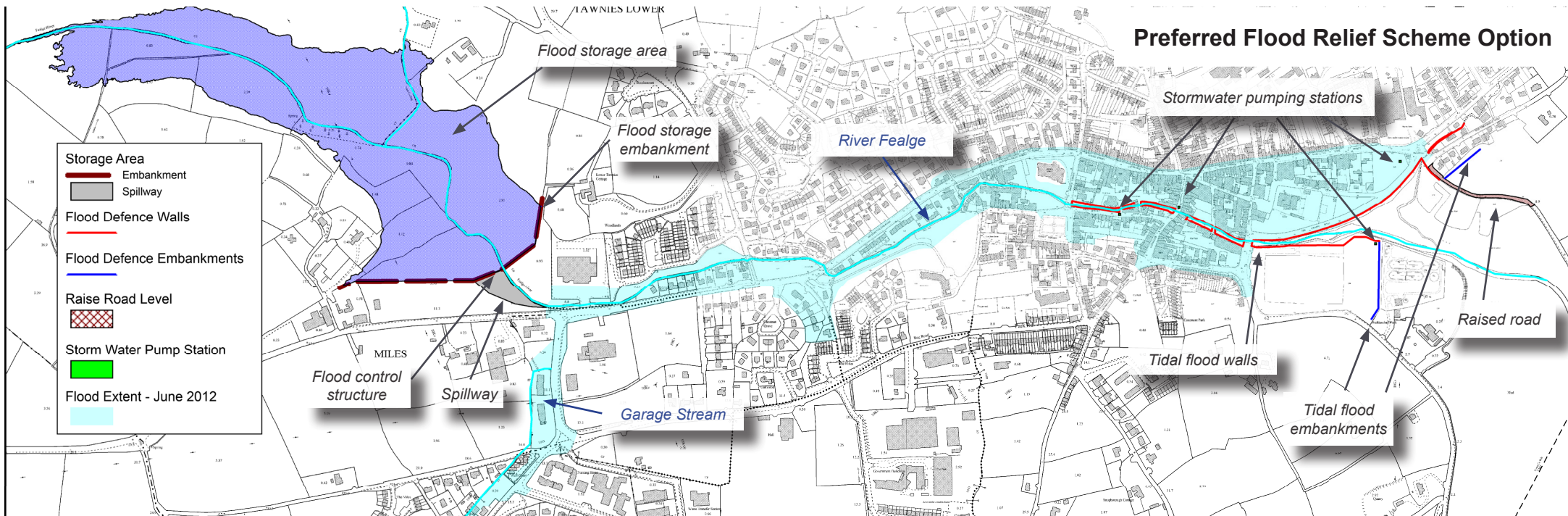
The arrangement of culverts on the Garage Stream to be optimised to manage flood risk.

Flood modelling has demonstrated that this Scheme will work to alleviate flooding. The tidal defence walls are relatively low and they will replace some of the existing flood walls in the town. The construction programme for this Scheme is relatively short (c.18 months) and will not significantly disrupt normal day businesses or retailers in the town.

Environmental Appraisal

Option 6 (fluvial storage and tidal defences) is the Preferred Scheme option because:

- minimal impact on the SAC and SPA in Clonakilty Bay
- minimal impact on the River Fealge
- acceptable level of flood defence walls within the town
- limits likelihood of delay on Scheme
- provides double protection; fluvial storage and tidal defences
- approximately 18 month construction programme



Appendix 8A - Water Quality Sampling Report



Jones Environmental Laboratory

Registered Address : Unit 3 Deeside Point, Zone 3, Deeside Industrial Park, Deeside, CH5 2UA. UK

Egan Environmental
17 Laureston Crescent Tower
Cork
Ireland

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

Tel: +44 (0) 1244 833780

Fax: +44 (0) 1244 833781

Attention : Declan Egan
Date : 4th November, 2014
Your reference :
Our reference : Test Report 14/13017 Batch 1
Location : Clonakilty
Date samples received : 29th October, 2014
Status : Final report
Issue : 1

Two samples were received for analysis on 29th October, 2014 of which two were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Kim Mills
Project Co-ordinator

Bob Millward BSc FRSC
Principal Chemist

Contact: Declan Egan

[illegible]

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 14/13017

SOILS

Please note we are only MCERTS accredited for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. If we are instructed to keep samples, a storage charge of £1 (1.5 Euros) per sample per month will be applied until we are asked to dispose of them.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

WATERS

Please note we are not a Drinking Water Inspectorate (DWI) Approved Laboratory . It is important that detection limits are carefully considered when requesting water analysis.

UKAS accreditation applies to surface water and groundwater and one other matrix which is analysis specific, any other liquids are outside our scope of accreditation

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

ABBREVIATIONS and ACRONYMS USED

#	UKAS accredited.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
OC	Outside Calibration Range

JE Job No: 14/13017

Test Method No.	Description	Prep Method No. (if appropriate)	Description	UKAS	MCERTS (soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM14	Analysis of waters and leachates for metals by ICP OES. Samples are filtered for dissolved metals and acidified if required.				
TM37	Modified USEPA 160.2 .Gravimetric determination of Total Suspended Solids. Sample is filtered and the resulting residue is dried and weighed.	PM0	No preparation is required.				
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM0	No preparation is required.				
TM58	Modified USEPA methods 405.1 and BS 5667-3. Measurement of Biochemical Oxygen Demand.	PM0	No preparation is required.				
TM73	Modified US EPA methods 150.1 and 9045D. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.				
TM76	Modified US EPA method 120.1. Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.				

Appendix 9A - Electro-fishing Survey

Clonakilty Flood Relief Scheme

AQUATIC ECOLOGY AND FISHERIES ASSESSMENT



August 2014

Inis

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EXECUTIVE SUMMARY

Atlantic salmon (*Salmo salar*) occurs throughout Ireland where their presence within a system is restricted by instream habitats and water quality. White clawed crayfish (*Austropotamobius pallipes*) are restricted to areas of relatively hard water with high calcium levels and have a limited distribution in Ireland. Three indigenous species of lamprey occur in Ireland; the non-parasitic resident brook lamprey *Lampetra planeri*, and the parasitic anadromous river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus*. All of the aforementioned species are listed under Annex II of the European Union Habitats Directive (92/43/EEC). This Directive requires the Irish Government to designate Special Areas of Conservation (SACs) and to maintain the favourable conservation status of these species.

The purpose of the electro-fishing survey was to address the concerns expressed by the IFI at a meeting held in April in Cork. As part of ongoing assessments of Annex II species within the River Fealge, OPW commissioned a survey of fish and white clawed crayfish *Austropotamobius pallipes* populations within the river at four locations. This survey was undertaken by INIS Environmental Consultants Ltd. during July 2014.

A total of 4 sites were sampled using electrical fishing and snorkelling hand searching methods. Physical habitat measurements were also recorded at each survey site.

The relationship between fish abundance and environmental conditions was explored using Principle Components Analyses (PCA). Mean depth, wetted width, bank height, pool/riffle presence and shade/canopy cover were all found to be important macrohabitat predictors for juvenile salmonids.

The presence of Atlantic salmon was confirmed during the current survey at 2 of 4 sample sites. The distribution and size characteristics of the juveniles recorded strongly suggest that salmon are spawning at the upper reaches of the River Fealge. Population structure of salmon was restricted to 1+ fish; no 0+ salmon were recorded.

No white clawed crayfish were recorded during extensive searches, which likely confirm their absence from this system.

Lampreys were not recorded during this survey but are known to be present in the system. Their absence from the survey results is most likely as a result of the low number of sites sampled coupled with there being no suitable habitat at the selected Sample Sites.

Brown Trout and European Eel were recorded at all 4 sites. Other species recorded included Three spined Stickleback (*Gasterosteus aculeatus*) and Stoneloach (*Barbatula barbatula*).

Population structure of trout did not vary significantly between most sample sites. All surveyed areas displayed a strong presence of both 0+ and 1+ fish with lower numbers of 2+ fish present at each site with the exception of site 2 where older fish were absent due to very low water conditions and the absence of pools.

Areas with a prominent 0+ year class generally also had other cohorts present. Standard length of trout and salmon encountered ranged from 5cm to 36cm and 7.9cm to 14.8cm respectively. Good numbers of European Eel were present at all sample sites; standard length of eels recorded ranged from 5.4cm to 45cm. Elvers were prominent at the two downstream sample sites (Samples sites 3 & 4).

Given the presence of anadromous salmonids at the upper sample site (Sample Site 1) any mitigation that is designed for salmonids on this scheme must allow for fish passage up to this area.

In total 327 fish (12.58 Kg) were intercepted during the electrical fishing activities over the four sites with five species of fish represented i.e. Brown Trout (n=275), Eel (n=38), Salmon (n=3), Stoneloach (n=5), Stickleback (n=5).

1 INTRODUCTION

INIS Environmental Consultants Ltd was commissioned to carry out an aquatic ecology survey at certain locations on the Fealge River, Clonakilty County Cork. The surveys commissioned for this assessment were an electrofishing survey to assess fish communities and a presence/ absence survey for White clawed crayfish. This work is being completed to support the Environmental Impact Statement being compiled by JBA Consulting for the Clonakilty Flood Alleviation Scheme as part of the South Western Catchment Flood Risk Assessment (SW CFRAM).

The objectives of the South Western River Basin District Catchment Flood Risk Assessment and Management (CFRAM) Study are as follows;

- Promote the active participation of the public in addressing flood risk;
- Create accurate flood maps for areas at significant risk from flooding;
- Develop plans to manage flood risk on a catchment wide scale.

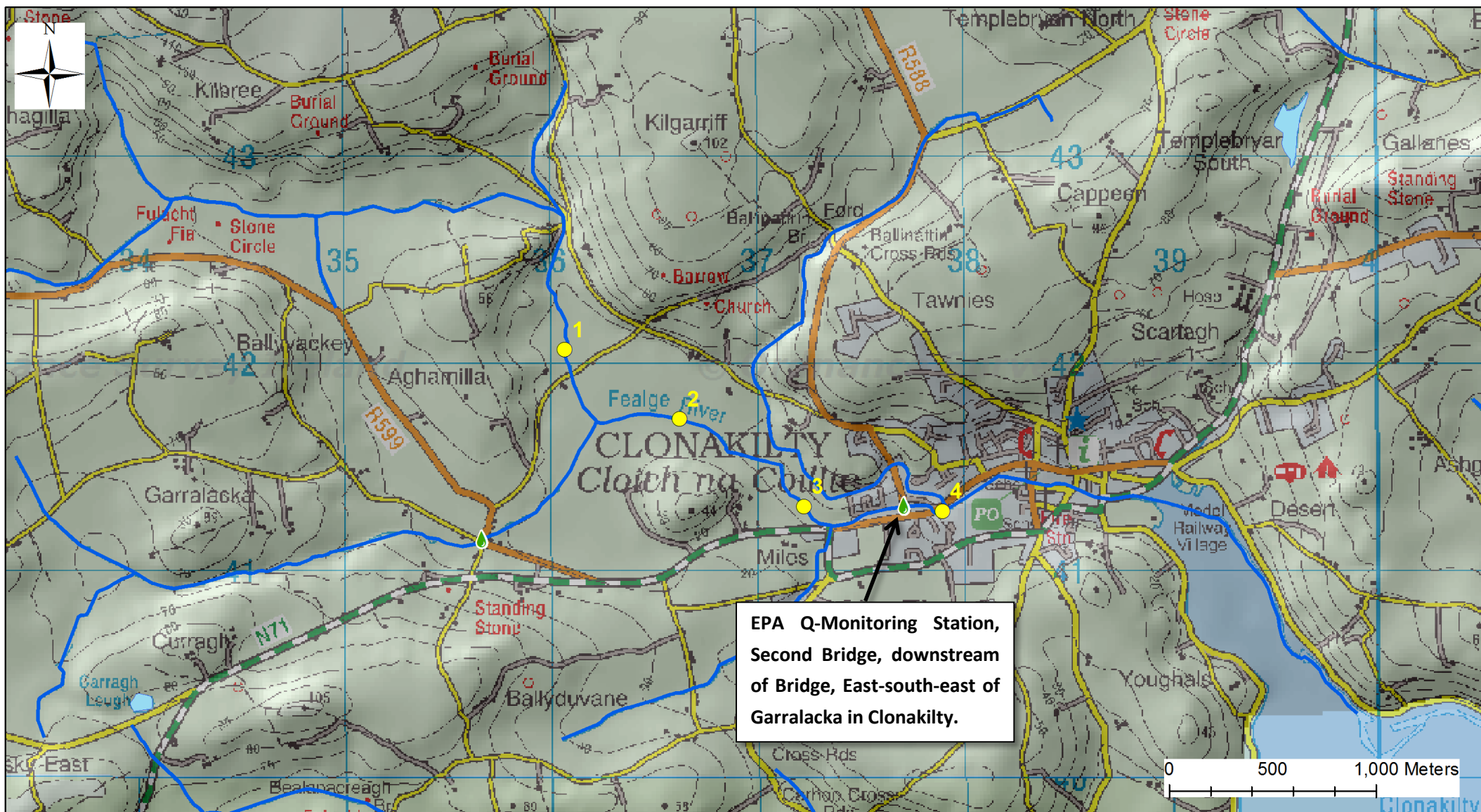
The SW CFRAM will identify and map existing and potential flood hazards within the South West. SW CFRAM will also identify systems and measures for the effective and sustainable management of flood risk. Prior to implementation of measures SW CFRAM will prepare Flood Risk Management Plans (FRMPs) for the Study Area, prepare Strategic Environmental Assessment (SEA) and Appropriate Assessment (AA) for the plans. The current electrofishing survey will help to inform these reports for the Clonakilty area, prior to implementation of any measures to alleviate flood risk e.g. dredging, bankside reinforcements etc.

There is a long history of flooding in Clonakilty Town with flooding events recorded in 1961, 1963, December 1996, 2004, 2006, 2008, three times during 2009, 2010, and five times in 2012. In the vast majority of these cases flooding was attributed to rivers and streams.

This report provides evidence of fish abundance, size/weight, distribution and species diversity and in addition a description of the receiving aquatic environment prior to the construction of any flood relief measures. A White clawed crayfish *Austropotamobius pallipes* survey was conducted simultaneously.

Four monitoring locations (as presented in Figure 1 overleaf) were supplied by JBA Consulting, in consultation with OPW. The monitoring locations were chosen to help inform the Environmental Impact Statement (EIS) for the flood relief work.

INIS Environmental ecologists carried out the entire assessment which took place during the weekend of the 26th-27th July 2014.



Legend

● INIS Sampling Points

EPA Water Quality

- Q4-5, Q5 - High Status
- Q4 - Good Status
- Q3-4 - Moderate Status
- Q2-3, Q3 - Poor Status
- Q1, Q1-2, Q2 - Bad Status

ELECTROFISHING AND WHITE CLAWED CRAYFISH SAMPLING POINTS

Figure 1. Location of INIS electrofishing and White clawed crayfish sampling points

Inis
ENVIRONMENTAL CONSULTANTS

Map produced by:
INIS Environmental
Consultants Ltd.
Not to scale;
for illustration purposes only.

1.1 Study River Description

Clonakilty town is on the southern coast of Ireland in County Cork and has the North Atlantic to the south of it. The landscape of the study area is a combination of rural, residential/commercial and maritime in nature. Clonakilty Town comprises the built environment. The outskirts of the town and associated ribbon development extend primarily to the Southeast with smaller areas to the north of the town. Clonakilty Harbour forms a large water body within the study area. Riverine landscapes include:

- The main River Feagle channel
- The Cappeen Stream
- The Garage Stream.

The River Feagle, in the upstream part of the study area, is a relatively narrow (approximately 3-4m in width), fast-flowing watercourse with a gravel/silt substrate. Directly upstream of the town of Clonakilty, the watercourse is tree-lined on the right bank. The left river bank upstream of the town is, in general, much more open with only occasional isolated shrubs or trees. In-channel vegetation in the upstream reach consisted predominantly of Hemlock Waterdropwort (*Oenanthe crocata*) and River Water-crowfoot (*Ranunculus fluitans*), with very occasional Water-starwort *Callitriche* sp. present in more slower flowing areas. At upstream locations there are lengths of channel which are choked by fallen vegetation (trees and branches). Extensive areas of Fools Watercress *Apium* spp indicating enrichment is evident in areas where agriculture is present. The banksides were modified in some locations, with stone protection. This was most especially true of the urban sample site (Sample Site 4).

Through the town itself the river becomes wider, but is constrained on both banks by walls and development. A number of bridges cross the river and some sections run through culverts beneath buildings. In-channel vegetation is very limited in these areas.

1.2 Statement of Authority

Howard Williams B.Sc.

- Full Member of Chartered Institute of Ecology and Environmental Management (CIEEM).
- Chartered Environmentalist (CEnv) with the Society for the Environment (Soc Env)
- Chartered Biologist (CBiol)
- Member of the Institute of Fisheries Management

Mr. Domhnall Finch, B.Sc. Env. Sc. (Hons), M.Sc. Biodiversity and Conservation (Distinction)

Ms Sarah Ingham B.Sc. (Hons.), MSc (Biodiversity and Conservation).

Anne Mullen B.Sc. Env. Sc. (Hons), M.Sc. (Ecological Assessment).

1.3 Guidelines and legislative context

1.3.1 Water Framework Directive:

The Water Framework Directive (WFD), adopted in 2000, requires governments to take a new approach to managing all their waters: rivers, canals, lakes, reservoirs, groundwaters, protected areas (including wetlands and other water-dependent ecosystems), estuaries (transitional) and coastal waters. Member states must ensure that their waters achieve at least good status by 2015, and that status does not deteriorate in any waters. To achieve good status and preserve the best waters, it is necessary to prepare and implement management plans for those waters.

The Water Framework Directive sets out four core objectives to be achieved by 2015:

- prevent deterioration;
- restore good status;
- reduce chemical pollution;
- achieve protected areas objectives.

The South Western River Basin District (SWRBD) has prepared a comprehensive River Basin Management Plan (2009-2015), under the Water Framework Directive (WFD) and monitoring is undertaken under the WFD National Water Quality Monitoring Programme. Detailed action plans were prepared for more locally focused catchment areas called Water Management Units. These extract the key measures and objectives in the overall plan, presenting them for the geographical areas in which implementation will be coordinated. Further detail on water quality is presented in Section 2.1.

1.3.2 EIA (Environmental Impact Assessment) Directive

The EIA Directive also provides an outline of the process involved with a site assessment for the purposes of an EIS. The EIA Directive (85/337/EEC) has been amended a number of times – 1997, 2009 and 2009 since its inception in 1985.

The EIA Directive sets out the general details of how and when an Environmental Impact Assessment should be carried out. Union policy on the environment is based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should, as a priority, be rectified at source and that the polluter should pay. Effects on the environment should be taken into account at the earliest possible stage in all the technical planning and decision-making processes.

The legislation refers to projects which should be subject to assessment (listed in Annex I), and which may need assessment. Selection is on a case by case basis and/or threshold criteria set by the individual states (Annex II). The criteria which should be taken into consideration for the decision about when an EIA is needed is outlined in Annex III of the legislation e.g. is the development in a specially protected area?

The Directive also gives provision for consultation between the developer and the competent authorities e.g. this is particularly relevant early in the process to allow for the developer to mitigate through design rather than at end of line emissions.

The main obligations of the developers and the content of the assessment is detailed in Articles 5-12 of the assessment and in Annex IV of the legislation e.g. under Article 5, Part 3 (b) an EIA should contain a description of the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects of the project.

1.3.3 Fisheries Legislation

The primary legislation governing the Inland Fisheries Sector are the Fisheries Consolidation Act 1959 (No. 14 of 1959) and the Inland Fisheries Act 2010 (No 10. of 2010).

Fisheries Consolidation Act, 1959-2007

The Fisheries Consolidation Act, 1959, has been amended and extended a number of times (1962, 1964, 1976, 1980, 1987, 1991, 1994, 1994, 1997 and 1999). The Fisheries Consolidation Act makes provisions for the licences for sea and freshwater fishing.

Under the Fisheries (Consolidation) Act, 1959, it is an offence to disturb the bed of a river. Section 171 of the Fisheries (Consolidation) Act 1959 creates the offence of throwing, emptying, permitting or causing to fall onto any waters deleterious matter. Deleterious matter is defined as any substance that is liable to injure fish: to damage their spawning grounds; or the food of any fish; or to injure fish in their value as human food; or to impair the usefulness of the bed and soil of any waters as spawning grounds or other capacity to produce the food of fish.

Inland Fisheries Act 2010

An Act to establish Inland Fisheries Ireland and to define its functions, to dissolve the Central Fisheries Board and Regional Fisheries Boards, which had been established under the Fisheries Act, 1980 (amended 1999). The Inland Fisheries Act, 2010, also provides for other matters connected with the foregoing and to amend and extend the Fisheries Acts 1959 to 2007.

1.3.4 Salmonid Regulations

For the protection of fisheries, Ireland supports a network of Salmonid Waters designated by the Department of Environment, Heritage and Local Government under the EU Freshwater Fish Directive (78/659/EEC), S.I. No. 293/1988 - European Communities (Quality of Salmonid Waters) Regulations, 1988. These rivers, and a number of other non-designated waters, are important for salmonids (salmon and trout) and, accordingly, their water quality and fish habitat must be maintained (NRA, 2009). These rivers must ensure to meet certain water quality standards as outlined in Schedule 2 of the legislation.

The regulations list particular rivers/waters which are to be protected under these regulations.

1.3.5 Other relevant legislation:

Under Section 3 of the Local Government (Water Pollution) Act, 1977 (as amended by Sections 3 and 24 of the 1990 Act) it is an offence to cause or permit any polluting matter to enter waters. Various elements of the Wildlife Act and the Habitats Directive are also relevant to riparian and riverine habitats. The Habitats Directive (gives provision for protection of the Natura 2000. The Habitats Directive also defines:

- Annex I – natural habitats whose conservation requires designation of SACs;
- Annex II – animal and plant species whose conservation requires designation of SACs;
- Annex III – criteria for selecting sites for SACs;
- Annex IV – animal and plant species in need of strict protection;
- Annex V – animal and plant species whose taking in the wild and exploitation may be subject to management measures;
- Annex VI – prohibited methods.

The aims of the Wildlife Act, 1976, (amended 2000) are to provide for the protection and conservation of wild fauna and flora, to conserve a representative sample of important ecosystems, to provide for the development and protection of game resources and to regulate their exploitation, and to provide the services necessary to accomplish such aims. As a consequence of the Wildlife Act all wild birds are now protected throughout the state and careful assessment of their habitats must take place before any development is allowed. The Wildlife Act lays out the protection for National Heritage Areas (NHAs), Nature Reserves and Refuges. It also lists a number of species of birds and animals in its schedules.

The Wildlife Act refers to other acts such as the Forestry and Fisheries Act where necessary in its amendment:

Section 40 (1)

(a): It shall be an offence for a person to cut, grub, burn or otherwise destroy, during the period beginning on the 1st day of March and ending on the 31st day of August in any year, any vegetation growing on any land not then cultivated.

(b) It shall be an offence for a person to cut, grub, burn or otherwise destroy any vegetation growing in any hedge or ditch during the period mentioned in paragraph (a) of this subsection.”,

(2) Subsection (1) of this section shall not apply in relation to—:

(c): The clearance of vegetation in the course of fisheries development works carried out by the Central Fisheries Board or a regional fisheries board in the exercise of its functions under the Fisheries Acts, 1959 to 1999;”

Essentially this means that the clearance of vegetation in the course of fisheries development works carried out by the Fisheries Board in the exercise of its functions under the Fisheries Acts is permitted within of bird-nesting season, with due regard to other ecological interests and the most suitable time of year to satisfy diverse habitats, flora and fauna (including fish) features should be sought.

2 DESKTOP REVIEW

A desktop review was carried out to determine information from previous studies in the area, and to determine the most suitable methods for carrying out the survey. The desktop review included a full review of all relevant literature (published reports, books, journals and peer reviewed papers) and websites for all pertinent information on aquatic areas of interest within the study area. Information sources included the websites of IFI, EPA and O'Reillys fly-fishers guide to the Rivers of Ireland (O'Reilly, 2004).

Various specific survey methodologies and field skills were utilized during these surveys. The sources of these are provided in the original reports and manuals listed below. Desktop reviews of relevant ecological/environmental assessments and survey guidance documents include:

- **River Habitat Survey in Britain and Ireland Field Survey Guidance Manual**, 2003 (EA, 2003). Environment Agency
- **Methods for the Water Framework Directive: Electric fishing in wadable reaches**. CFB, 2008.
- **A Guide to Habitats of Ireland**. Dr. J. Fossit, NPWS, DoEHLG, Dublin; (2000)
- A Desk Study to Determine a Methodology for the Monitoring of the Morphological Condition of Irish Rivers for the Water Framework Directive (Philip McGinnity, Paul Mills, William Roche & Mark Muller, 2006) Central Fisheries Board and Informatics, EPA;
- **Water Quality in Ireland 2006**, Key Indicators of the Aquatic Environment (2006) EPA Report;
- **Irish Wildlife Manuals, No 45**. Reynolds, J.D., O'Connor, W., O'Keeffe, C. & Lynn, D. (2010) A technical manual for monitoring White clawed crayfish *Austropotamobius pallipes* in Irish lakes. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.
- **IFI Biosecurity Protocol for Field Survey Work. Inland Fisheries**. (2010)
- **Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish**. King, J.L., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., FitzPatrick, Ú., Gargan, P.G., Kelly, F.L., O'Grady, M.F., Poole, R., Roche, W.K. & Cassidy, D. (2011) National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.
- **EPA Web Browser Envision Portal** Surface Water Quality, <http://gis.epa.ie/Envision>
- **Geological Survey Ireland Mapping Tools**; www.gsi.ie
- **NPWS Web Browser Mapping Tool** Environmental designations, NPWS, DoEHLG, www.npws.ie.
- **National Biodiversity Data Centre Mapping Tool**. www.nbdc.ie

2.1 Biological Water Quality Q-Values

The Environmental Protection Agency (EPA) and its predecessors have assessed the water quality (Chemical and Biological) of Irish rivers since 1971 as part of the National Water Quality Monitoring Programme (McGarrigle *et al.*, 2002).

The published water quality study results for water quality in the locality around the 4 Sample Sites and Study Area are given in Table 1. The results of EPA biological water quality monitoring surveys downstream of the sampling sites indicate that water quality has been consistently of good status for the past 20 years.

Table 1: EPA Water Quality at Clonakilty Stream (the EPA name for this section of the Fealge River, Clonakilty Cork. The location of this point can be seen in Figure 1.

Sample location	Monitoring Site	1989	1994	1997	2000	2003	2006	2009	2012
Second Br d/s Br ESE of Garralacka (in Clonakilty)	RS20C050300	3-4	4	4	4	4	4	4	4 (Good)

The Water Framework Directive (WFD), adopted in 2000, requires governments to take a new approach to managing all their waters: rivers, canals, lakes, reservoirs, groundwater, protected areas (including wetlands and other water-dependent ecosystems), estuaries (transitional) and coastal waters.

The river is part of the South Western River Basin District (SWRBD). Clonakilty (Fealge River) is within the Skibbereen Clonakilty WMU, and is considered to be continuing satisfactorily, with good ecological quality in 2009 (Source: www.wfd.ie, Skibbereen Clonakilty WMU, River Section SW_20_2260). Threats to this section of the catchment are primarily believed to be agricultural. Point pressures on the system include two areas for Waste Water Treatment Plant (WWTP) for Clonakilty. From the EPA datasets Article 5 point pressures, both WWTP areas are located downstream of the study site, as is the landfill and the combined sewer overflow (CSO).

2.2 Species Descriptions

2.2.1 White clawed crayfish (*Austropotamobius pallipes*)

Freshwater White clawed crayfish require relatively hard water with a pH of 7 or above and calcium concentrations of at least 5 mg/l. They thrive where there is a firm substrate and moderate productivity levels. White-clawed crayfish occur in both streams and lakes in Ireland, but chiefly in streams elsewhere in Europe. Their living requirements are rather similar to those of brown trout - good water quality (above 50% oxygen saturation, BOD below 3 ppm) and moderate summer water temperatures (below 20°C) although they only feed actively and moult above 10°C (Reynolds, 1998).

White clawed crayfish are large, mobile, omnivorous (predators and grazers) freshwater crustacean. The species is largely nocturnal. White clawed crayfish are now generally considered as a keystone species wherever they occur: the grazing impacts of White clawed crayfish on aquatic macrophytes have long been known; their grazing checks primary productivity and in their absence, luxuriant macrophyte growth may occur (Reynolds, 1998).

The White clawed crayfish typically occupies a 'refuge' which it will leave to forage. Refuges can take many forms, including large boulders and water-saturated logs, rocks and cobbles, slates, crevices in man-made walls, accumulations of fallen leaves, tree roots, holes in banks or sediment, constructions such as piers and fishing platforms and anthropogenic debris.

The White clawed crayfish has been classified as vulnerable in the 2010 IUCN Red List and is listed under Appendix III of the Bern Convention (82/72/EEC) and Annexes II and V of the EU Habitats Directive (92/43/EEC).

White clawed crayfish Distribution

The distribution of freshwater White clawed crayfish is generally throughout the lime rich midlands, and in some of the western areas of Connacht (records from the NBDC and Demers et al, 2005). Consultation with the National Parks and Wildlife Service (NPWS), NPWS Web Browser and the National Biodiversity Data Centre showed that there are no known records of White clawed crayfish within a 65 km radius of the Clonakilty sites. Given that the species requires relatively hard water with high calcium levels, the sandstone bedrock of the area is probably unsuitable for White clawed crayfish.

It has not been recorded within the study area, but it may be under recorded and suitable habitat is present at the sample sites (overhanging roots, stone and rock river walls with a number of cracks and crevices and a gravel substrate on the bed), so a comprehensive check was completed at all four sample sites during the survey to confirm presence or absence.

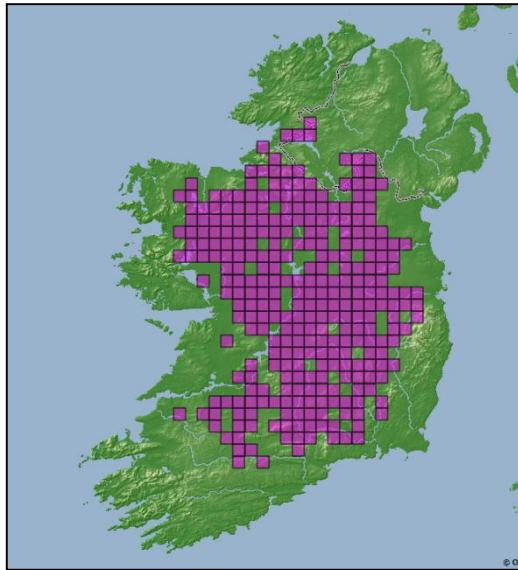


Figure 2: Irish White clawed crayfish distribution (source: NBDC, accessed 7/8/14).

2.2.2 Brown Trout (*Salmo trutta*)

The brown trout (*Salmo trutta*) is an originally European species of salmonid fish. It includes both purely freshwater populations, referred to *Salmo trutta* morpha *fario* and *S. trutta* morpha *lacustris*, and anadromous forms known as the sea trout, *S. trutta* morpha *trutta*. Spawning occurs in the late autumn – early spring period in channels of suitable gradient and cobble/gravel bed type. Juveniles may spend entire life in natal stream, or may descend to lower reaches. Trout feed primarily on a range of invertebrates and on small fish e.g. stickleback and minnow. The retention of tree lines along rivers and streams serves to provide shading and cooler thermal regimes for instream salmon and brown trout. The anadromous form of trout, sea trout *Salmo trutta trutta*, can spend up to 4 years in freshwater before spending a number of years in the sea as adults.

Sea trout 'parr' are indistinguishable from parr of resident brown trout. Sea trout parr remain in fresh water for 1 to 5 years, most migrating to sea after 2 or 3 years. Growth rates, and the age at which they enter the sea, varies over their geographical range. Female parr are more likely to become smolts and migrate to sea than males. Smoltification happens in the spring, typically when the fish reach 5–9 inches (or 13-22cm) long. They turn silver with spotted flanks and yellow pectoral fins. The seaward migration takes place between April and June. The bulk of smaller fish (0.75–1.5lbs or 350-700g) return to freshwater between June and August. Larger Sea trout (4lb+ (or 1800g+)) usually run in April and May of the following year. Spawning takes place in October/November. Sea trout can survive the rigours of spawning and migrate to sea to recover their condition and spawn again the following year (Inland Fisheries Ireland, www.fishinginireland.info). Trout feed primarily on a range of invertebrates and on small fish e.g. stickleback and minnow.

Brown trout do not have the ability to leap as high as salmon. SEPA (2009) provide a figure of 1.81m height in that which is impassable to trout, but note that trout may ascend using shallower side channels.

While the populations of Irish sea trout have reduced in recent years, the conservation status for brown trout is *Least Concern* (both in Irish terms and global status), and brown trout are ubiquitous in rivulets, brooks, streams, rivers and lakes in Ireland (King et al. 2011). Brown trout stocks in Ireland are now regarded as a “family of fishes” and not a single species.

2.2.3 Atlantic Salmon (*Salmo salar*)

The Atlantic salmon, *Salmo salar*, is a fish in the family Salmonidae, which is found in the northern Atlantic Ocean and in rivers that flow into the north Atlantic and, due to human introduction, the north Pacific. Spawning occurs in freshwater in channels of suitable gradient and cobble/gravel bed type in the November - March period. Juvenile stages live for two years in freshwater, and descend to sea as smolts in the spring period of their third year. To complete their life cycle they must return to their spawning river. Adult salmon exhibit remarkable "homing instinct" with a very high proportion able to locate their river of origin using the earth's magnetic field, the chemical smell of their river and pheromones (chemical substances released by other salmon in the river). Good water quality is a requirement of salmon fisheries. SEPA (2009) note that barriers to salmon migration are waterfalls >3.7m high, but that water depth below obstacles are also of critical importance in determining the maximum leaping height.

Significant declines that have been observed since the 1970s, largely driven by reduced marine survival attributed to climate effects (Friedland *et al.* 2009), which justify the species assessment as *Vulnerable* in Ireland.

2.2.4 European Eel (*Anguilla anguilla*)

Eels have a complicated life cycle, and similar to salmon spend a stage of their life cycle at sea, but in their case it is the spawning stage. Irish populations spawn in the Gulf of Mexico. The larvae, known as glass eels, migrate from the Sargasso Sea to Irish coastal waters. These juveniles become progressively more pigmented as they grow and migrate up estuaries into freshwaters. Immature adult fish are known as brown or yellow eel while the downward-migrating maturing adults are known as silver eel. Eels are widespread in fisheries surveys of rivers and lakes of all sizes in Ireland. Eels do not have the ability to leap, but where they meet obstacles they may crawl up along vegetation and rocks, and even across fields to ascend rivers and streams.

Eel are a very long-lived species, emigrating freshwater as reproductive adults, on average, 10 to 20 years after recruitment from the ocean, but eels up to 50+ years have been recorded. Adult fish feed widely on a range of invertebrates and on small fish species. Eels inhabit all types of benthic habitats from coastal and estuarine saline waters to small streams, large rivers and lakes.

A dramatic pan-European decline in glass eel returning from the sea occurred in the early 1980s and glass eel numbers are now at <7% of pre 1980s averages. Recruitment of juveniles into Irish catchments has declined dramatically, in line with experience along the Atlantic seaboard. Due to the shared nature of the eel stock, continental threats also impact on recruitment of eel to Ireland. The conservation status of eel is *Critically Endangered* (both in an Irish and a global context) (King et al. 2011).

2.2.5 Lamprey

Three indigenous species of lamprey occur in Ireland; the parasitic anadromous river lamprey *Lampetra fluviatilis*, the non-parasitic resident brook lamprey *Lampetra planeri*, and sea lamprey *Petromyzon marinus*. All three species are listed under Annex II of the European Union Habitats Directive (92/43/EEC). This Directive requires the Irish Government to designate Special Areas of Conservation (SACs) and to maintain the favourable conservation status of these species. It is now appreciated that lampreys are an important element in river ecosystems. The key importance of lampreys is the fact that, together with the hagfishes, they are the sole survivors of the agnathan (jawless) stage in vertebrate evolution. Recent work on fossils in China indicates that lampreys arose over 500 million years ago (O'Connor, 2004).

Lampreys are of high ecological value and can play an important role in processing nutrients, nutrient storage, and nutrient cycling in streams. Moreover, they also constitute a food source for other animals and can act as a buffer for salmon from predators in areas where they are abundant. It is now understood that they are susceptible to the same threats facing other native freshwater fish (i.e. pollution, barriers to migration, habitat destruction, etc.) and will require careful management and consideration in the future. The status of the three lamprey species in Ireland as a whole has been recorded as indeterminate (Whilde, 1993), largely due to the very limited records in the scientific literature. However, recent studies have greatly added to our knowledge of lampreys in Ireland. Kurz and Costello (1999) undertook a desk study which gathered information on locations where lamprey species were recorded in Ireland during the period 1960 - 1995, Kelly and King (2001) reviewed aspects of lamprey ecology and conservation relevant to Ireland, while King & Linnane (2004) reported the results of a survey of lamprey species in the Slaney and Munster Blackwater catchments.

The aims of the current investigation were to:-

- Establish which species of lamprey are present at the 4 Sample Sites, and
- Assess the distribution of these species within the catchment.

2.2.6 Other fish

Stoneloach (*Barbatula barbatula*)

A non-native species, Stoneloach is widely, but erratically, distributed throughout Ireland. Stoneloach were used as live bait and this may explain the somewhat random distribution in Ireland. Distributional information suggests a capacity to thrive in nutrient-enriched rivers and streams in Ireland, but no specific Irish studies are available (King et. al. 2011), but it appears to tolerate moderate organic pollution. It is nocturnal, living in gravelled and stony areas. It uses its distinctive barbels, present on the lower jaw, to forage for invertebrate food. Some fish attain 5.0 cm by the winter of their first year of life and spawn when 1 year old; others less than 5.0 cm do not spawn until the next season.

Three spined Stickeback (*Gasterosteus aculeatus*)

Three-spined Stickleback is widely distributed in rivers of all sizes and in lakes and transitional waters around the coast. They occur in a variety of habitats in freshwater from small streams to lakes. In the sea they are confined to coastal areas and are commonly found in upper reaches of estuaries and in tidal freshwater zone. Spawning takes place in spring, with the males building a nest. Young fish feed on zooplankton while adult fish feed on a range of invertebrates and cannibalism is also known. (Kelly et al., 2007) notes relatively high abundance in waters with poor water quality. Sticklebacks are commonly predated on by other fish species and also by otters (Gormally & Fairley, 1982). Daoud et al. (1985b) found that spawning took place in littoral vegetation in the reservoir they examined. Fluctuations in water level would severely impact on spawning success in such habitats.

2.3 Evaluation of Ecological Importance

The scheme used to evaluate the ecological importance of watercourses (based on NRA, 2008) in the study area is presented in Appendix III, along with the criteria for assessing the impact significance on aquatic sites. Further to the gathering of data from the surveying, professional judgement has been used in some cases to help evaluate the ecological importance of the study area. This evaluation will help to inform the measures that may need to be put in place prior to flood relief works.

3 SURVEY METHODOLOGIES

Salmonids, White clawed crayfish and riparian/ riverine habitats were investigated using a combination of desktop reviews and on-site investigations. A desktop review also established the water quality of the river as close as possible to the Study Area and details background ecological information for species of fish and White clawed crayfish.

The sampling points were chosen to allow information on the baseline presence (or absence) and abundance of White clawed crayfish and various species of fish within the area. This is not within the known distribution range of the species in Ireland, (usually confined to the centre of the country - see Figure 2), but a specific request was made to sample for these, as they are under-recorded, and to confirm absence/presence from the monitoring locations.

The site was surveyed during the weekend of the 25th - 27th July 2014. The location of the sites surveyed is presented in Figure 1 and Table 2.

Table 2 Location of the sampling sites

Sample Site No.	Grid Reference	Location
1	W 36037, 42265	Location upstream of the embankment
2	W 36484, 41753	Location upstream of the embankment
3	W 37360, 41214	Embankment upstream from Dunnes Stores
4	W 37885, 41293	Between Bridge street and Clarkes

3.1 Assessment of Aquatic Habitat Suitability for Fish

An aquatic and riparian habitat assessment was carried out at the four Sample Sites shown in Figure 1. The diversity (species richness) of aquatic/riparian fauna is primarily a function of the integrity and physical diversity of the aquatic habitats. The more diverse the aquatic habitat is in terms of substrate, depth, riparian vegetation, etc. the richer the biological community is likely to be. Salmonid fish (trout and salmon) in particular have specific habitat requirements and the presence and abundance of these fish has been shown to be strongly correlated with key physical habitat variables (Haury, 1999).

Habitat considerations for juvenile salmonids in streams and rivers include stream size and flow (Hatfield & Bruce 2000), depth and gradient (Kennedy & Strange 1986), substrate (Greenberg & Dahl 1998), canopy (O'Grady 1993) and engineering history of the river (O'Grady and Curtin 1993). The habitat considerations for lampreys in watercourses have been reviewed in an Irish context by Kelly & King (2001).

Physical habitat assessments were undertaken at the four sampling sites. These sites were assessed in terms of: -

- Wetted width (m)
- Bank height (m)
- Mean depth (cm)
- Maximum depth (cm)
- Thalweg width (m)
- Canopy cover (%)
- Bank slope (degrees)
- Riffle (%)
- Glide (%)
- Pool (%)
- Vegetation cover (%)
- Shade (%)
- Rock substrate (%)
- Cobble substrate (%)
- Gravel substrate (%)
- Clay/silt substrate (%)
- Bank cover (%)
- Large Woody Debris (%)

These predictors were used to assess the physical suitability of each channel for supporting (i) populations of salmonids, lampreys and other fish, and (ii) a 'normal' macro-invertebrate community (these physical habitat characteristics in relation to macro-invertebrate community are provided in Table 4).

The results of the physical habitat study were used to assess habitat class (spawning, nursery, rearing, and foraging) for salmonids, lampreys, and other fish and provide an overall evaluation of the watercourses. The habitat classes used are defined as follows;

- Spawning habitat is used by fish for the specific act of spawning;
- Nursery habitat is used by developing embryos and young-of-the-year (YOY);
- Rearing habitat is used by sub-adult fish other than YOY for foraging and refuge from predators; and,
- Foraging habitat is used by adult fish for feeding or periods between feeding events.

Habitat Rating Index:

Habitat class at each site was rated using a habitat rating index (HRI). The index and descriptions used to represent habitat quality during the aquatic habitat survey are presented in Table 3. The index works on a scale of 1-5 where 1=Unsuitable, 2=Poor, 3=Satisfactory, 4=Good and 5=Excellent. A rating of "1" indicates that the ecologist carrying out the assessment regarded it as impossible that the stream could support Salmonid fish in the relevant life stage. A rating of "1-2" indicates that it was regarded as possible but unlikely that the stream could support Salmonid fish in the relevant life stage. The HRI results are given in Table 6.

Table 3 Habitat rating index (HRI) and descriptions used to represent habitat quality during the aquatic habitat survey.

HRI	Value Habitat Description
1	Unsuitable
2	Poor
3	Satisfactory
4	Good
5	Excellent

Assessment of Habitat Suitability for Macro-invertebrates

The habitats of aquatic areas within the Study Area were appraised in relation to macro-invertebrates using a method given by Barbour and Stribling (1991). A table showing how the habitats are assessed using this method is provided in Table 4. This method assesses habitat parameters and rates each parameter as optimal, sub-optimal, marginal or poor (scores 5, 10, 15 and 20 respectively). The scores for each parameter are then added up to give an overall habitat score. This is useful to evaluate the macro-invertebrate habitat present.

Table 4: Physical habitat assessment of streams for their suitability for macro-invertebrate production (adapted from Barbour and Stribling, 1991).

	Excellent	Good	Marginal	Poor
Score	20	15	10	5
Bottom substrate	More than 60% of bottom is gravel, cobble, and boulders. Even mix of substratum size classes.	30-60% of bottom is cobble or boulder substrata. Substrate may be dominated by one size class.	10-30% of substrata consist of large materials. Silt or sand accounts for 70-90% of bottom.	Substrate dominated by silt and sand. Gravel, cobble and larger substrate sizes <10%.
Habitat complexity	A variety of types and sizes of material form a diverse habitat.	Structural types or sizes of material are less than optimum but adequate cover still provided.	Habitat dominated by only one or two structural components. Amount of cover is limited.	Monotonous habitat with little diversity. Silt and sand dominate and reduce habitat diversity and complexity.
Pool quality	25% of the pools are as wide as or wider than the mean stream width and area >1m deep.	<5% of the pools are >1m deep and wider than the mean stream width.	<1% of the pools are >1m deep and wider than the mean stream width. Pools present may be very deep or very shallow. Variety of pools or quality is fair.	Majority of pools are small and shallow. Pools may be absent.
Bank stability	Little evidence of past bank failure and little potential for future mass wasting into channel.	Infrequent or very small slides. Low future potential of slides.	Mass wasting moderate in frequency and size. Raw spots eroded during high floods.	Frequent or large slides. Banks unstable and contributing sediment to the stream.
Bank protection	Over 80% of stream bank surfaces are covered by vegetation, boulders, bedrock, or other stable materials.	50-80% of the stream banks covered with vegetation, cobble, or larger material.	25-50% of the stream bank is covered by vegetation.	<25% of the stream bank is covered by vegetation or stable materials.

Table 4: Physical habitat assessment of streams for their suitability for macro-invertebrate production (adapted from Barbour and Stribling, 1991).

	Excellent	Good	Marginal	Poor
Score	20	15	10	5
Canopy	Vegetation of various heights provides a mix of shade and filtering light to water surface.	Discontinuous vegetation provides areas of shade alternating with areas of full exposure. Or filtering shade occurs <6h/day.	Shading is complete and dense. Or filtering shade occurs <3h/day.	Water surface is exposed to full sun nearly all day long.

3.2 Surveying for White clawed Crayfish

Work followed best practice methods and was carried out in suitable environmental conditions e.g. Avoid periods of high water, winds, heavy rain and low water visibility. Survey work was carried out in the optimal survey period, between the months of July and September (Table 5).

Table 5: Shows best practice time of year is the most appropriate to survey for White clawed Crayfish

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sub-optimal Survey Period – Limited Activity						Optimal Survey Period		Mating – No Surveys			

Snorkelling Hand Search

This method was found to be the most successful method in surveying White clawed crayfish (O'Connor *et al.* 2009) and involves using a wetsuit or drysuit and snorkel gear to search the river bed. Once in the water a competent ecologist can use both hands to search underneath rocks for any evidence of White clawed crayfish. This method means that the surveyor is closer to the river bed which increases visibility and increases the chances of finding evidence of White clawed crayfish. Manoeuvrability and careful displacement of potential refuges is also made easier. This method allows deeper or more inaccessible areas to be searched, as the surveyor is often swimming over the area being surveyed, as opposed to standing in it. Moreover, the use of snorkel gear helps reduce the amount of soft debris disturbed from river bed. With this method, one can search actual refuges and catch juveniles using a small hand held net.

Sweep netting

This method is carried out by sweeping a fine net (diameter of holes <0.05 mm) through the soft substrate or heavy vegetation in the water. This is a highly efficient method of surveying White clawed crayfish due to the amount of area sampled in a short period of time and so reduces survey time and effort. This method of survey is one of the most effective for catching smaller White clawed crayfish (hatchlings/juveniles) (Reynolds *et al.* 2010).

These two methods of surveying White-clawed crayfish were used at the four Sample Sites along the River Feagle in Clonakilty County Cork (Table 2 and Figure 1). Where very low water conditions made it impossible to snorkel, a combination of sweep netting and large bathyscope was used to assess all suitable refuges at these two sites. All suitable potential refuges at all 4 sample sites were searched comprehensively during this survey.

3.3 Electro Fishing Survey

Electrofishing was undertaken at selected sites under authorisation from the Department of Communication, Energy and Natural Resources (DCENR), under Section 14 of the Fisheries Act (1980). Survey locations are shown in Figure 1 and Table 2 detailing the grid co-ordinates of the survey site locations. The letter of Authorisation (Section 14) dated July 27th 2014 is included in Appendix I of this report.

It was proposed to electro fish four sample sites with two number replicates at each sample site to ascertain the status of the fish populations present.

The semi quantitative electrical fishing method used for the current study is widely utilized in the UK and Ireland; the methodology follows the manual '*Methods for the Water Framework Directive: Electric fishing in wadable reaches*' by Central Fisheries Board (2008) and (Winstone, 1993; Crozier & Kennedy, 1994, 1995) where it has been shown to have a high degree of predictive ability in relation to juvenile salmonids. All fish captured were released unharmed after the survey.

Sites were fished using a portable GFT Safari Researcher 660D portable electrical fishing unit with pulsed DC current at 200V for attraction and stunning. A fishing operation started with the gear constantly 'on' followed by a regular on/off sequence. While the gear was 'on' the anode was slowly pulled backwards in the water to cause fish present under stones to emerge as a result of electro-taxis (Bohlin *et al.*, 1982). This procedure was repeated throughout the operation. By keeping the anode 1-15cm above the bottom and pulling the anode backwards the number of fish stunned within rock crevices was reduced. An assistant held an insulated dip net (mesh size 20mm; 40cm x 40cm frame, handle length 182cm) for collecting fish that failed to be captured by the operator.

Electrical fishing for larval lampreys is unique because the larvae, unlike most other fish, normally burrow into the substrate. Sampling areas, if present at each site, should be fished in a zigzag manner. The area fished varies depending on the extent of fine-grained bed material and suitable water depth available at any site. Each one m² section of the surveyed area should be fished for 1-2 minutes or until lampreys stop emerging from their burrows. A fishing operation starts with the gear constantly 'on' followed by a regular on/off sequence. This intermittent operation of the electrode is used to irritate larvae out of the substrate. While the gear is operated, the anode is slowly pulled backwards in the water to cause lampreys to emerge from burrows as a result of electro-taxis. This procedure is repeated throughout the operation. When lampreys emerge the electrode is held in the 'on' position to stun (or electro-narcotise) the larvae for capture. By keeping the anode 1-15 cm above the sediment and pulling the anode backwards, the number of lampreys stunned within the substrate is thought to be reduced.

All captured fish were netted and placed into a container of river water. Captured fish were then anaesthetized using a solution of 2-phenoxyethanol, identified and measured to the nearest mm using a measuring board and weighed to the nearest decigram using a portable scales. Lampreys, if recorded, are measured to the nearest mm (Standard Length), weighed to the nearest 0.1g and identified using the keys in Gardiner (2003). Fish were then allowed to recover in a container of river water and were released alive in the sampling area.

Site characteristics were also recorded e.g. average water depth, wetted area width and length of the area fished (where it was not possible to fish the recommended 50m). Habitat features were also noted at every site e.g. nursery habitat, and the percentage of riffle, glide, pool etc.

Single-pass fishing estimates the fish population of a stretch 'per unit effort'. Standardisation of operation is important to obtain good relative data. Not all the fish in a stretch are caught by electric fishing during a 'single pass' fishing sampling. Multi-pass fishing attempts to derive an absolute abundance estimate by deplete sampling, as was used in this case.

While multiple passes were made, the productivity of the system meant that not all fish present were captured and results of the investigations are presented using two Catch per Unit Effort (CPUE) indices; fish number/m² and fish number/minute fishing. Catch per Unit Effort is impacted by the catchability (differs from species to species as well as from site to site), as well as its abundance.

The fish communities at the 4 sample sites were investigated during the weekend July 26th - 27th 2014.

4 RESULTS

4.1 Aquatic Habitat Assessment

The habitat rating index (HRI) (Table 3) identifies that the habitat at the 4 sample sites is *good to excellent* and the potential for macro-invertebrate production is *satisfactory to excellent*.

The results for the physical habitat assessment of the four sample sites within the study area for their suitability for macro-invertebrate production are provided in Table 7. All sites scored high and can be considered to provide good to excellent macro-invertebrate production conditions. The results of the ecological habitat evaluation indicate that there should be a high volume of macro-invertebrates available, which will allow fish populations to thrive.

Table 6: Results of Habitat Rating Index for each site.

HRI	Value Habitat Description
Sample Site 1	Excellent
Sample Site 2	Good
Sample Site 3	Excellent
Sample Site 4	Excellent

Table 7: Results of physical habitat assessment of streams for their suitability for macro-invertebrate production (adapted from Barbour and Stribling, 1991).

	Sample Site 1	Sample Site 2	Sample Site 3	Sample Site 4
Bottom substrate	Cobble substrate with large areas of sediment. A combination of low water conditions and high macrophytic content give a congested appearance and therefore flow is sluggish. 15	Substrate dominated by gravel however areas of deposition/ sediment were present. Macrophytic growth dominated by Fools Watercress <i>Apium</i> spp indicating enrichment. 15	Substrate dominated by gravel and cobble. Areas of sediment were present. Larger substrate sizes ca10%. 20	Substrate dominated by cobbles. Areas of gravel were present. Larger substrate sizes c15%. 20
Habitat complexity	Structural types or sizes of material are less than optimal but adequate cover still provided. 15	Structural types or sizes of material are less than optimal but adequate cover still provided. 15	Structural types or sizes of material are less than optimal but adequate cover still provided. 15	Habitat dominated by only one or two structural components. Amount of cover is limited. 10
Pool quality	25% of the pools are as wide as or wider than the mean stream width and area >1m deep. 20	Majority of pools are small and shallow. Pools may be absent. 5	25% of the pools are as wide as or wider than the mean stream width and area >1m deep. 20	25% of the pools are as wide as or wider than the mean stream width and area >1m deep. 20
Bank stability	Infrequent or very small slides. Low future potential of slides. 15	Infrequent or very small slides. Low future potential of slides. 15	Infrequent or very small slides. Low future potential of slides. 15	Infrequent or very small slides. Low future potential of slides. 15
Bank protection	Over 80% of riparian surfaces are covered by vegetation, boulders, bedrock, or other stable materials. 20	Over 80% of riparian surfaces are covered by vegetation, boulders, bedrock, or other stable materials. 20	Over 80% of riparian surfaces are covered by vegetation, boulders, bedrock, or other stable materials. 20	Over 80% of riparian surfaces are covered by vegetation, boulders, bedrock, or other stable materials. 20
Canopy	Discontinuous vegetation provides areas of shade alternating with areas of full exposure. Or filtering shade occurs <6h/day. 15	Shading is complete and dense. Or filtering shade occurs <3h/day. 10	Discontinuous vegetation provides areas of shade alternating with areas of full exposure. Or filtering shade occurs <6h/day. 15	Discontinuous vegetation provides areas of shade alternating with areas of full exposure. Or filtering shade occurs <6h/day. 15
Score (Max 120)	100	80	105	100

4.2 White clawed crayfish

After searching all suitable refuges at each site using the methodologies outlined in Section 3.2, no White clawed crayfish were recorded at any of the sites. These survey results combined with the known current distribution the species in Ireland and the sandstone rock type in the area most likely confirms the absence of White clawed crayfish in this river.

4.1 Fisheries Assessment

4.1.1 Fish Habitats

The four sample sites provide significant sections of good to excellent fish habitat (See Table 6). However instream characteristics such as macrophytic growth affect the quality of certain sites as water levels rise and fall, by congesting the water course. Some sites provided some potential for lamprey but overall lamprey habitat was not widespread in the sections under investigation. A description of each site is detailed below, to provide further information on the suitability of each site for fish.

Sample Site 1:

Sample site 1, on a 1st order stream, comprised an approximate 31m transect adjacent to the horse arena. This site was electrofished twice taking 21 minutes to complete in total. This section of the river ranged from 0.5 – 1.25 m in width and was not easily fished due to shallow water conditions in some places, fallen vegetation blocking areas of pools and also dense vegetation (*Rubus* sp and Hawthorn) within the river channel itself making movement within the channel very difficult.

This site is banked on both sides by improved agricultural grassland and a high proportion (approximately 80%) of riparian vegetation and mature trees. The water level of the stream was very low with approximately 80% macrophytic content in total including a lot of filamentous algae growing in the slower moving areas of the sample site. There are two large pools at the western end of the sample site which accounts for approximately 50% of the total area of the sample location while the remainder of the sample site consists of approximately 30% riffle and 20% glide. With a substrate of gravel and sand the pool provides excellent rearing habitat for young fish and feeding ground for older 1+ fish.

The pools associated with this site hold good numbers of both adult and 1+ salmonids. There are glide areas which will not hold many fish in low water conditions. Most of this sample site is choked with overhanging vegetation and instream blockages of twigs and branches. While these blockages provide good fish habitat, they also facilitate the deposition of fine particulate matter and this is evident at this location, most especially at the head of the pools. This build-up of sediment provides potential lamprey habitat and these areas were surveyed for lamprey. No invasive species were recorded at the site.

Sample Site 2:

This was a relatively shallow section of river adjacent agricultural grassland with a maximum depth of 0.45 m. The transect was approximately 30 m in length and on average was 2.5 m wide (channelized). This site was not easily fished due the amount of aquatic vegetation choking the river and extensive overhanging bushes and trees. Very strong instream vegetation is a clear indication of agricultural influence on this stream.

Riparian vegetation (mature hedgerow) is limited to one side of the bank. This hedgerow while shading large parts of the river will provide invertebrate prey items for adult, 0+ and 1+ salmonids and can be described as beneficial and is an integral part of this section of river due to one bank being devoid of vegetation (due to agriculture). No potential lamprey habitat was evident at this sample site. No invasive species were recorded at the site.

Sample Site 3:

This sample site is located within the urban district of Clonakilty town. The average width of Sample Site 3 was 4.1 m and the transect was 50 m long. This section of river had some pools, with the deepest parts reaching 0.6 m in depth. While there were overhanging bushes and trees this site was accessible and relatively easily fished with very little macrophytic growth within the river channel itself due to shading over large sections.

The substrate is gravel and sand with the combinations of habitats at this site supporting the greatest abundance of fish of the four sample sites with one deep pool especially providing an excellent nursery for 1+ fish and feeding areas for adult fish. No potential lamprey habitat was evident at this sample site. No invasive species were recorded at the site.

Sample Site 4:

The transect length of Sample Site 4 was approximately 52 m and on average it was 3.8 m wide (channelized). Both sides of this section are highly altered by walls and concrete supporting walls with significant shading due to buildings along the riparian areas. The maximum depth within this section of the river was 0.5 m. The site was easily accessible and did not prove difficult to fish. The low water conditions made some areas impossible to snorkel and a large bathyscope was used in conjunction with sweep netting at this site to survey for White clawed crayfish.

Located within the urban district of Clonakilty town the substrate at this location is primarily cobbles and small stones. Approximately 65% of the sampling site comprises of pools of various sizes with 25% glide and 10% of riffle areas. The site does not contain any macrophytic growth due to shading although there is heavy riparian growth present along some sections of the river's edge causing vegetative debris to build up in those areas. Although this debris has the potential to alter the flow of the river, it can provide good

habitat for smaller fish. Both younger and older fish will thrive with habitat characteristics such as found at the sample site i.e. larger pools with faster flowing highly oxygenated riffles and glides. No potential lamprey habitat was evident at this sample site. No invasive species were recorded at the site.

Table 8: Physical habitat assessment of sites within the study area for their suitability for fish.

Sample Site number	Sample Site 1	Sample Site 2	Sample Sites 3	Sample Site 4
Grid co-ordinates.	W 36037, 42265	W 36484, 41753	W 37360, 41214	W 37885, 41293
Bank height range (m)	0.5 - 1.2 – 1.2m	0.5 – 0.8 m (channelised)	0.1 – 0.5m	0.5 - 2m (channelised)
River width range (m)	0.5 -1.25m	2 – 2.9m	2.3 – 4.6m	5m (channelised)
Depth range (m)	0.1 – 0.75m	0.1 – 0.45m	0.15 – 0.6m	0.1 - .05 m
*Riffle %	30	5	50	10
*Glide %	20	15	40	25
*Pool %	50	80	10	65
Bank stability	High – Stable	High - stable	High - stable	High - stable
Canopy/ tunnelling	50%	20%	70%	40%
Riparian vegetation	80%	50%	30%	15%
Total Assessment	Limited foraging habitat present due to filamentous algal growth. Two deep pools but congested with brambles. Silt deposition in places. No spawning habitat present.	Macrophytic growth has congested this stretch of river. Good foraging habitat is present in places but is limited. Limited but high quality spawning habitat present.	Excellent foraging and nursery habitat present. Some deep pools exist, as do good spawning gravels. Average macrophytic growth due to shading.	Average foraging habitat present in addition to spawning habitat. No macrophytic growth due to shading.

*Riffle, pool and Glide % equal 100% of that classification.

Table 9: Assessment of habitat class (spawning, nursery, rearing, and foraging) for salmonids in watercourses within the study area.

	Site 1		Site 2		Sites 3		Site 4	
	Salmonids	Lampreys	Salmonids	Lampreys	Salmonids	Lampreys	Salmonids	Lampreys
Spawning	1	2	2	1	3	1	3	1
Nursery	2	2	3-4	1	3	1	4	1
Rearing	2	2	4	1	5	1	5	1
Foraging	3	2	4	1	5	1	5	1

1=Unsuitable, 2=Poor, 3=Satisfactory, 4=Good and 5=Excellent

4.1.2 Fish Catch

At the designated sample sites areas with optimal salmonid habitat (riffles, glides and pools) were chosen where possible. Sample sites were distributed along the section of river being investigated and each location has varying characteristics.

Water levels were considered to be very low after a prolonged dry period and at some sample sites this affected the sampling methods i.e. it was not possible to snorkel hand search all areas at each sample site as a lot of suitable habitat was either above water or in water that was too shallow due to low water conditions.

Water was running clear and dry areas of river bed were present at each of the sample sites illustrating the very dry conditions that this area had witnessed over the past few months. The GPS co-ordinates of the Sample Sites are given in Table 2.

In total 327 fish were caught over the four sites with five species of fish represented i.e. Brown Trout (n=275), Eel (n=38), Salmon (n=3), Stoneloach (n=5), Stickleback (n=5).

Further detail of the electrofishing results is presented in Table 10. Analysis of the relative abundance of each species is presented in Table 11, which has been adjusted to take into account the differences in area (m²) fished and the time differences of electrofishing at each site. These results are presented as Catch per Unit Effort (CPUE).

Data on the age profile of the salmonids in the river is also provided to help determine the ecological importance of the sample sites for salmonids.

Table 10: The overall results of the electrical fishing survey.

	Sample Site 1 (2 replicates)	Sample Site 2 (2 replicates)	Sample Site 3 (2 replicates)	Sample Site 4 (2 replicates)
Area Fished (m²)	31	95	205	197.6
Channel mean width (m)	1	2.5	4.1	3.8
Channel length (m)	31	30	50	52
Average length of time fished (mins)	10	4	10	13
Trout	63	32	112	68
Average length (forked length) (mm)	12.8	11.4	13.3	13.2
Average weight (g)	35.3	28.7	36.6	38.1
Maximum length (mm)	36	16.9	35.6	25.1
Minimum length (mm)	5	6.7	5.9	5.6
Eel	6	2	9	22
Average length (mm)	30	23	24.3	19.9
Average weight (g)	52.5	37.2	41	16.6
Maximum length (mm)	35.9	33	45	30.5
Minimum length (mm)	21.8	13	5.4	8
Three spined stickleback	1	3	0	1
Average length (forked length) (mm)	5	5.2	n/a	5.3
Average weight (g)	1.1	4.2	n/a	2.3
Maximum length (mm)	5	5.5	n/a	5.3
Minimum length (mm)	5	4.5	n/a	5.3
Atlantic Salmon	1	0	2	0
Average length (forked length) (mm)	14.8	n/a	11	n/a
Average weight (g)	44.9	n/a	22.7	n/a
Maximum length (mm)	14.8	n/a	14	n/a
Minimum length (mm)	14.8	n/a	7.9	n/a
Stoneloach	2	1	0	2
Average length (forked length) (mm)	9.5	7.1	n/a	7.2
Average weight (g)	14.7	4.1	n/a	4.6
Maximum length (mm)	11.7	7.1	n/a	7.4
Minimum length (mm)	7.3	7.1	n/a	7
Total length of time channel fished (minutes)	21	9	20	27
Total number of fish	73	38	123	93

Table 11: Catch per Unit Effort (CPUE). Catch per min and per m² at each site, as well as biomass per m²

Site	Fishing times (min)	Area Fished (m ²)	Brown Trout				Eel				Salmon			
			n	Fish/ m ²	Fish/ min	Biomass (g /m ²)	n	Fish/ m ²	Fish/ min	Biomass (g /m ²)	n	Fish/ m ²	Fish/ min	Biomass (g /m ²)
Site 1	21	31	63	2.03	3.00	71.72	6	0.19	0.29	10.16	1	0.03	0.05	1.45
Site 2	9	95	32	0.34	3.56	9.68	2	0.02	0.22	0.78	0	n/a	n/a	n/a
Site 3	20	205	112	0.55	5.60	20.01	9	0.04	0.45	1.80	2	0.01	0.10	0.22
Site 4	27	198	68	0.34	2.52	13.12	22	0.11	0.81	1.85	0	n/a	n/a	n/a
Site	Fishing times (min)	Area Fished (m ²)	Stoneloach				Stickleback							
			n	Fish/ m ²	Fish/ min	Biomass (g /m ²)	n	Fish/ m ²	Fish/ min	Biomass (g /m ²)				
Site 1	21	31	2	0.06	0.10	0.95	1	0.03	0.05	0.03548				
Site 2	9	95	1	0.01	0.11	0.04	3	0.03	0.33	0.13263				
Site 3	20	205	0	n/a	n/a	n/a	0	n/a	n/a	n/a				
Site 4	27	198	2	0.01	0.07	0.05	1	0.01	0.04	0.01164				

Figure 3: Age profile of salmonid fish in the river.

(0+, 1+ and 2+ denote age class i.e. 1+ = more than 1 year old)

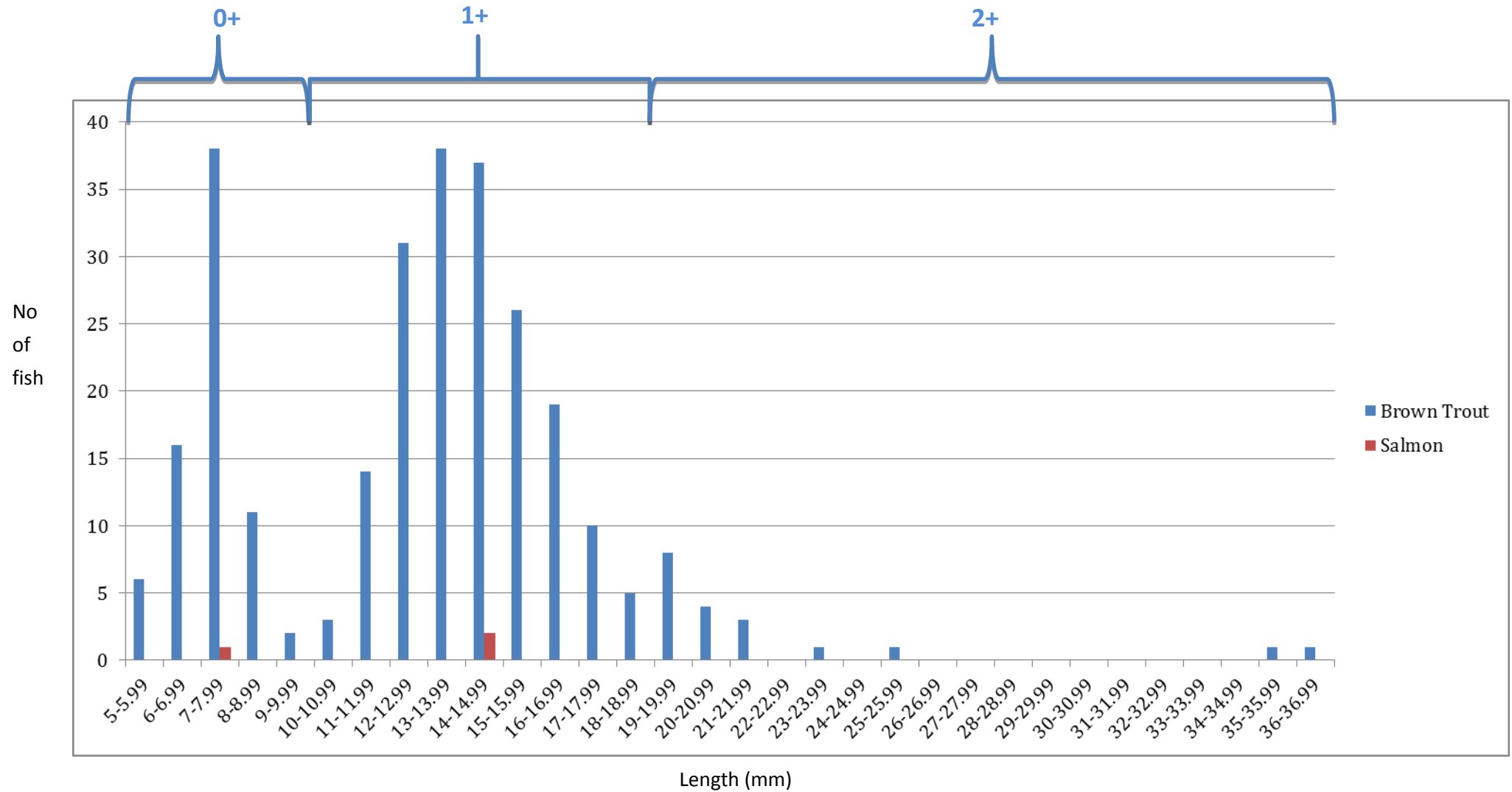


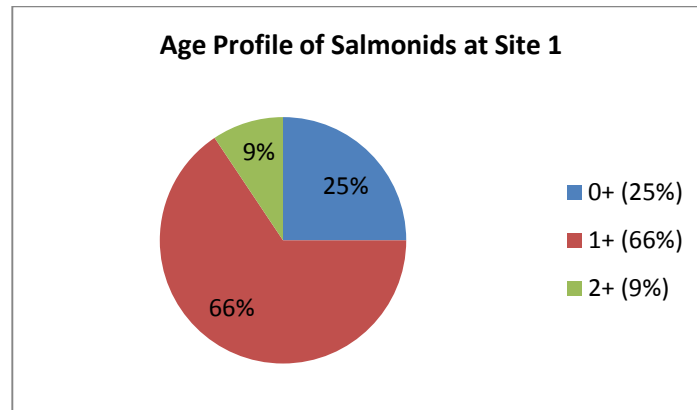
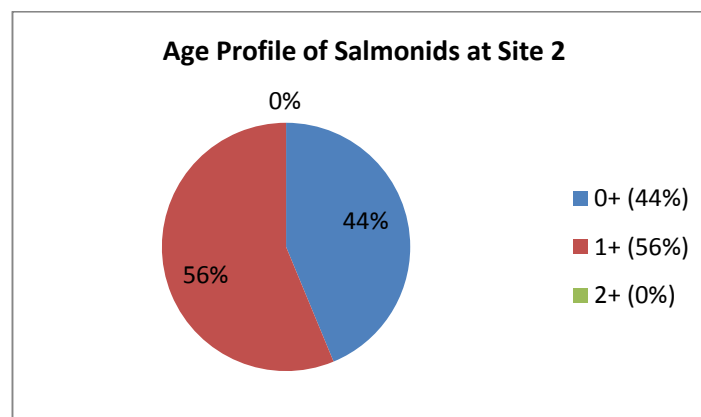
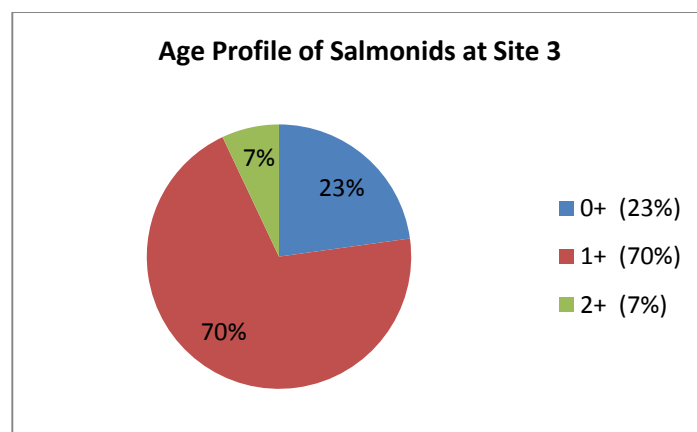
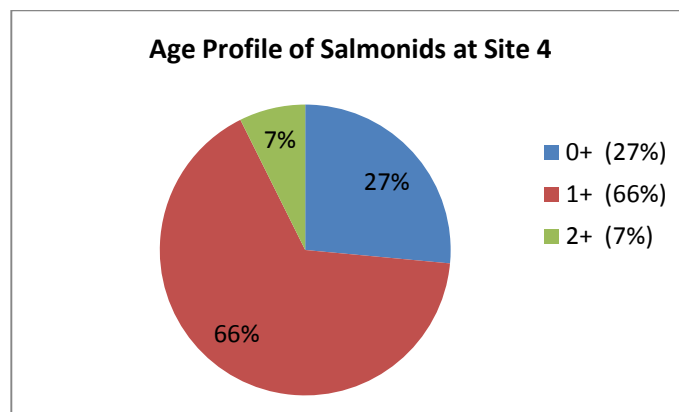
Figure 4: Percentage breakdown of the age profile of salmonids at Site 1.**Figure 5:** Percentage breakdown of the age profile of salmonids at Site 2.**Figure 6:** Percentage breakdown of the age profile of salmonids at Site 3.

Figure 7: Percentage breakdown of the age profile of salmonids at Site 4.

4.2 Overall Evaluation of Sample Sites

The scheme used to evaluate the ecological importance of watercourses (based on NRA, 2008) in the study area is presented in Appendix III. Watercourses were evaluated on the basis of a number of characteristics and features as outlined below. The characteristics are defined as follows:

- Aquatic habitat refers to the in-water conditions of any watercourse; including substrate and stream structure (i.e. proportion of riffles, runs and pools).
- The fisheries value of a watercourse refers to its suitability for fish, primarily salmonids (salmon and trout), and to the associated value for recreational angling purposes.
- Annex II species are those that are listed under the EU Habitats Directive (92/43/EEC).
- Annex I habitats are those that are listed under the EU Habitats Directive, including Priority Habitats.

The results for the physical habitat assessment of sites within the study area for their suitability for macro-invertebrate production are provided in Table 7. All sites scored high and can be considered to provide good to excellent macro-invertebrate production conditions (in particular Sites 1, 3 and 4). The results of the ecological habitat evaluation indicate that there should be a high volume of macro-invertebrates available, which will allow fish populations to thrive. All Sample Sites 1-4 were rated as C – High Value, Locally Important, based on the NRA evaluation criteria (2008).

The resident salmonid populations of fish in the river are primarily brown trout (including sea trout) (n=275), with just a few salmon encountered (n=3). The vast majority of the salmonid fish encountered are 0+ and 1+ (see Figure 3), estimated at 91%. This indicates that Sample Sites 1-4 provides excellent nursery and rearing habitat for salmonids. In particular Site 2 and Site 4 provide good to excellent habitat for nursery and rearing areas

for salmonids (both trout and salmon). Population structure of trout did not vary significantly between most sample sites. All surveyed areas displayed a strong presence of both 0+ and 1+ fish with lower numbers of 2+ fish present at each site with the exception of Site 2 where older fish were mostly absent due to very low water conditions and the absence of pools (see Figures 4 -7).

Taken as a whole this is a very productive river for salmonids, with large numbers of juvenile brown trout present. Salmon numbers are low but the fact that salmon were recorded at Sample Site 1 is significant and illustrates that salmon are migrating to the top of the system. None of the salmon or trout caught was returning sea trout or salmon.

Regarding the separation of brown trout from their anadromous form (sea trout) it is not possible to tell the parentage (based on life history phenotype i.e. sea trout or brown trout) of juvenile brown trout of the size range 6cm to 19cm captured in freshwater in July from visual inspection. Neither is it possible to determine the life history type (resident brown trout or sea trout or a combination of both) of the parents of juvenile brown trout sampled in freshwater in July using genetic techniques, unless:

1. A pre-existing genetic baseline is available that differentiates sea trout and brown phenotypes in that specific river.
2. A complete or near complete family pedigree has been established based on the sampling of known adult sea trout ascending the specific river.
3. A genetic marker or quantitative trait loci (QTL) exists that is diagnostic for the trait in this particular river.

We have consulted with the pre-eminent sea trout scientist in Ireland (Dr Phillip McGinnity*) regarding the issue of identifying what percentage of sea trout are within our sample and Dr McGinnity has indicated that to the best of his knowledge neither a genetic baseline of brown or sea trout phenotypes nor a pedigree of known migrating adult sea trout exists for the Fealge River. Also to the best of his knowledge he does not know of the existence of a genetic marker that is indicative of the trait in the Feagle or is definitively diagnostic for the trait of any other river. This being the case he does not believe it possible to determine the life history phenotype of the parents of the juvenile brown trout collected in our present survey. In this scenario it must be assumed that sea trout spawn and live at the uppermost sample site which was assessed, i.e. Sample Site 1, and that any mitigation that is designed for salmonids on this scheme must take fish passage up to this area into account.

* Dr Phillip McGinnity is Principal Investigator at the Beaufort Marine Research Award in Fish Population Genetics at the School of Biological, Earth & Environmental Sciences of University College Cork.

While lampreys are present in this system no lampreys were recorded during this survey. The reason for this is that little suitable habitat is present at any of the 4 Sample Sites given the substrate is dominated by cobble at these locations. Where potential lamprey habitat was encountered this was electrofished.

Good numbers of European Eel were recorded most especially at Sample Site 4 within the urban zone of Clonakilty. No White clawed crayfish were recorded at any of the Sample Sites, and given the national distribution, this survey can be considered to confirm their absence from the river.

While the stream is somewhat congested in places with vegetation, the water quality over the past 20 years has remained in good condition, and has maintained good water quality status.

5 REFERENCES

- Abel, P.D. (1996) *Water Pollution Biology*. Second Edition. Taylor and Francis. England.
- Barbour, M.T. and Stribling, J.B. (1991) Use of Habitat Assessment in Evaluating the Biological Integrity of Stream Communities. In: *Methods in Stream Ecology* (Eds. Hauer, F.R. and Lamberti, G.A. Academic Press.
- Bain, M.B. & Stevenson, N.J. (1999) *Aquatic habitat assessment: common methods*. American Fisheries Society, Bethesda, Maryland, USA.
- Bohlin, T., Dellefors, C., and Faremo, U. (1982) Electrofishing for salmonids in small streams – aspects of sampling design. *Rep. Inst. Freshwat. Res., Drottningholm*, **60**:19-24.
- Chapman, P.J. & Chapman, L.L. (1982) *Otter survey of Ireland*. Vincent Wildlife Trust, London.
- Clabby K.J., Lucey J., McGarrigle M.L. (2006) *Interim Report on the Biological Survey of River Quality Results of the 2004 Investigations*. EPA
- Crozier WW, & Kennedy, GJA (1995) Application of a fry (0+) abundance index, based on semi-quantitative electrofishing, to predict Atlantic salmon smolt runs in the River Bush, Northern Ireland. *J. Fish. Biol.*, **47**(1): 107-114.
- Crozier, WW, & Kennedy, GJA (1994) Application of semi-quantitative electrofishing to juvenile salmonid stock surveys *J. Fish. Biol.*, **45**(1): 159-164.
- Clesceri, L.S., Greenberg, A.A., & Eaton, A.D. (1999) *Standard Methods for Examination of Water & Wastewater*. American Public Health Association. 20th edition.
- EPA (2001) *Parameters of Water Quality – Interpretation and Standards*. Environmental Protection Agency, Ireland.
- EPA (2001) *River Water Quality Report 2001*. Available online.
- Flannagan P.J., & Toner, P.F. (1972) *The National Survey of Irish Rivers – A Report on Water Quality*. Water Resources Division. An Foras Forbartha. Dublin.
- Greenberg, L.A. and Dahl, J. 1998. Effect of habitat type on growth and diet of brown trout (*Salmo trutta* L.) in stream enclosures. *Fisheries Management & Ecology* **5**: 331-348.
- Grieve I. and Gilvear D. (2010). Effects of wind farm construction on concentrations and fluxes of dissolved organic carbon and suspended sediment from peat catchments at Braes of Doune, central Scotland. *Mires and Peat, Volume 4 (2008–2010)*, Article 03, <http://www.mires-and-peat.net/>, ISSN 1819-754X. International Mire Conservation Group and International Peat Society.
- Hatfield, T. & Bruce, J. (2000) Predicting Salmonid Habitat–Flow Relationships for Streams from Western North America. *North American Journal of Fisheries Management* **20**:1005–1015, 2000

Heggenes, J, Saltveit, SJ (1996) Habitat selection by brown trout (*Salmo trutta*) and young Atlantic salmon(*S. salar*) in streams: Static and dynamic hydraulic modelling. *Regul. Rivers: Res. Manage.*, **12**(2-3):155-169, 1996.

Haury, J, Ombredane, D, & Bagliniere, JL (1999) The habitat of the Brown Trout (*Salmo trutta* L.) in watercourses. *Biology and ecology of the brown and sea trout*. 37-89. (1999).

Kelly & King (2001) A review of the ecology and distribution of three lamprey species, *Lampetra fluviatilis* (L.), *Lampetra planeri* (Bloch), and *Petromyzon marinus* (L.): A context for conservation and biodiversity considerations in Ireland. *Biology and the Environment*. **101B**(3):165-185.

Jennings, E., NicAonghusa, C., Allott, N., Naden, P., O'Hea, B., Pierson, D., & Schneiderman, E. (2006). Future climate change and water colour in Irish peatland catchments: results from the CLIME project. *Environmental Pollution*, **116**, 143-14.

Kennedy, GJA & Strange, CD (1986) The effects of intra- and inter-specific competition on the distribution of stocked juvenile Atlantic salmon, *Salmo salar* L., in relation to depth and gradient in an upland trout, *Salmo trutta* L., stream. *J. Fish. Biol.*, **29**(2):199-214.

Kurz, I. and Costello, M. J. (1999). An outline of the biology, distribution and conservation of lampreys in Ireland. *Irish Wildlife Manuals No. 5*. Dúchas, The Heritage Service, Dublin.

Lucey (2006) The Pearl water mussel *Margaritifera margaritifera* (L.) in hard water in Ireland. *Proceedings of the Royal Academy Vol. 106B*, No. 2 143-153.

Maitland, P.S. & Campbell, R.N. (1992) *Freshwater Fishes of the British Isles*. The New Naturalist. Harper Collins.

MacCarthaigh (1997) Hydrological data. A listing of water recorders and summary statistics at selected gauging stations. Environmental Protection Agency.

McGarrigle, M.L., Bowman, J.J., Clabby, K.J., Lucy, P., Cunningham, M., MacCarthaigh, M., Keegan, M., Cantrell, B., Lehan, M., Clenaghan, C., Toner, P.F. (2002) *Water Quality in Ireland 1998-2000*. Second (Revised) Edition. Environmental Protection Agency.

NRA (2008). Environmental Impact Assessment of National Road Schemes – A Practical Guide. Revision 1, 20 November, 2008. National Roads Authority. www.nra.ie

NRA (2009). Guidelines for Assessment of Ecological Impacts of National Road Schemes. Revision 2, 1st June, 2009. National Roads Authority. www.nra.ie

O'Connor W (2004) A survey of juvenile lamprey populations in the Moy catchment. *Irish Wildlife Manuals*, No. 15. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

O' Connor, W. (2007). A survey of Juvenile lamprey Populations in the Corrib and Suir Catchments. *Irish Wildlife Manuals No. 26*. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

O'Connor, W., Hayes, G., O'Keeffe, K., & Lynn, D. (2009) Monitoring of White-clawed crayfish *Austropotamobius pallipes* in Irish Lakes during 2007. Irish Wildlife Manuals No. 37. National Parks and Wildlife Service

O'Grady, M.F., Curtin, J (1993) The Enhancement of drained salmonid rivers in Ireland. A bioengineering perspective. *Hydroecol. Appl.*, **5**(2):7-26.

O'Grady, M. & Caffrey, J. (1987) A fishery survey of the River Suir catchment. Dublin: Central Fisheries Board.

O' Reilly, P. (2002) Rivers of Ireland – A fly fisher's guide. 5th Ed. Merlin Unwin Books.

Peay, S. (2003) Guidance on habitat for white-clawed crayfish. Environment Agency R&D Technical Report W1-067/TR.

Reynolds, J.D. (1998) Conservation management of the white-clawed crayfish, *Austropotamobius pallipes*. Part 1. Irish Wildlife Manuals, No. 1.

Reynolds, J.D., O'Connor, W., O'Keeffe, C. & Lynn, D. (2010) A technical manual for monitoring white-clawed crayfish *Austropotamobius pallipes* in Irish lakes. Irish Wildlife Manuals, No 45, National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.

Rodgers, M., O'Connor, M., Robinson, M., Muller, M., Poole, R., & Xiao, L. (2011). Suspended solid yield from forest harvesting on upland blanket peat. *Hydrological Processes*, **25**(2), 207-216.

Sottocornola, M., Laine, A., Kiely, G., Byrne, K. A., & Tuittila, E. S. (2009). Vegetation and environmental variation in an Atlantic blanket bog in South-western Ireland. *Plant Ecology*, **203**(1), 69-81.

Walley W.J. and Hawkes H.A. (1996) A computer-based reappraisal of Biological Monitoring Working Party scores using data from the 1990 River Quality Survey of England and Wales. *Water Research*, **30** (9), 2086-2094

Winstone, AJ (1993) Juvenile salmon stock assessment and monitoring by the National Rivers Authority -- a review. In: Production of Juvenile Atlantic Salmon, *Salmo salar*, in natural waters., 1993, pp. 123-126, Can. Spec. Publ. Fish. Aquat. Sci., No. 118.

Appendix 1:
Authorisation Letter from Inland Fisheries Ireland



Roinn Cumarsáide, Fuinnimh agus Acmhainní Náúúrtha
Department of Communications, Energy & Natural Resources

**CERTIFICATE OF AUTHORISATION UNDER SECTION 14 OF THE
FISHERIES (CONSOLIDATION) ACT, 1959 AS SUBSTITUTED BY
SECTION 4 OF THE FISHERIES (AMENDMENT) ACT, 1962.**

The Minister for Communications, Energy and Natural Resources in exercise of the powers conferred on him by Section 14 of the Fisheries (Consolidation) Act, 1959 as substituted by Section 4 of the Fisheries (Amendment) Act, 1962 hereby authorises:

Mr Howard Williams, INIS Environmental Consultants Ltd, Edenvale, Ennis Co Clare and or person(s) nominated by him to undertake an electro operation on the River Fealge, Clonakilty, Co Cork.

This authorisation is granted subject to the following conditions:

- 1. This authorisation shall not confer on the holder thereof, independently of the conditions therein;**
 - (a) any rights or title which the holder would not have had if this Authorisation had not been given, or;**
 - (b) any authority in any way to interfere with or infringe the lawful rights of any other person.**
- 2. This authorisation is issued to and valid for use by Howard Williams and or person(s) nominated by him.**
- 3. This authorisation is valid from 10 July 2014 to 30 September 2014.**

Fáiltítear roimh comhfhreagras i nGaeilge

Teach Leamhán.	+353 1 6782000	Elm House.
Bóthar Ghleann an Iarla,	L6Ghlao 1890 44 99 00 LoCall	Earlsvale Road.
An Cabhán	Feaics +353 1 6783057 Fax	Cavan

4. Inland Fisheries Ireland (IFI) Macroom, shall be notified at least 5 working days in advance of the proposed commencement of the electro-fishing operations by email to: Patricia.OConnor@fisheriesireland.ie . The holder of this authorisation shall comply with any instructions given to them in relation to fishing operations.
5. Three days notice of the actual commencement of electrofishing shall be given email and shall include the County, Site Number, River Name, Townland and Irish Grid Reference as well as mobile telephone contact details for the relevant on-site supervisory personnel. All sites and schedules to be agreed with IFI Macroom (Patricia O'Connor, SFEO or her nominee) in advance of the electrofishing operation.
6. The written consent of the fishery owner, or his or her representative, of any fishing rights in the waters fished is obtained and submitted to IFI, Macroom before operations commence under the authority of this authorisation.
7. The fishing gear when not in use shall be kept in a secure place known to an Officer of IFI Macroom and the local Garda Siochana.
8. Any fish captured shall be carefully handled and returned alive to the water from which they are taken, following the gathering of data. No fish of any species should be sacrificed during the appraisal, except in circumstances where tissue/body burden analysis is to be carried out and excessive trampling and disturbance of spawning beds should be avoided if at all possible, or at least kept to a minimum. IFI Macroom is to be immediately informed of any fish mortalities. Details including the County, Site Number, River Name, Townland, Irish Grid Reference and the species and numbers killed shall be communicated to IFI Macroom by telephone to (026) 41222 for the attention of Patricia O' Connor.
9. To facilitate post works monitoring, IFI recommend that quantitative electrofishing is conducted and robust population estimates derived. Adherence to methods outlined in the CFB "Electric Fishing in Wadeable reaches" manual is advised. Furthermore, whilst electrofishing is

continuing, all captured fish should be fully removed from the river and held in a bin of well oxygenated water or held outside of the area impacted by the electrical current. All juvenile and small fish captured should be retained, measured and returned alive to the water from which they are taken following each survey. Adult salmonids may be recorded and immediately returned to the river, outside of the electrical current if required.

10. Any and all of the electro fishing gear/equipment, including the transformer, generator nets etc shall be disinfected prior to and after use at each electro fishing site to prevent the spread of pathogens, disease, parasites or exotic species and to avoid the transfer of species such as anguillicola, zebra mussels and various plants etc. The holder of this authorisation shall strictly comply with the submitted Biosecurity measures and as directed by an officer of IFI Macroom.
11. When doing anything pursuant to this authorisation, the holder shall, if requested by any person affected, produce this authorisation to that person.
12. The survey report including the survey quantitative data obtained in the appraisal shall be forwarded electronically in the standard IFI format to Sandra Doyle, Inland Fisheries Ireland, Swords Business Campus Swords, Co Dublin, Sandra.doyle@fisheriesireland.ie within 30 days of completion of the survey. For ease of reference an electronic copy of IFI's standard template will be forwarded directly to the applicant.
13. The holder of this authorisation is competent in the use of electro-fishing gear. All equipment should be disinfected prior to and after use to prevent the spread of disease, parasites or invasive species and must strictly comply with IFI's Biosecurity measure (<http://www.fisheriesireland.ie/Invasive-Species/biosecurity-protocol-for-field-survey-work.html>) and as directed by an officer of IFI Macroom.
14. Failure to comply with any of the conditions of this authorisation may result in revocation of this authorisation.

15. The holder of this authorisation should be mindful of the potential occurrence of invasive alien species, either in the wetted channels being surveyed or in the adjoining riparian zone. IFI would be grateful if the presence of such species could be recorded along with geo-reference and indication of the extent of occurrence and submitted in report form directly to IFI.
16. The holder of this authorisation shall indemnify and keep indemnified the State, the Minister for Communications, Energy and Natural Resources and the Minister for Finance against any claims, arising in any manner whatsoever in connection with the user of the fishing gear or in the exercise of the permission hereby granted.
17. Notwithstanding the foregoing, this authorisation may be revoked or amended by the Minister for Communications, Energy and Natural Resources without the payment of compensation to the holder on giving one weeks notice in writing to the holder if he considers it necessary in the public interest to do so.

Dated this 10 July 2014

For the Minister for Communications, Energy and Natural Resources.


Gerry Clerkin

An officer authorised on that behalf by the said Minister

Appendix 2:

Plates



Plates 1 -6: (1) Snorkel hand searching for crayfish, (2) using bathyscope for crayfish survey (Site 1) (3) Sweep netting for crayfish (4) Heavy effluent algal growth at Sample Site 1 (5) Three spined Stickleback (6) Stoneloach from Sample Site 1.



Plates 7 – 12: (7) European Eel (8) Atlantic salmon & Brown trout (9 & 10) at Sample site 1 (11 & 12) habitat characteristics at Sample Site 1.



Plates 13 - 18: (13) Note sediment in the water column at Sample site 1 (14, 15 & 17) Sample site 2 (16 & 18) stoneloach and salmonids from Sample site 2.



Plates 19, 20 & 22: Sample site 2 showing the congested stream and habitat characteristics
(21) Difficult electrofishing conditions.



Plates 23 - 28: (23 & 24) Sample site 2 (25 – 27) Eels from Sample site 3 (28) Downstream of Sample site 3.



Plates 29 - 34: (29 & 30) Downstream of Sample site 3. (31 & 32) Sample site 4 (33 & 34) fish from Sample site 4.

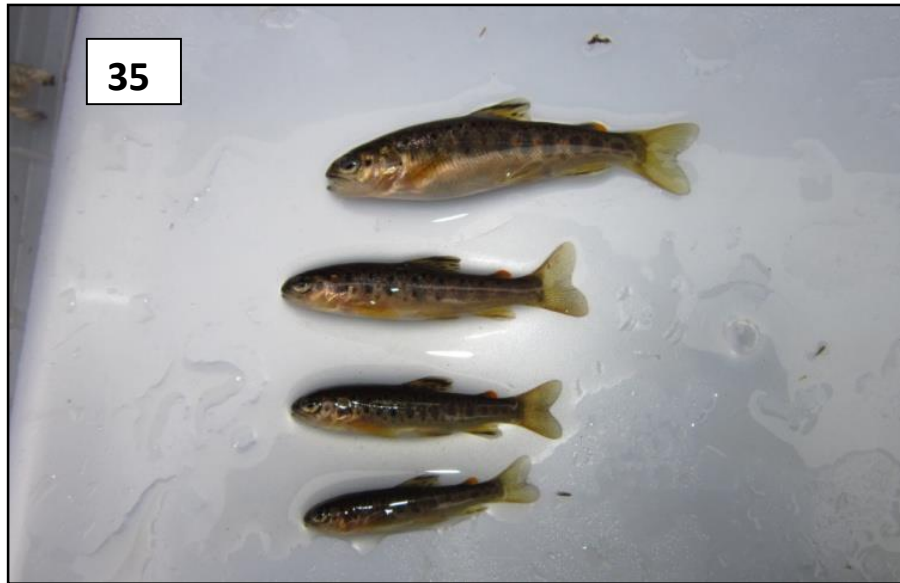


Plate 35: Young trout caught during electrofishing on the River Fealge.

Appendix 3:

Evaluation of Ecological Importance of Aquatic Sites

Table 1: Criteria for assessing ecological importance of watercourse sites (Adapted from NRA, 2008).

Rating	Aquatic Habitat	Fisheries Importance	Presence of Protected species	Water Quality
International importance (A)	Internationally important sites designated (or qualifying for designation) as SAC* under the EU Habitats Directive. Priority Annex I Habitats	Designated Salmonid waters. Major salmon fisheries. Major Salmonid lake fisheries.		
National importance (B)	Sites or waters designated or proposed as NHA* or statutory Nature Reserves. Annex I Habitats	Significant populations of breeding salmonids. Major trout river fisheries and commercially important coarse fisheries.	Significant numbers of resident or regularly occurring populations of Annex II species	
High value, local importance (C)	Semi-natural habitat types with high biodiversity in a local context. Poor examples of Annex I Habitats	Waters containing some resident salmonids or good stocks of coarse fish species.	Sites containing any resident or regularly occurring populations of Annex II species	Q5, Q4-5, Q4
Moderate value, local importance (D)	Some semi-natural habitat limited in size	Small water bodies with some coarse fisheries value or some potential Salmonid habitat.	Headwater or tributary of watercourse with Annex II species.	Q3-4
Low value, local importance (E)	Artificial or highly modified habitat	No significant populations of any species of fish	No importance to Annex II species.	Q3 or less
F	Sites that have not been adequately assessed but may contain habitats or species of note			

SAC = Special Areas of Conservation; NHA = Natural Heritage Areas

Table 2: Criteria for assessing impact significance on aquatic sites (taken from NRA, 2008).**A Sites**

	Temporary	Short-term	Medium-term	Long-term
Extensive	Major	Severe	Severe	Severe
Localised	Major	Major	Severe	Severe

B Sites

	Temporary	Short-term	Medium-term	Long-term
Extensive	Major	Major	Severe	Severe
Localised	Moderate	Moderate	Major	Major

C Sites

	Temporary	Short-term	Medium-term	Long-term
Extensive	Moderate	Moderate	Major	Major
Localised	Minor	Moderate	Moderate	Moderate

D Sites

	Temporary	Short-term	Medium-term	Long-term
Extensive	Minor	Minor	Moderate	Moderate
Localised	Not significant	Minor	Minor	Minor

E Sites

	Temporary	Short-term	Medium-term	Long-term
Extensive	Not significant	Not significant	Minor	Minor
Localised	Not significant	Not significant	Not significant	Not significant

Appendix 4: Fish Data

ID	Site	Species	Length (cm)	Weight (g)
1	1	BTW	12.9	14.4
2	1	BTW	15.8	56.6
3	1	BTW	12.7	28.1
4	1	BTW	18.1	31.9
5	1	BTW	14.3	45.7
6	1	BTW	23.1	143.7
7	1	BTW	12.1	28.9
8	1	BTW	14.1	41.7
9	1	BTW	8.4	8
10	1	BTW	17.6	70.3
11	1	BTW	13.9	40.3
12	1	BTW	21.5	111.8
13	1	BTW	13.8	22.8
14	1	BTW	16.8	65
15	1	BTW	19.6	90.5
16	1	BTW	13.1	31.2
17	1	BTW	12.1	29.9
18	1	BTW	12.2	29.1
19	1	BTW	13.9	37.7
20	1	BTW	11.8	27.7
21	1	BTW	15.2	57.2
22	1	BTW	15.5	54.1
23	1	BTW	10.8	21.2
24	1	BTW	12.2	29.6
25	1	BTW	11.6	24.9
26	1	BTW	16.1	54.8
27	1	BTW	7.7	13.1
28	1	BTW	19.1	94.4
29	1	BTW	12	29.5
30	1	BTW	12.1	27.4
31	1	BTW	14.1	33.2
32	1	BTW	14.3	40.8
33	1	BTW	14.7	43.5
34	1	ELE	33.1	73.7
35	1	BTW	15.3	49.7
36	1	BTW	11.1	23.2
37	1	BTW	11.7	26.3
38	1	BTW	12.6	30.8
39	1	ELE	35.9	84.5
40	1	BTW	14.1	39.7
41	1	BTW	19.1	87.4

ID	Site	Species	Length (cm)	Weight (g)
42	1	BTW	14.7	46.7
43	1	BTW	11	22.9
44	1	BTW	13.3	24.9
45	1	BTW	11.6	24.2
46	1	BTW	36	101.6
47	1	BTW	11.9	26.6
48	1	SAL	14.8	44.9
49	1	BTW	12.2	28.4
50	1	BTW	14.1	40.3
51	1	BTW	7.9	12
52	1	BTW	7.8	13.1
53	1	BTW	12.7	29.5
54	1	BTW	7.8	12.1
55	1	BTW	12.7	29.8
56	1	ELE	34	63.3
57	1	FTL	11.7	23.3
58	1	BTW	7.2	11.5
59	1	ELE	30.5	49.2
60	1	BTW	5.9	10.5
61	1	ELE	24.7	25.7
62	1	BTW	7	10.5
63	1	BTW	8.5	11.6
64	1	ELE	21.8	18.7
65	1	BTW	5	6.2
66	1	BTW	7	7
67	1	BTW	7.2	6.3
68	1	BTW	7.8	3
69	1	BTW	6.1	2.8
70	1	BTW	6.7	2.5
71	1	TSS	5	1.1
72	1	FTL	7.3	6.1
73	1	BTW	5	3.1
74	2	BTW	16.9	67.2
75	2	BTW	15.6	53.8
76	2	BTW	14.7	47.2
77	2	BTW	15.2	47.7
78	2	BTW	13.1	26.5
79	2	BTW	12.1	27.6
80	2	BTW	15.5	57
81	2	BTW	13	28.3
82	2	BTW	12.7	33.3
83	2	BTW	7.4	11.3
84	2	BTW	12	29.2

ID	Site	Species	Length (cm)	Weight (g)
85	2	BTW	15.1	46.3
86	2	BTW	14.1	43.9
87	2	BTW	16	55.7
88	2	BTW	12.9	31.6
89	2	BTW	14.3	28
90	2	BTW	7.5	9.1
91	2	BTW	9.2	28.7
92	2	BTW	15	48.1
93	2	BTW	7.7	12.9
94	2	BTW	13.7	37.1
95	2	BTW	13.6	36.9
96	2	BTW	8.4	14.1
97	2	BTW	8.7	11.8
98	2	BTW	7.2	11.4
99	2	BTW	8.1	13.4
100	2	FTL	7.1	4.1
101	2	TSS	4.5	1.6
102	2	BTW	7.7	12.1
103	2	BTW	6.7	9.6
104	2	BTW	7.3	10.5
105	2	BTW	7.2	9.7
106	2	BTW	7	8.1
107	2	BTW	7.7	11.3
108	2	ELE	13	6.7
109	2	TSS	5.5	5.5
110	2	ELE	33	67.6
111	2	TSS	5.5	5.5
112	3	BTW	5.9	0.7
113	3	BTW	13.4	31.3
114	3	BTW	8	12.3
115	3	BTW	14.2	40.1
116	3	BTW	15.6	23.4
117	3	BTW	7.7	14.2
118	3	BTW	13.2	26.5
119	3	BTW	15.2	48.5
120	3	BTW	12.3	31.1
121	3	BTW	15.9	54.6
122	3	BTW	13.8	29.9
123	3	BTW	7.2	8.2
124	3	BTW	12.1	10.9
125	3	BTW	15.8	56.1
126	3	SAL	7.9	12.4
127	3	BTW	13.3	33.2

ID	Site	Species	Length (cm)	Weight (g)
128	3	BTW	20.5	99.1
129	3	BTW	19.5	102.3
130	3	BTW	14.4	42.8
131	3	BTW	16.1	63.7
132	3	BTW	13.6	34.4
133	3	BTW	15.2	52.8
134	3	BTW	15.9	54.8
135	3	BTW	8.4	13.1
136	3	BTW	14.1	39.7
137	3	BTW	17.8	73.4
138	3	BTW	13.9	40.5
139	3	BTW	16.4	56.6
140	3	BTW	16.1	56.7
141	3	BTW	11.9	28.5
142	3	BTW	16.9	72.4
143	3	BTW	13.6	38
144	3	BTW	17.5	75
145	3	BTW	18.7	87.5
146	3	BTW	12.5	31.1
147	3	BTW	13.3	37
148	3	BTW	14.6	45.2
149	3	BTW	13.2	35.8
150	3	BTW	17.6	68.5
151	3	BTW	20.9	90.8
152	3	BTW	14.2	40.6
153	3	BTW	12.9	34.4
154	3	BTW	14	43.7
155	3	BTW	16.2	60.9
156	3	BTW	16.9	60.5
157	3	BTW	16.5	63.6
158	3	BTW	19.5	89.8
159	3	BTW	15.1	49.1
160	3	BTW	18.1	75.3
161	3	BTW	13.5	39.9
162	3	BTW	15.3	55.8
163	3	BTW	11.8	28.3
164	3	BTW	21	80
165	3	BTW	13.4	40.6
166	3	BTW	13.4	42.8
167	3	BTW	13.8	39.7
168	3	BTW	11	25.7
169	3	BTW	12.8	37.5
170	3	BTW	12.5	32.7

ID	Site	Species	Length (cm)	Weight (g)
171	3	BTW	14.8	26.4
172	3	BTW	12.8	24.7
173	3	BTW	20.5	13.3
174	3	BTW	13.2	28.4
175	3	BTW	12.1	19.8
176	3	BTW	7.8	5.7
177	3	BTW	20.4	102.8
178	3	BTW	13.5	32.3
179	3	BTW	7.9	5.5
180	3	BTW	16.1	45.9
181	3	BTW	13.5	28.6
182	3	SAL	14	32.9
183	3	BTW	11.8	18.9
184	3	BTW	16.2	46.7
185	3	BTW	13.8	28.7
186	3	ELE	29.8	39.8
187	3	BTW	16	52.3
188	3	BTW	7.6	4.8
189	3	BTW	7.9	4.9
190	3	BTW	12.1	193.4
191	3	BTW	14.3	33.4
192	3	BTW	12	19.5
193	3	BTW	12.9	24.9
194	3	BTW	14.7	38.2
195	3	BTW	7	4.2
196	3	BTW	16.1	53.1
197	3	BTW	17.4	59.6
198	3	BTW	35.6	31.1
199	3	BTW	6.3	13.2
200	3	BTW	13.2	30.1
201	3	BTW	17.8	63.9
202	3	BTW	15.8	44.8
203	3	BTW	7.8	6.3
204	3	ELE	45	100.2
205	3	ELE	42.1	163.7
206	3	BTW	13.6	41.7
207	3	BTW	13.2	27.2
208	3	BTW	15.6	33.8
209	3	BTW	13.7	33.3
210	3	BTW	15	39.1
211	3	ELE	34.5	29
212	3	ELE	29.5	23.9
213	3	BTW	8.6	5.4

ID	Site	Species	Length (cm)	Weight (g)
214	3	ELE	5.4	0.7
215	3	ELE	12.4	3.7
216	3	BTW	7.8	3.5
217	3	BTW	13.7	28.9
218	3	BTW	7.9	3.1
219	3	BTW	7.8	0.3
220	3	BTW	7	2.6
221	3	BTW	14.2	29.3
222	3	BTW	6.5	0.5
223	3	BTW	6.1	0.7
224	3	BTW	6.5	1.5
225	3	BTW	8.3	6.9
226	3	ELE	11.2	3.4
227	3	BTW	11.3	3.5
228	3	BTW	9	3.1
229	3	BTW	10.3	3.2
230	3	BTW	11.1	3.5
231	3	BTW	6.9	7.4
232	3	BTW	6.8	8.8
233	3	BTW	6.6	8.1
234	3	ELE	9.2	4.4
235	4	BTW	25.1	200
236	4	BTW	16.2	45.8
237	4	BTW	13.4	30.4
238	4	BTW	6.9	4.3
239	4	BTW	14.1	36.9
240	4	BTW	14.7	45.5
241	4	BTW	14.7	46.4
242	4	BTW	16.8	69.9
243	4	BTW	6	8.2
244	4	BTW	8.2	60.7
245	4	BTW	8.4	60.3
246	4	BTW	15.7	37.1
247	4	BTW	19.3	103.1
248	4	BTW	14.5	43
249	4	BTW	15.9	62.2
250	4	BTW	17.8	69.9
251	4	BTW	13.5	37.2
252	4	BTW	13.7	38
253	4	BTW	19.8	99.9
254	4	BTW	15.3	45.2
255	4	BTW	16.5	59.7
256	4	BTW	21.8	136.9

ID	Site	Species	Length (cm)	Weight (g)
257	4	BTW	18.1	57.3
258	4	BTW	17	54.4
259	4	BTW	14.1	20.5
260	4	BTW	18.5	77
261	4	BTW	14.9	30
262	4	BTW	16.8	54.8
263	4	BTW	10.8	11.7
264	4	BTW	19.5	88.6
265	4	BTW	12.3	22.1
266	4	BTW	17	31.9
267	4	BTW	14	26.3
268	4	BTW	15.6	49.4
269	4	BTW	15.7	53.2
270	4	BTW	6.8	3.2
271	4	BTW	12.4	21.9
272	4	BTW	13.5	32.7
273	4	BTW	13.3	27.3
274	4	BTW	14.7	41.6
275	4	BTW	13.7	26.2
276	4	BTW	14.5	36.6
277	4	BTW	15.6	44.9
278	4	BTW	14.2	25.7
279	4	BTW	14.6	39.8
280	4	BTW	14.7	45.5
281	4	BTW	14.1	36.6
282	4	BTW	17	57.9
283	4	BTW	14.8	28.3
284	4	BTW	14.5	29.8
285	4	BTW	11.5	17.9
286	4	BTW	7.1	1.7
287	4	BTW	12.9	21.1
288	4	BTW	14.2	32.5
289	4	BTW	5.8	2
290	4	FTL	7.4	6.7
291	4	BTW	7	3.9
292	4	BTW	7.9	5.8
293	4	BTW	7.9	9.1
294	4	BTW	5.6	2.9
295	4	BTW	12.2	12.7
296	4	ELE	25.5	30
297	4	BTW	13.5	31
298	4	BTW	7.9	10.7
299	4	BTW	7.2	5.4

ID	Site	Species	Length (cm)	Weight (g)
300	4	ELE	20.9	15.6
301	4	ELE	29.5	38
302	4	ELE	28.5	41.8
303	4	BTW	7.6	5.8
304	4	ELE	19.2	11.9
305	4	ELE	18.4	7
306	4	ELE	28.8	25.7
307	4	ELE	22.8	15.2
308	4	ELE	9.8	1.7
309	4	ELE	30.5	40.6
310	4	ELE	21.8	19.8
311	4	ELE	19.2	14.1
312	4	ELE	18	29.8
313	4	ELE	19.2	11.3
314	4	ELE	8	1
315	4	BTW	7.2	4.2
316	4	ELE	15.1	6.9
317	4	ELE	10.9	3.6
318	4	ELE	12.4	2.6
319	4	TSS	5.3	2.3
320	4	ELE	24.3	16
321	4	ELE	26	19.2
322	4	ELE	19.8	12.3
323	4	BTW	6.5	3.8
324	4	FTL	7	2.4
325	4	BTW	6.7	3.6
326	4	BTW	6.2	2.2
327	4	ELE	8.3	2

BTW= Brown trout (non-stocked)

ELE = European Eel

SAL = Salmon

FTL = Stone loach

TSS = Three spined stickleback

Appendix 9B - Bat Survey

A.1 Date: 20 August 2014

Personnel: Kieran Sheehan & Declan Egan

Location Ref	Location Description	Species	Activity	Approximate time	Surveyor
20	Field near Hedge	45 Pip (x1)	Distant call	21:40	KS
		45 Pip (x1)	Distant call	21:43	KS
19	Field near Bridge	?	?	21:44	DE
20	Field near Hedge	45 Pip (x1)	Commuting	21:45	KS
		45 Pip (x1)	Seen through trees	21:47	KS
		45 Pip (x1)	Not seen	21:48	KS
		45 Pip (x1)	Heard but not seen	21:49	KS
19	Field near Bridge	?	?	21:55	DE
		55 Pip (x1)	Foraging	21:59	DE
		55 Pip (x1)	Foraging	22:01	DE
		55 Pip (x1)	Foraging (continuous to 22:26)	22:02	DE
20	Field near Hedge	55 Pip (x1)	Foraging	22:02	KS
		55 Pip (x1)	Distant call	22:05	KS
		55 Pip (x1)	Foraging	22:06	
19	Field near Bridge	55 Pip (x1)	Commuting	22:07	DE
		55 Pip (x1)	Foraging (continuous)	22:08	DE
20	Field near Hedge	55 Pip (x1)	Foraging	22:08	KS
19	Field near Bridge	55 Pip (x1)	Foraging (continuous)	22:09	DE
		55 Pip (x1)	Foraging (continuous to 22:24)	22:10	DE
20	Field near Hedge	55 Pip (x1)	Foraging	22:10	KS
		55 Pip (x1)	Foraging	22:12	KS
		55 Pip (x1)	Constant distant activity	22:13	KS
		55 Pip (x1)	Two close passes	22:20	KS
		55 Pip (x1)	Three close passes	22:24	KS
		55 Pip (x1)	Close pass	22:27	KS
19	Field near Bridge	55 Pip (x1)	Commuting	22:29	DE
		55 Pip (x1)	Commuting	22:30	DE
20	Field near Hedge	55 Pip (x2)	Foraging	22:31	KS
		45 Pip (x1)	Foraging	22:33	KS
		55 Pip (x1)	Foraging	22:33	KS
		55 Pip (x1)	Foraging	22:36	KS
19	Field near Bridge	55 Pip (x1)	Commuting	22:38	DE
20	Field near Hedge	45 Pip (x1)	Foraging	22:38	KS
19	Field near Bridge	55 Pip (x1)	Foraging	22:39	DE
		55 Pip (x1)	Foraging (continuous to 22:54)	22:40	DE
20	Field near Hedge	45 Pip (x1)	Foraging	22:51	KS

A.2 Date: 21-22 August 2014



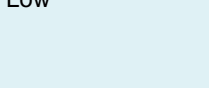
Personnel: Kieran Sheehan & Declan Egan








Location Ref	Location Description	Species	Activity	Approximate time	Surveyor
1	Fack's Bridge (Convent Road)	45 Pip (x1)	Distant foraging	21:31	KS
		45 Pip (x1)	Foraging	22:05	KS
2	Clarke Street Bridge	NO RECORD		21:10	DE
3	Seymour Street Bridge	NO RECORD		22:15	KS
4	Rossa Street Bridge	45 Pip (x1)	Foraging	22:05	DE
		45 Pip (x1)	Foraging	22:08	DE
		45 Pip (>1)	Foraging	22:30	KS
		55 Pip (>1)	Foraging	22:40	KS
5	Car Park near Library	45 & 55 Pip	Foraging at light	22:13	DE
		45 & 55 Pip	Foraging over river	22:20	DE
		45 Pip (x2)	Foraging	22:50	KS
		55 Pip (x1)	Foraging	23:00	KS
6	Footbridge at Library	55 Pip (2-3)	Foraging	23:10	KS
7	Credit Union	45 Pip (x1)	Foraging in trees and around lights	22:43	DE
		55 Pip (x1)	Foraging on road beside river	22:48	DE
8	Bridge Street	45 Pip (x1)	Foraging	22:50	DE
		45 Pip (x1)	Foraging over river	23:00	DE
		45 Pip (x1)	Foraging along west side of bridge	23:13	DE
10	Old Brewery (adjacent footbridge)	55 Pip (x1)	Foraging downstream	23:20	KS
		Myotis. Spp (x1)	Distant call	23:22	KS
		45 Pip (x1)	Foraging	23:25	KS
10	Adjacent large Georgian and timber-framed building (seen from above location)	45 Pip (x1)	Occasional foraging	23:25	KS
10	Woodbrook Car Park (NE)	45 Pip (x1)	Recorded along brook behind houses	23:35	KS
11	Woodbrook Car Park (SW)	55 Pip (x1)	Foraging (possibly not over river)	23:20	DE
13	Tobin's Bridge (N Side)	55 pip and 25 pip (x7-8 on	Constant foraging over river 55 Pip larger numbers.	23.45 continuous....	DE








		occasions)	Artificial light.		
12	Tobin's Bridge (S Side)	NO RECORD		00:00	KS
14	Fernhill Bridge	55 Pip (x1)	Occasional foraging and observed flying upstream and around an Ash tree.	00:10	KS
16	Dunnes Stores Bridge (E)	55 Pip (x1)	Distant foraging activity (heard not seen)	00:30	KS
17	Dunnes Stores Bridge (W)	NO RECORD		00:45	KS
15	Wooden footbridge downstream of Dunnes Stores	55 Pip (x1)	Distant foraging activity.	01.03	KS









A.3 Trees and Structures






Surveyors: Kieran Sheehan and Declan Egan







Number	Species	Features	Notes	Roost Potential
1	Group: Oak, Ash, Sycamore, Horse Chestnut	Cracks Split Loose Bark Ivy Cover	Large group of trees along Right bank of Fealge. Typically up to 150 years old and ivy covered.	High 
2	Ash	Loose bark Ivy Cover	One trimmed Ash within Group 1 that has additional potential.	High 
3	Hawthorn Group	None	Three multi-stemmed overgrown hedge plants.	None 
4	Sycamore	Ivy Cover	One 50 year old tree with ivy cover on lower trunk	Low 
5	Group : 4 Hawthorn 1 Alder)	Ivy Cover	Small multi-stemmed Hawthorn, One sickly Alder with thick Ivy growth.	Low 
6	Ash	Ivy Cover	Multi-stemmed Ash tree with ivy cover on lower trunk.	Low 
7	Group: 4 Alder 1 Grey Sallow (bush)	Ivy Cover Loose bark	Group of open-canopied Alder trees with ivy- covered trunks.	Low 







				
8	Ash	Ivy Cover	Sub-mature Ash with sparse ivy cover on lower 3m of stem.	None 
9	Alder	Ivy Cover	Multi-stemmed tree with trimmed branches and broken through stem in one location.	None 
10	Alder group	Ivy Cover	Ivy over is thick on one of the main stems. Smaller branches have been trimmed. Not clear if this is a single tree or not.	Low 
11	Alder group	Ivy Cover	Two multi-stemmed trees that has now been trimmed on some branches. Generally in good health.	Low 
12	Alder group	Ivy Cover	Two multi-stemmed trees, the westernmost of which has extensive Ivy cover.	Low 
13	Alder group	Ivy Cover	Group of two or three ivy-clad trees on some of which the Ivy seems dead.	Low 
14	Group: 1 Hawthorn 8 Alder 3 Ash	Ivy Cover	Tall Ash trees with Alder either side (Multi-stemmed) and tall Hawthorn at the eastern end. Some trimming of small branches.	Low
15	Ash	None	Sub-mature Ash, sabre-ing over the river.	None








				
16	Group: Alder, Hawthorne, Sycamore, Holly	Ivy Cover	Multi-stemmed, large stooped Alder with Ivy cover and a couple of intertwining Hawthorn. Sycamore at the We end is very large.	None 
17	Group: 2 Sycamore 1 Grey Sallow	Ivy Cover	Two mature Sycamores in healthy condition with a large Grey Sallow at the eastern side.	Low
18	Group: 2 Ash 1 Alder	Ivy Cover	Three sub-mature trees – the Alder has lost its leader and the westernmost Ash looks sickly.	None 
19	Group: Ash, Alder	Ivy Cover	One mature Ash and a multi-stemmed Alder with some scattered Hawthorn beneath. Some branch trimming.	Low 
20	Group: 1 Sycamore 2 Alder	Ivy Cover	One sub-mature Sycamore with two main stems and scattered Hawthorn bushes. Some trimming of lower branches.	None 
21	Sycamore	Ivy Cover	Sub-mature Sycamore with associated Hawthorn and sparse Ivy covering the lower part of the stem and in clumps.	None 
(1)	Group: 1 Sycamore 10 Ash 1 Alder	Ivy Cover	Group of sub-mature mainly multi-stemmed Ash trees up to 30m in height. All sitting on top of a wall.	Low 
(2)	Group: Sitka Spruce	None	Dense plantation.	None







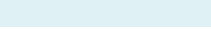
				
(3)	Alder	None	Ancient coppice stool.	None 
(4)	Ash	Ivy Cover	Large, mature, healthy tree with a few dead, small branches.	Low 
(5)	Group: Alder	Ivy Cover	Group of two Alder trees that are not in the best of health.	Low 
(6)	Wych Elm	None	Group of 20m tall Wych Elm trees that are suffering from Dutch Elm Disease	Low 
(7)	Group: 2 Ash 1 Wych Elm 1 Alder	Ivy Cover	Group of closely grown trees with very dense Ivy cover.	Low 
(8)	Alder	Loose Bark Ivy Cover	Multi-stemmed tree that is not in the best of health. Heavily covered with Ivy.	Low 
(9)	Alder	Ivy Cover	Mature multi-stemmed Alder with a few trimmed branches	Low 







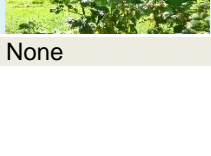
				
(10)	Group: 6 Alder 2 Sycamore	Split Woodpecker Hole Rot Hole Ivy Cover	Group of mature trees that have had some work on them that has caused some damage: the largest Alder tree in particular.	Medium 
(11)	Group: Hawthorn Holly 5 Alder	Cracks Woodpeckers Holes Rot Holes Loose Bark Ivy Cover	Westernmost Alder and Easternmost Alder have most of these features.	Medium 
(12)	Alder	Ivy Cover	Solitary young multi-stemmed Alder with some trimmed branches.	Low 
(13)	Group: 2 Alder 2 Hawthorn 1 Field Maple 1 Holly	Woodpecker Hole Rot Hole Ivy Cover	Two large multi-stemmed Alder trees with an overgrown Alder hedge. The N Alder is the best but there are trees beneath (sub-canopy) these.	Medium 
(14)	Group: 4 Alder	Cracks Split Woodpecker Holes Rot Hole Ivy Cover	Mature Alder trees with a good growth of Ivy on field boundary.	Medium 
(15)	Ash	Split Ivy Cover	Mature Ash tree with a single stem and a well developed crown.	None 
(16)	Group: 1 Alder 1 Alder (dead) 1 Ash	Rot Hole Ivy Cover	Two mature trees and one dead tree.	Low

				
(17)	Ash	Rot Hole Ivy Cover	Twin stems for older stool. The stems are about 100 years old with ivy and evidence of past management.	Low 
(18)	Group: 2 Ash	Split Ivy Cover	Two spindly Ashes that are mature and about 100 years old. There are a few features including a split and rot hole.	Low 
(19)	Ash	Split Rot Hole Ivy Cover	Ash pollard up to 300 years old with detaching ivy, a few splits and small holes.	Low 
(20)	English Elm	Ivy Cover	Two stems from suckers, A healthy tree with a branching crown just reaching the mature phase. Ivy cover lower down on trunks.	Low 
(21)	Sycamore	Ivy Cover	Mature tree constrained by the canopies of other trees.	None 
(22)	Group of English Elm suckers	Ivy Cover	Suckers forming tall trees (30m) along a hedge line. All in pretty good health but a few of the branches higher up show evidence of Dutch Elm Disease.	None

				
(23)	English Elm clone	Ivy Cover	Six stems that are mature and in good health.	None 
(24)	Hawthorn	Ivy Cover	Multi-stemmed tree to 10m with Ivy cover on lower 3m.	None 
(25)	Ash	Rot Hole Ivy Cover	Mature and healthy with a spreading crown.	Low 
(26)	Ash	Splits Rot Hole Ivy Cover	Very large Ash from an ancient stool that has a broad canopy from re-grown poles.	Low 
(27)	Hawthorn	Ivy Cover	Hawthorn to 15m but with dense Ivy cover all the way around the trunk.	Low
(28)	Group: 1 Grey Sallow 2 Hawthorn	Ivy Cover	A Grey Sallow clonal group to 8m that are Ivy clad. The clonal group contains 2 Hawthorn bushes.	Low 
(29)	Group: 4 Hawthorn	Ivy cover	Group of four separate trees: one is mostly dead. Ivy-clad for bottom 3m.	Low

				
(30)	Group: 6 Hawthorn	Ivy Cover	Overgrown hedgerow with a few bushes reaching 10m. Ivy-clad.	None 
(31)	Alder	Ivy Cover	On the N side of the Fealge and multi-stemmed. Hedgerow on the S side and there is a good growth of lichens and mosses.	None 
(32)	Alder	Ivy Cover	Stag's-headed Alder (Phytophthora disease?) that has three main stems.	Low 
(33)	Alder	Rot Hole Loose Bark	Stag's-headed Alder on the North side of the Fealge.	Low 
(34)	Ash	Ivy Cover	Solitary Ash on North side of the Fealge. Some branches have been flailed.	None 
(35)	Beech	Ivy Cover	Sub-mature tree with no features.	None 
(36)	Alder	Ivy Cover	Very sickly looking Alder that was leafless at the time of the visit.	None






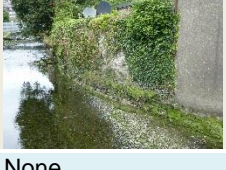



				
(37)	Hawthorn	None	Large specimen with dense canopy up to 12m in height.	None 
(38)	Ash	Slits Rot Hole Ivy Cover	Mature Ash on West side of a drain with a spreading canopy.	Low 
(39)	English Elm	None	Semi-mature tree with a branching crown on the base of a floodwall containing a small stream.	None 
(40)	English Elm	None	Sub-mature tree in healthy condition.	None 
(41)	Ash	Ivy Cover	Mature 150 year old tree with Ivy that is situated 5m behind the drain.	Low 
(42)	Sycamore	Ivy Cover	Sub-mature tree with a dense, Ivy-clad crown.	Low 






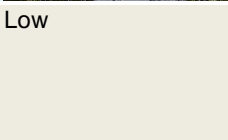
				
(43)	Ash	Ivy Cover Slits Loose Bark	Mature, multi-stemmed tree with Ash Bacterial Canker.	Low 
(44)	Ash	Ivy Covered	Mature tree with a dense crown and a small Hawthorn present in South side.	Low 
(45)	Alder	Ivy Covered	Over-mature Alder with an open crown and Ivy on the North side.	Low 
(46)	Group: 1 Sycamore 2 Wych Elm 1 Ash	Ivy Covered	Sub-mature trees between R Fealge and the main road.	Low 
(47)	Group: 2 Ash	Rot Holes Splits Ivy Covered	Two Ash trees with a suppressed Sycamore. Some trimming beside man road.	Low 
(48)	Group: 2 Sycamore 1 Ash	Ivy Covered	Sub-mature groups of trees: all multi-stemmed.	None 
(49)	Wych Elm	None	Large, healthy tree with no	None







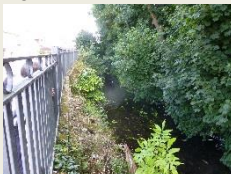
			features.	
(50)	Sycamore	None	Sub-mature Sycamore.	None 
(52)	Sycamore	Ivy Covered	Sub-mature and healthy with two main stems. Very little Ivy.	None 
(53)	Alder	Rot Holes Splits Lifting Bark	Sub-mature tree with sparse crown. Perhaps suffering from Phytophthora disease.	None 
(54)	Sycamore	None	South bank of stream. Mature Sycamore with very few features.	Low 
(55)	Sycamore	None	Sub-mature single-stemmed tree.	None 
(56)	Hawthorn	Ivy Covered	South side of Fealge. 10m tall bush.	Low

				
(57)	Alder (dead)	Rot Holes Ivy Covered	Large tree with spreading crown.	Low 
(58)	Sycamore	Ivy Covered	Mature tree on North bank of Fealge with a spreading crown.	Low 
(59)	Alder	Ivy Covered Rot Holes Woodpecker Holes	Mature tree on North bank of Fealge with a broad canopy with a large spread and heavy Ivy cover.	Medium 
(60)	Alder	Ivy Covered Lifted Bark Splits Rot Holes	Mature tree on South bank of Fealge with sparse canopy.	Low 
(61)	Group: 2 Ash 2 Sycamore	Rot Holes	Two Ash on North bank and two Sycamores on South bank. All sub-mature specimens growing very closely together on both sides of the Fealge.	None 




A.4 Structures

Number	Structure	Features	Notes	Roost Potential
A	Wall on Fealge	Cracks	Local stone walling style on tidal reach	None 
B	Culvert at Fack's Mill Roundabout	None	Concrete culvert over tidal stream	None 
C	Gabion baskets	Cracks, crevices	Gabion baskets on S side of tidal R Fealge	None 
D	Wall	Cracks, crevices	Wall covered in seaweed	None 
E	Wall	None	New wall	None 
F	Old Wall	Cracks, crevices, holes, Ivy covered	Natural rubble-built wall that looks Norman in parts. Some work has been done but covered in Ivy	None 
G	New Wall	None	New wall	None 
H	Old Wall	Cracks, crevices, holes, Ivy covered	Natural rubble-built wall that looks Norman in parts. Some work has been done but covered in Ivy	Medium 
I	Rossa Street Bridge (DS)	Cracks, Ivy cover	Ancient bridge with houses on top and low inverts.	Low 

J	Rossa Street Bridge (US)	Cracks, Ivy cover	Ancient stone road bridge with low inverts	Low 
K	Library Bridge (DS)	Cracks	Old stone bridge that has been re-pointed and reinforced	None 
L	Old Wall behind Fire Station	Cracks, crevices, holes, Ivy covered	Natural rubble-built wall that looks Norman in parts. Some work has been done but covered in Ivy	High 
M	Library Bridge (US)	Cracks	Old stone bridge that has been re-pointed and reinforced	None 
N	Walls Upstream of Credit union	Cracks, crevices and holes	Recently reconstructed stone walls on both sides of the R Fealge	Low 
O	Bridge Street Bridge (DS)	Cracks, crevices and holes	Stone arched bridge on DS side, which has been repointed.	Low 
P	Bridge Street Bridge (US)	Holes	Concrete extension to existing stone-arched bridge.	None 
Q	Walls upstream of Bridge Street	Holes	LB wall has no potential as it is new. LB wall is older but low down and subject to flooding and predators	Low 
R	Walls downstream of Brewery	Holes	LB wall has no potential as it is new. LB wall is older but low down and subject to flooding and predators	Low 

				
S	Walls at eastern end of Brewery	Cracks, crevices, holes, Ivy cover	LB wall holes some potential but is low, RB walls are higher, older and very suitable with vegetation.	Medium 
T	Walls DS of Brewery Footbridge	Cracks, crevices, holes, Ivy cover	LB wall holes some potential but is low, RB walls are higher, older and very suitable with vegetation.	High 
1	Brewery Bridge	None	Concrete beam footbridge to blocked doorway on Brewery	None 
U	Walls US of brewery Footbridge	Cracks, crevices, holes, Ivy cover	LB wall holes some potential but is low, RB walls are higher, older and very suitable with vegetation.	High 
V	Walls upstream of Brewery	Crevices and vegetation cover	Concrete block walls in good condition but marginal and climbing vegetation covering them in parts	Low 
W	Banks US of Woodbrook	Vegetation covered	Heavily vegetation covered on RB. Less so on LB which is a wall	Low 
X	Banks DS of Woodbrook	Vegetation covered	Heavily vegetation covered on RB (woodland). LB is a wall below which there is a	Low

			bank.	
Y	Walls behind Michael Collins Road DS	Vegetation covered	LB is new wall. RB is woodland with potential low wall.	Low 
Z	Walls behind Michael Collins Road US	Vegetation cover	LB is a new wall. RB is woodland with some old stone wall	None 
Aa	Walls DS Tobin's Bridge	Vegetation cover	LB is a new wall. RB is woodland with some old stone wall	None 
Ab	Walls near Tobin's Bridge	Vegetation cover	RB is a low old wall but subject to flooding, predators	None 
(61)	Tobin's Bridge	Cracks	4 Arches. Pointed but washed-out at the lower part of the piers.	Low 
Ac	Wall US Tobin's Bridge	Cracks, holes, vegetation cover	Wall is old but in places it is plastered and pointed and in other has vegetation cover.	Low 
(51)	Bridge	Cracks	Twin stone arches with low invert	Low
Ad	Footbridge	None	New wooden footbridge	None

				
(6)	Bridge at Dunnes Stores	None	Modern, concrete-lined bridge.	None 
(1)	Small, asbestos shed	Ivy over	Broken sheeting on the sides and fire damage.	None 

Appendix 9C - Clonakilty Bay SAC (000091) and SPA (004081) Conservation Objectives

National Parks and Wildlife Service

Conservation Objectives Series

Clonakilty Bay SAC 000091



*An Roinn
Ealaíon, Oidhreachta agus Gaeltachta*

*Department of
Arts, Heritage and the Gaeltacht*



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Introduction

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

A site-specific conservation objective aims to define favourable conservation condition for a particular habitat or species at that site.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:

- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Notes/Guidelines:

1. The targets given in these conservation objectives are based on best available information at the time of writing. As more information becomes available, targets for attributes may change. These will be updated periodically, as necessary.
2. An appropriate assessment based on these conservation objectives will remain valid even if the targets are subsequently updated, providing they were the most recent objectives available when the assessment was carried out. It is essential that the date and version are included when objectives are cited.
3. Assessments cannot consider an attribute in isolation from the others listed for that habitat or species, or for other habitats and species listed for that site. A plan or project with an apparently small impact on one attribute may have a significant impact on another.
4. Please note that the maps included in this document do not necessarily show the entire extent of the habitats and species for which the site is listed. This should be borne in mind when appropriate assessments are being carried out.
5. When using these objectives, it is essential that the relevant backing/supporting documents are consulted, particularly where instructed in the targets or notes for a particular attribute.

Qualifying Interests

** indicates a priority habitat under the Habitats Directive*

000091	Clonakilty Bay SAC
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1140	Mudflats and sandflats not covered by seawater at low tide
1210	Annual vegetation of drift lines
2110	Embryonic shifting dunes
2120	Shifting dunes along the shoreline with <i>Ammophila arenaria</i> (white dunes)
2130	Fixed coastal dunes with herbaceous vegetation (grey dunes)*
2150	Atlantic decalcified fixed dunes (<i>Calluno-Ulicetea</i>)*

Please note that this SAC overlaps with Clonakilty Bay SPA (004081). See map 2. The conservation objectives for this site should be used in conjunction with those for the overlapping site as appropriate.

Supporting documents, relevant reports & publications

Supporting documents, NPWS reports and publications are available for download from: www.npws.ie/Publications

NPWS Documents

Year :	2009
Title :	Coastal Monitoring Project 2004-2006
Author :	Ryle, T.; Murray, A.; Connolly, K.; Swann, M.
Series :	Unpublished report to NPWS
Year :	2013
Title :	Monitoring survey of Annex I sand dune habitats in Ireland
Author :	Delaney, A.; Devaney, F.M.; Martin, J.R.; Barron, S.J.
Series :	Irish Wildlife Manual No. 75
Year :	2014
Title :	Clonakilty Bay SAC (site code: 091) Conservation objectives supporting document- coastal habitats V1
Author :	NPWS
Series :	Conservation objectives supporting document
Year :	2014
Title :	Clonakilty Bay SAC (site code: 091) Conservation objectives supporting document- marine habitats V1
Author :	NPWS
Series :	Conservation objectives supporting document

Other References

Year :	2008
Title :	The phytosociology and conservation value of Irish sand dunes
Author :	Gaynor, K.
Series :	Unpublished PhD thesis, National University of Ireland, Dublin
Year :	2012
Title :	Intertidal benthic survey of Clonakilty Bay SAC and Clonakilty Bay SPA
Author :	MERC
Series :	Unpublished report to the Marine Institute and NPWS

Spatial data sources

Year :	Interpolated 2014
Title :	Intertidal benthic survey 2011
GIS Operations :	Polygon feature classes from marine community types base data sub-divided based on interpolation of marine survey data. Expert opinion used as necessary to resolve any issues arising
Used For :	1140, marine community types (maps 3 and 4)
Year :	2005
Title :	OSi Discovery series vector data
GIS Operations :	High water mark (HWM) and low water mark (LWM) polyline feature classes converted into polygon feature classes and combined; EU Annex I Saltmarsh and Coastal data erased out if present
Used For :	Marine community types base data (map 4)
Year :	2013
Title :	Sand Dune Monitoring Project 2011. Version 1
GIS Operations :	QIs selected; clipped to SAC boundary; overlapping regions with Saltmarsh CO data investigated and resolved with expert opinion used
Used For :	2110, 2120, 2130 (map 5)

Conservation Objectives for : Clonakilty Bay SAC [000091]

1140 Mudflats and sandflats not covered by seawater at low tide

To maintain the favourable conservation condition of Mudflats and sandflats not covered by seawater at low tide in Clonakilty Bay SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	The permanent habitat area is stable or increasing, subject to natural processes. See map 3	Habitat area was estimated using OSi data as 313ha
Community distribution	Hectares	Conserve the following community type in a natural condition: Sand to sandy mud with <i>Tubificoides benedii</i> and <i>Peringia ulvae</i> community complex. See map 4	Based on an intertidal survey undertaken in 2011 (MERC, 2012). See marine supporting document for further information

Conservation Objectives for : Clonakilty Bay SAC [000091]

1210 Annual vegetation of drift lines

To maintain the favourable conservation condition of Annual vegetation of drift lines in Clonakilty Bay SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession	Based on data from the Coastal Monitoring Project (CMP) (Ryle et al. 2009) and Sand Dunes Monitoring Project (SDM) (Delaney et al., 2013). The habitat is very difficult to measure in view of its dynamic nature which means that it can appear and disappear within a site from year to year. CMP mapped an area of 0.25ha but it was not recorded by SDM reflecting the dynamic nature of this habitat. NB further unsurveyed areas maybe present within the site. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, or change in habitat distribution, subject to natural processes	Based on data from Ryle et al. (2009) and Delaney et al. (2013). As stated above, the habitat was not recorded during the SDM (Delaney et al., 2013). See coastal habitats supporting document for further details
Physical structure: functionality and sediment supply	Presence/ absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions	Dunes are naturally dynamic systems that require continuous supply and circulation of sand. Accumulation of organic matter in tidal litter is essential for trapping sand and initiating dune formation. Physical barriers can lead to fossilisation or over-stabilisation of dunes, as well as beach starvation resulting in increased rates of erosion. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from Ryle et al. (2009) and Delaney et al. (2013). Sand dunes at Inchydoney are part of a coastal complex that includes estuarine and intertidal habitats as well as inland marshes. See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative number of monitoring stops	Maintain the presence of species-poor communities with typical species: sea rocket (<i>Cakile maritima</i>), sea sandwort (<i>Honckenya peploides</i>), prickly saltwort (<i>Salsola kali</i>) and orache (<i>Atriplex</i> spp.)	Based on data from Ryle et al. (2009). See coastal habitats supporting document for further details
Vegetation composition: negative indicator species	Percentage cover	Negative indicator species (including non-natives) to represent less than 5% cover	Negative indicators include non-native species, species indicative of changes in nutrient status and species not considered characteristic of the habitat. See coastal habitats supporting document for further details

Conservation Objectives for : Clonakilty Bay SAC [000091]

2110 Embryonic shifting dunes

To maintain the favourable conservation condition of Embryonic shifting dunes in Clonakilty Bay SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: Inchydoney - 1.62ha. See map 5	Based on data from the Sand Dunes Monitoring Project (SDM) (Delaney et al., 2013). Habitat mapped at one sub-site to give a total estimated area of 1.62ha. Habitat is very difficult to measure in view of its dynamic nature. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 5 for known distribution	Based on data from Delaney et al. (2013). See coastal habitats supporting document for further details
Physical structure: functionality and sediment supply	Presence/absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions	Dunes are naturally dynamic systems that require continuous supply and circulation of sand. Physical barriers can lead to fossilisation or over-stabilisation of dunes, as well as beach starvation resulting in increased rates of erosion. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from Gaynor (2008), Ryle et al. (2009) and Delaney et al. (2013). The sand dunes at Inchydoney are part of a coastal complex that includes estuarine and intertidal habitats as well as inland marshes. See coastal habitats supporting document for further details
Vegetation composition: plant health of foredune grasses	Percentage cover	More than 95% of sand couch grass (<i>Elytrigia juncea</i>) and/or lyme grass (<i>Leymus arenarius</i>) should be healthy (i.e. green plant parts above ground and flowering heads present)	Based on data from Delaney et al. (2013). See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative number of monitoring stops	Maintain the presence of species-poor communities with typical species: sand couch grass (<i>Elytrigia juncea</i>) and/or lyme grass (<i>Leymus arenarius</i>)	Based on data from Delaney et al. (2013). All dune habitats at Inchydoney support a typical flora. See coastal habitats supporting document for further details
Vegetation composition: negative indicator species	Percentage cover	Negative indicator species (including non-native species) to represent less than 5% cover	Based on data from Delaney et al. (2013). Negative indicators include non-native species, species indicative of changes in nutrient status and species not considered characteristic of the habitat. Sea-buckthorn (<i>Hippophae rhamnoides</i>) should be absent or effectively controlled. Encroachment by bracken (<i>Pteridium aquilinum</i>) is considered a major problem at this site (Delaney et al., 2013). See coastal habitats supporting document for further details

Conservation Objectives for : Clonakilty Bay SAC [000091]

2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)

To maintain the favourable conservation condition of Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes') in Clonakilty Bay SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes including erosion and succession. For sub-site mapped: Inchydoney - 0.72ha. See map 5	Based on data from the Sand Dunes Monitoring Project (SDM) (Delaney et al., 2013). Habitat mapped at one sub-site to give a total estimated area of 0.72ha. Habitat is very difficult to measure in view of its dynamic nature. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, or change in habitat distribution, subject to natural processes. See map 5 for known distribution	Based on data from Delaney et al. (2013). See coastal habitats supporting document for further details
Physical structure: functionality and sediment supply	Presence/ absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions	Dunes are naturally dynamic systems that require continuous supply and circulation of sand. Marram grass (<i>Ammophila arenaria</i>) reproduces vegetatively and requires constant accretion of fresh sand to maintain active growth encouraging further accretion. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from Gaynor (2008), Ryle et al. (2009) and Delaney et al. (2013). See coastal habitats supporting document for further details
Vegetation composition: plant health of dune grasses	Percentage cover	95% of marram grass (<i>Ammophila arenaria</i>) and/or lyme-grass (<i>Leymus arenarius</i>) should be healthy (i.e. green plant parts above ground and flowering heads present)	Based on data from Delaney et al. (2013). See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative number of monitoring stops	Maintain the presence of species-poor communities dominated by marram grass (<i>Ammophila arenaria</i>) and/or lyme-grass (<i>Leymus arenarius</i>)	Based on data from Delaney et al. (2013). See coastal habitats supporting document for further details
Vegetation composition: negative indicator species	Percentage cover	Negative indicator species (including non-natives) to represent less than 5% cover	Based on data from Delaney et al. (2013). Negative indicators include non-native species; species indicative of changes in nutrient status and species not considered characteristic of the habitat. Sea-buckthorn (<i>Hippophae rhamnoides</i>) should be absent or effectively controlled. Encroachment by bracken (<i>Pteridium aquilinum</i>) is considered a major problem at this site (Delaney et al., 2013). See coastal habitats supporting document for further details

Conservation Objectives for : Clonakilty Bay SAC [000091]

2130 Fixed coastal dunes with herbaceous vegetation (grey dunes)

To restore the favourable conservation condition of Fixed coastal dunes with herbaceous vegetation ('grey dunes') in Clonakilty Bay SAC, which is defined by the following list of attributes and targets:

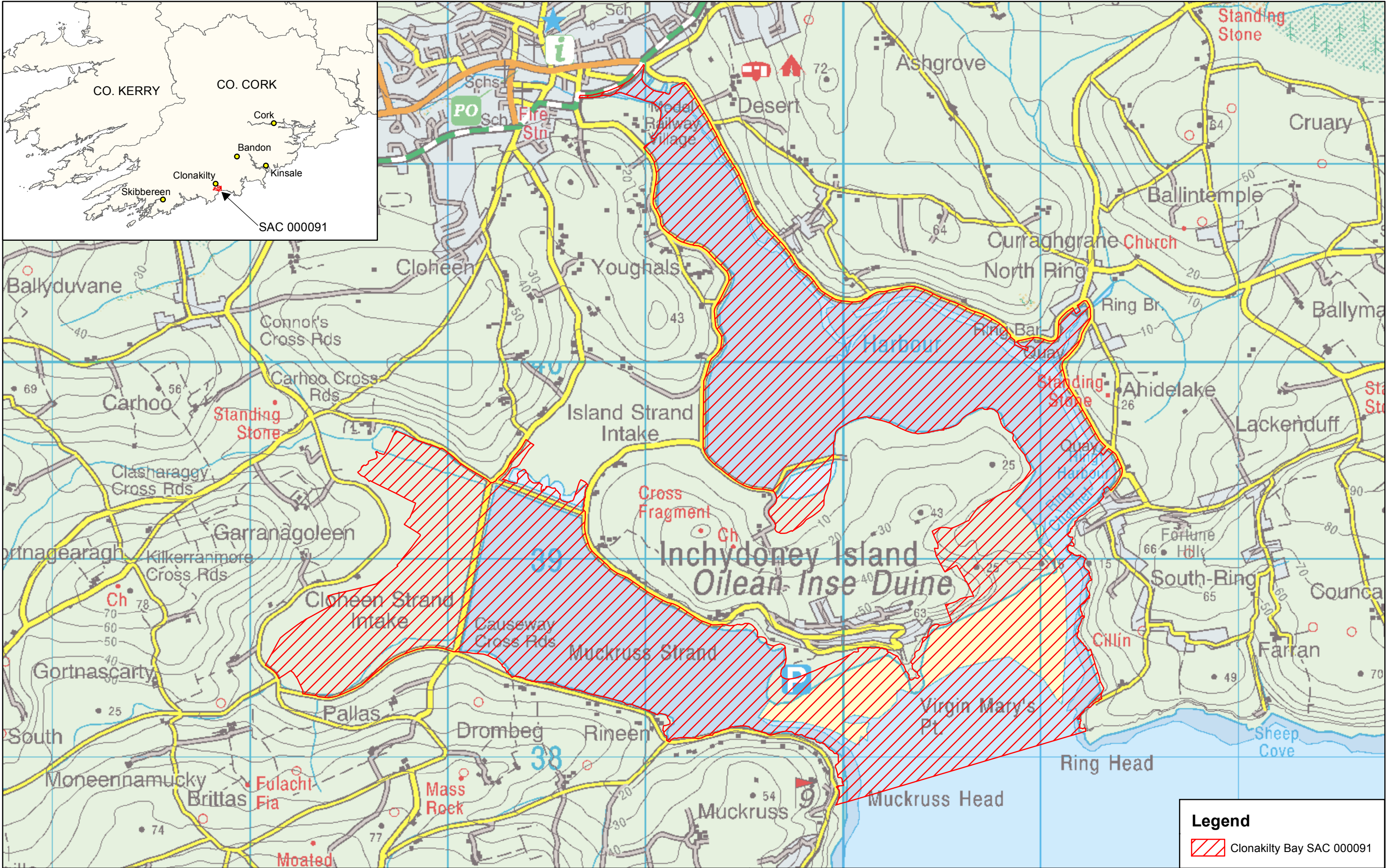
Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes including erosion and succession. For sub-site mapped: Inchydoney - 16.30ha. See map 5	Based on data from the Sand Dunes Monitoring Project (SDM) (Delaney et al., 2013). Habitat mapped at one sub-site to give a total estimated area of 16.30ha. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, or change in habitat distribution, subject to natural processes. See map 5 for known distribution	Based on data from Delaney et al. (2013). The total sand dune area at Inchydoney is almost entirely accounted for by fixed dunes. See coastal habitats supporting document for further details
Physical structure: functionality and sediment supply	Presence/ absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions	Physical barriers can lead to fossilisation or over-stabilisation of dunes, as well as beach starvation resulting in increased rates of erosion. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from Gaynor (2008), Ryle et al. (2009) and Delaney et al. (2013). The sand dunes at Inchydoney are part of a coastal complex that includes estuarine and intertidal habitats as well as inland marshes. See coastal habitats supporting document for further details
Vegetation structure: bare ground	Percentage cover	Bare ground should not exceed 10% of fixed dune habitat, subject to natural processes	Based on data from Gaynor (2008), Ryle et al. (2009) and Delaney et al. (2013). There are several large tracks and blowouts in the fixed dunes at Inchydoney. See coastal habitats supporting document for further details
Vegetation structure: sward height	Centimetres	Maintain structural variation within sward	Based on data from Gaynor (2008), Ryle et al. (2009) and Delaney et al. (2013). See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative number of monitoring stops	Maintain range of sub-communities with typical species listed in Delaney et al. (2013)	Based on data from Delaney et al. (2013). All dune habitats at Inchydoney support a typical flora. See coastal habitats supporting document for further details
Vegetation composition: negative indicator species	Percentage cover	Negative indicator species (including non-natives) to represent less than 5% cover	Based on data from Delaney et al. (2013). Negative indicators include non-native species, species indicative of changes in nutrient status and species not considered characteristic of the habitat. Sea-buckthorn (<i>Hippophae rhamnoides</i>) should be absent or effectively controlled. Encroachment by bracken (<i>Pteridium aquilinum</i>) is considered a major problem at this site (Delaney et al., 2013). See coastal habitats supporting document for further details
Vegetation composition: scrub/trees	Percentage cover	No more than 5% cover or under control	Burnet rose (<i>Rosa pimpinellifolia</i>) was recorded in the fixed dune habitat at Inchydoney. Several shrub-sized trees were also recorded including sycamore (<i>Acer pseudoplatanus</i>), ash (<i>Fraxinus excelsior</i>) and hawthorn (<i>Crataegus monogyna</i>). See coastal habitats supporting document for further details

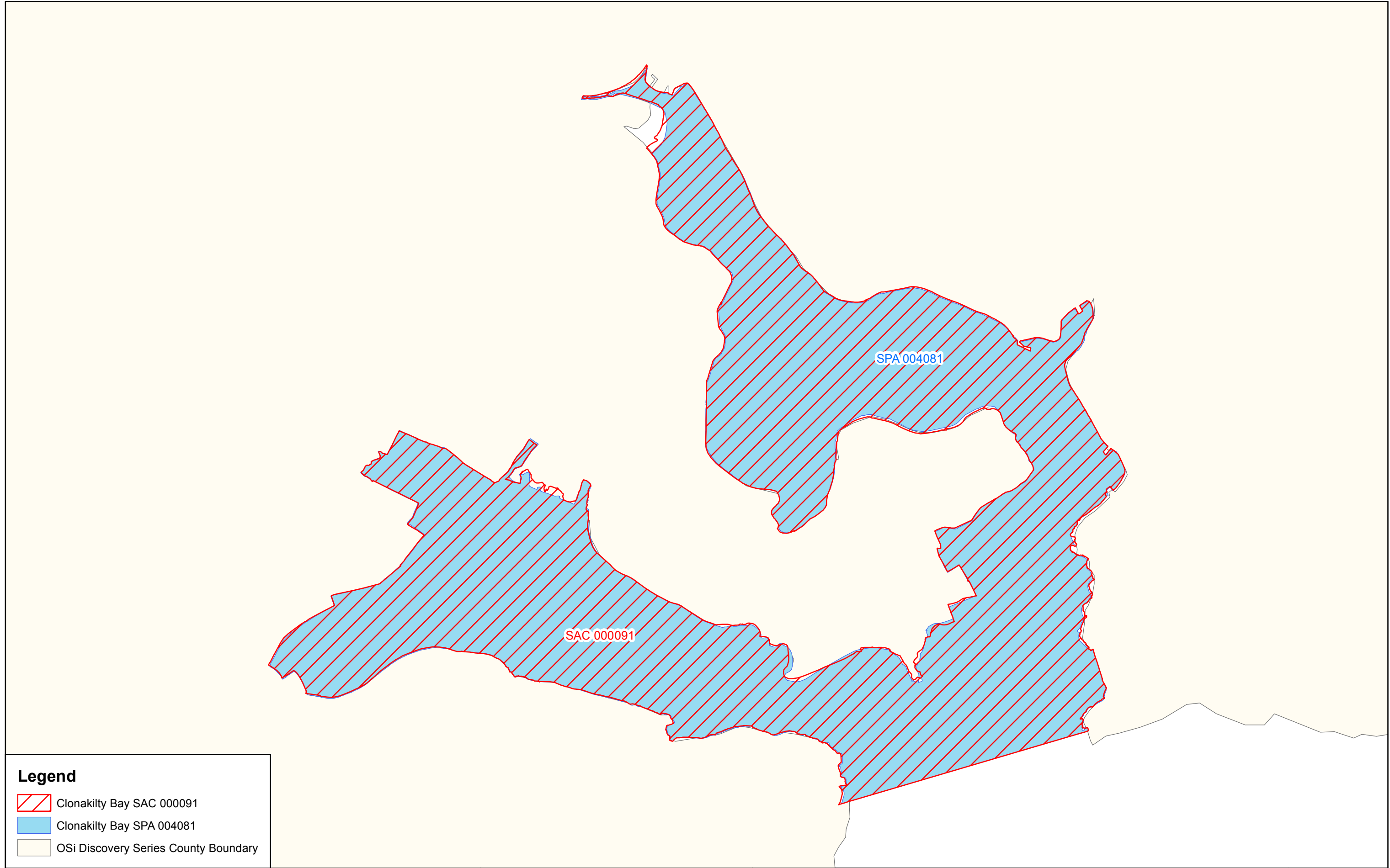
Conservation Objectives for : Clonakilty Bay SAC [000091]

2150 Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)

To maintain the favourable conservation condition of Atlantic decalcified fixed dunes (*Calluno-Ulicetea*) in Clonakilty Bay SAC, which is defined by the following list of attributes and targets:


Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes including erosion and succession	Based on data from the Coastal Monitoring Project (CMP) (Ryle et al., 2009) and Sand Dunes Monitoring Project (SDM) (Delaney et al., 2013). No area was mapped for this habitat at Inchydoney by the CMP or SDM, but is potentially present as evidenced by the occurrence of European gorse (<i>Ulex europaeus</i>). Possibly occurs in mosaic with fixed dune. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline or change in habitat distribution, subject to natural processes	Based on data from Ryle et al. (2009). This habitat is characterised by the presence of European gorse (<i>Ulex europaeus</i>). The CMP mapped the location of patches of gorse, most of which are in the northeastern corner of the dune system. See coastal habitats supporting document for further details
Physical structure: functionality and sediment supply	Presence/ absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions	Physical barriers can lead to fossilisation or over-stabilisation of dunes, as well as beach starvation resulting in increased rates of erosion. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from Gaynor (2008), Ryle et al. (2009) and Delaney et al. (2013). Sand dunes at Inchydoney are part of a coastal complex that includes estuarine and intertidal habitats as well as inland marshes. See coastal habitats supporting document for further details
Vegetation structure: bare ground	Percentage cover	Bare ground should not exceed 10% of fixed dune habitat, subject to natural processes	Based on data from Gaynor (2008), Ryle et al. (2009) and Delaney et al. (2013). The CMP noted several large tracks and blowouts in the fixed dunes at Inchydoney. See coastal habitats supporting document for further details
Vegetation structure: sward height	Centimeters	Maintain structural variation within sward	Based on data from Gaynor (2008), Ryle et al. (2009) and Delaney et al. (2013). Fixed dunes are undergrazed. The absence of large grazers may be beneficial for the development of decalcified dunes. See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative number of monitoring stops	Maintain range of sub-communities with typical species listed in Delaney et al. (2013)	Based on data from Gaynor (2008), Ryle et al. (2009) and Delaney et al. (2013). See coastal habitats supporting document for further details
Vegetation composition: negative indicator species	Percentage cover	Negative indicator species (including non-natives) to represent less than 5% cover	Based on data from Ryle et al. (2009). Negative indicators include non-native species, species indicative of changes in nutrient status and species not considered characteristic of the habitat. Sea-buckthorn (<i>Hippophae rhamnoides</i>) should be absent or effectively controlled. Encroachment by bracken (<i>Pteridium aquilinum</i>) is considered a major problem at this site (Delaney et al., 2013). See coastal habitats supporting document for further details
Vegetation composition: scrub/trees	Percentage cover	No more than 5% cover or under control	Based on data from Ryle et al. (2009). Burnet rose (<i>Rosa pimpinellifolia</i>) was recorded in the fixed dune habitat at Inchydoney. Several shrub-sized trees were also recorded such as sycamore (<i>Acer pseudoplatanus</i>), ash (<i>Fraxinus excelsior</i>) and hawthorn (<i>Crataegus monogyna</i>). See coastal habitats supporting document for further details





Legend

-  Clonakilty Bay SAC 000091
-  Clonakilty Bay SPA 004081
-  OSi Discovery Series County Boundary




*An Roinn
Ealaíon, Oidhreacht agus Gaeltachta
Department of
Arts, Heritage and the Gaeltacht*

**MAP 2:
CLONAKILTY BAY SAC
CONSERVATION OBJECTIVES
ADJOINING / OVERLAPPING
DESIGNATIONS**

Map to be read in conjunction with the NPWS Conservation Objectives Document.

**SITE CODE:
SAC 000091; version 3.01.
SPA 004081; version 2. CO. CORK**

0 0.2 0.4 0.6 0.8 1 km

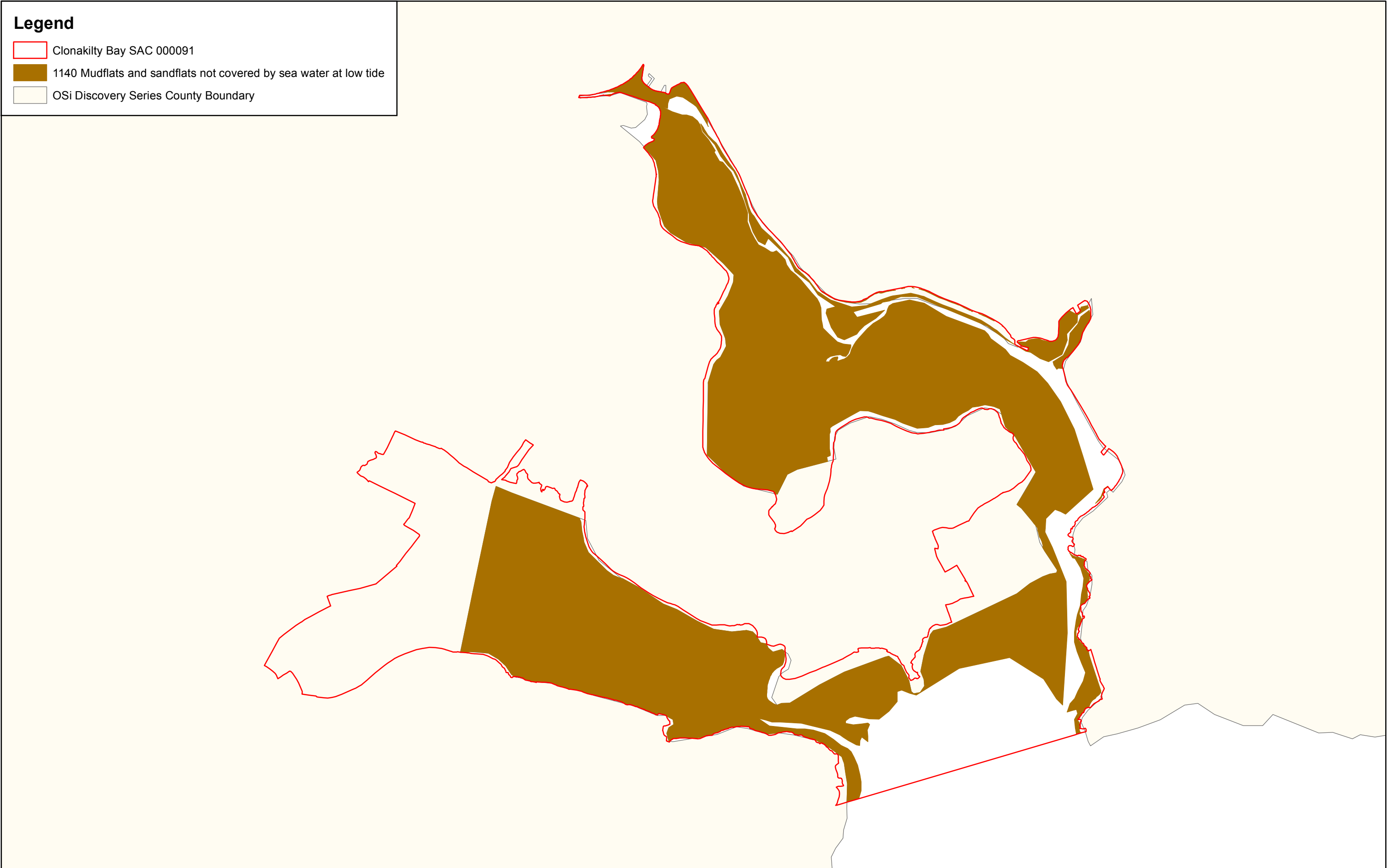


The mapped boundaries are of an indicative and general nature only. Boundaries of designated areas are subject to revision.
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Níl sna teorainneacha ar na léarscáileanna ach nod garshuíomhach ginearálta. Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe.
Suirbhéarachta Ordonáis na hÉireann Ceadúnas Uimh EN 0059214. © Suirbhéarachta Ordonáis na hÉireann Rialtas na hÉireann



**Map Version 1
Date: May 2014**

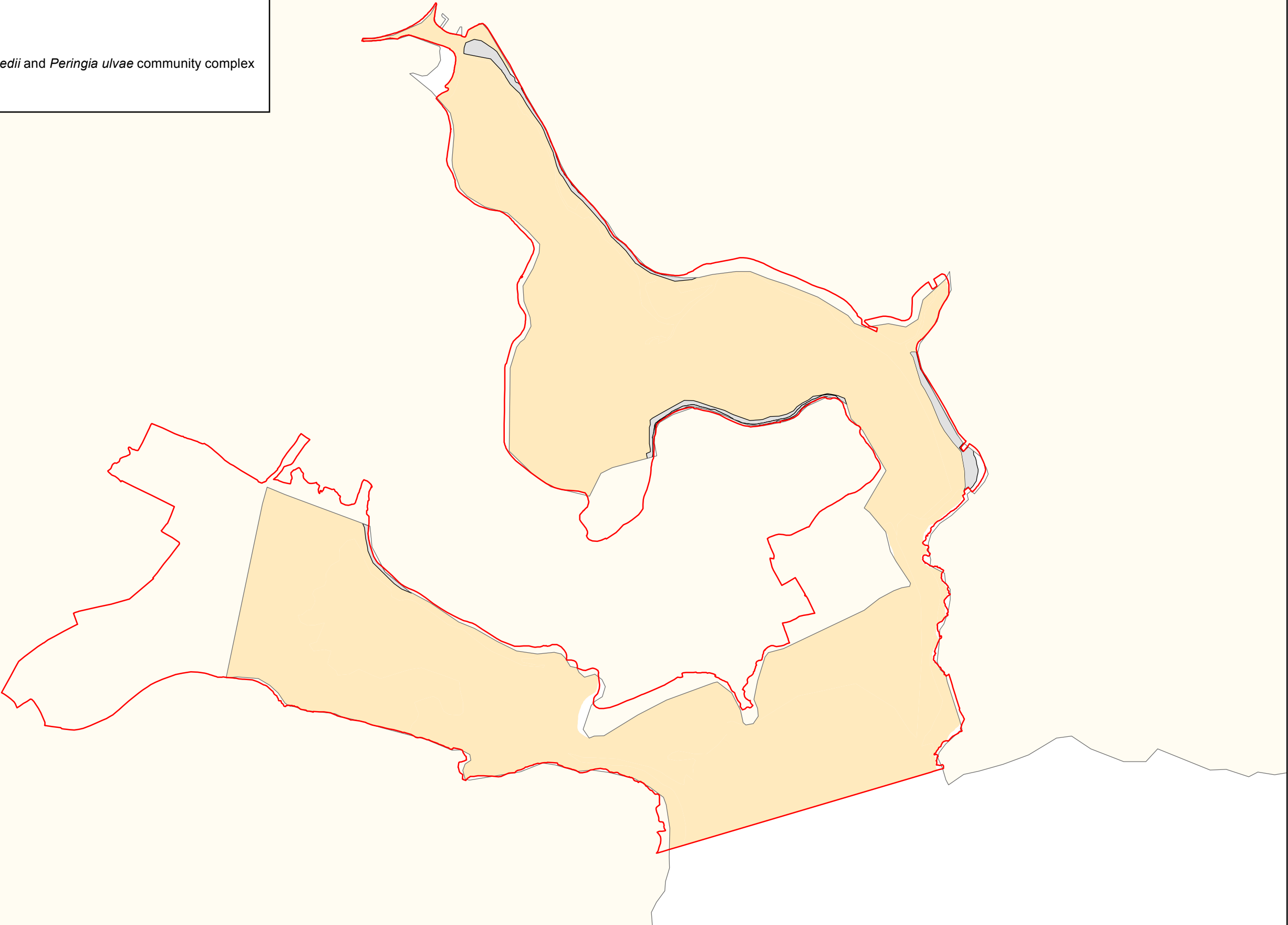


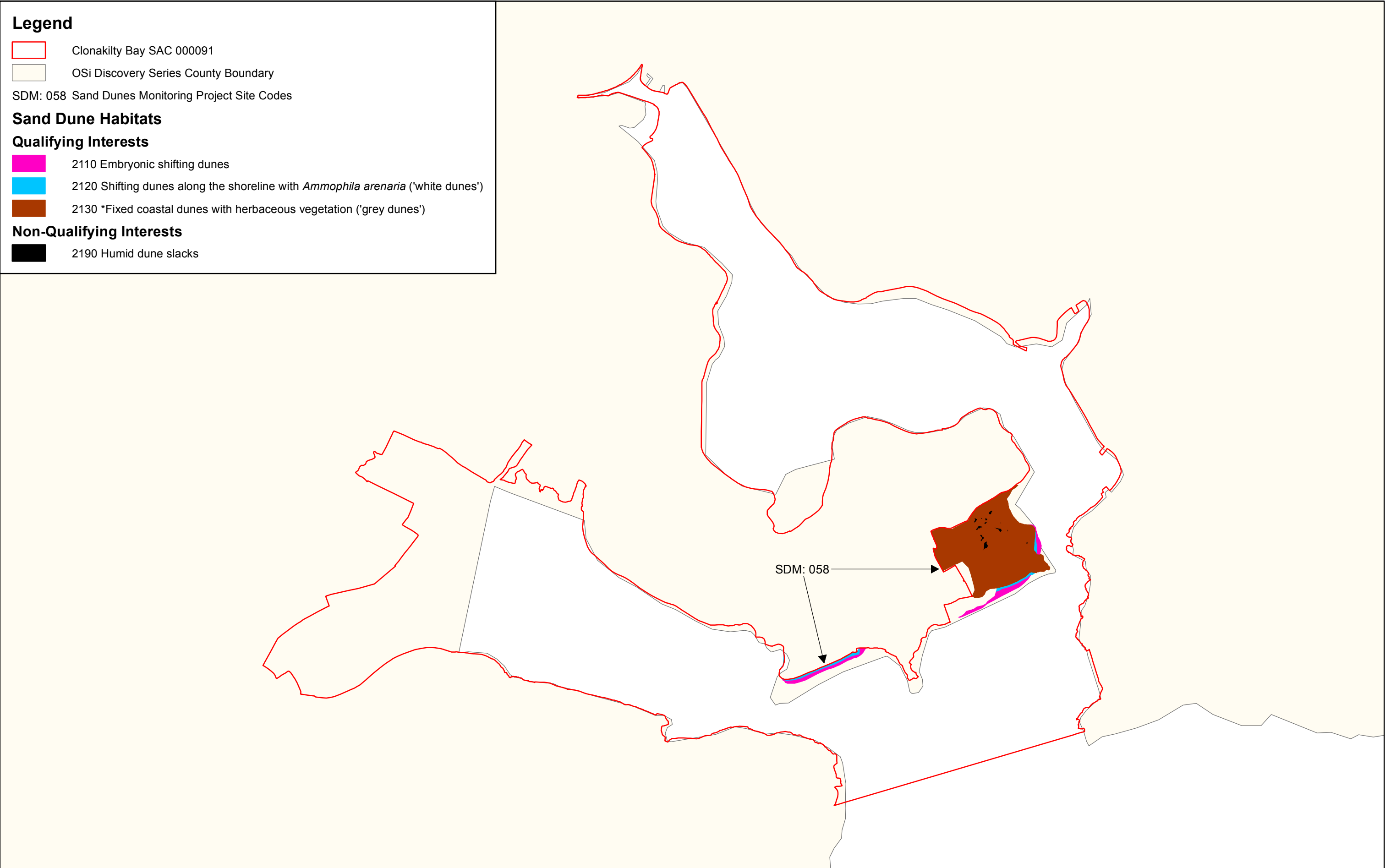
Legend

- Clonakilty Bay SAC 000091
- OSi Discovery Series County Boundary

Marine Community Types

- Sand to sandy mud with *Tubificoides benedii* and *Peringia ulvae* community complex
- Shingle





Conservation Objectives for Clonakilty Bay SPA [004081]

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:

- its natural range, and area it covers within that range, are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation status of a species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Objective: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:

♦ <i>Tadorna tadorna</i>	[wintering]
♦ <i>Calidris alpina</i>	[wintering]
♦ <i>Limosa limosa</i>	[wintering]
♦ <i>Numenius arquata</i>	[wintering]
♦ Wetlands	[]

Citation:

NPWS (2011) *Conservation objectives for Clonakilty Bay SPA [004081]. Generic Version 4.0. Department of Arts, Heritage & the Gaeltacht.*

For more information please go to: www.npws.ie/protectedsites/conservationmanagementplanning

Appendix 10A - Hydromorphology Audit

Hydromorphology and Gravel Condition Survey

Final Report

September 2014

JBA Project Manager

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Revision History

Revision Ref / Date Issued	Amendments	Issued to
V1.0 / September 2014		Declan Egan - for inclusion in the EIS.

Contract

This report describes work commissioned by Patrick McAlinney, on behalf of OPW, by a letter dated 19 June 2014. Matthew Hemsworth and David Mould of JBA Consulting carried out this work.

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Purpose

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1 Introduction

1.1 Background

JBA Consulting were commissioned by the Office of Public Works (OPW) to undertake a geomorphological assessment and gravel condition survey, for the purpose of assessing salmonid spawning habitat) along the watercourses in Clonakilty, County Cork, to map baseline conditions prior to the construction of the proposed flood relief scheme. An experienced hydromorphologist and hydroecologist from JBA Consulting conducted a site walkover survey during July 2014.

A desk based assessment and site audit were conducted along the Clonakilty watercourses and within the wider area to gain an understanding of local and system wide dynamics and processes and areas of potential spawning habitat for salmonid fish.

1.2 Methodology

The following steps were undertaken:

- A desk based assessment to collate information relating to the existing hydromorphological condition of the watercourses in Clonakilty, including the River Basin Management Plan.
- An initial field based hydromorphological audit and gravel condition survey to gain a further understanding of the current character and dynamics of the watercourse, along with the potential areas of gravel spawning habitats for salmonid fish species.
- A more detailed hydromorphic audit and gravel condition survey covering all of the watercourses impacting on the study area. This included aerial photography analysis and field survey of all watercourses (where accessible) upstream of Clonakilty to determine sediment sources, potential spawning sites and hydrological issues. The estuary downstream of Clonakilty was also assessed to allow prediction of potential response to flood risk proposals.

The findings of the audit and gravel condition assessment are used to develop a conceptual model of the form and dynamics of the interacting watercourses allowing key gravel beds to be identified. This conceptual model will be key to ensuring a sustainable Water Framework Directive (WFD) compliant solution is developed to address the flooding problems that minimises hydromorphic and ecological impact locally and elsewhere, and works with natural river processes where possible.

1.3 Report structure

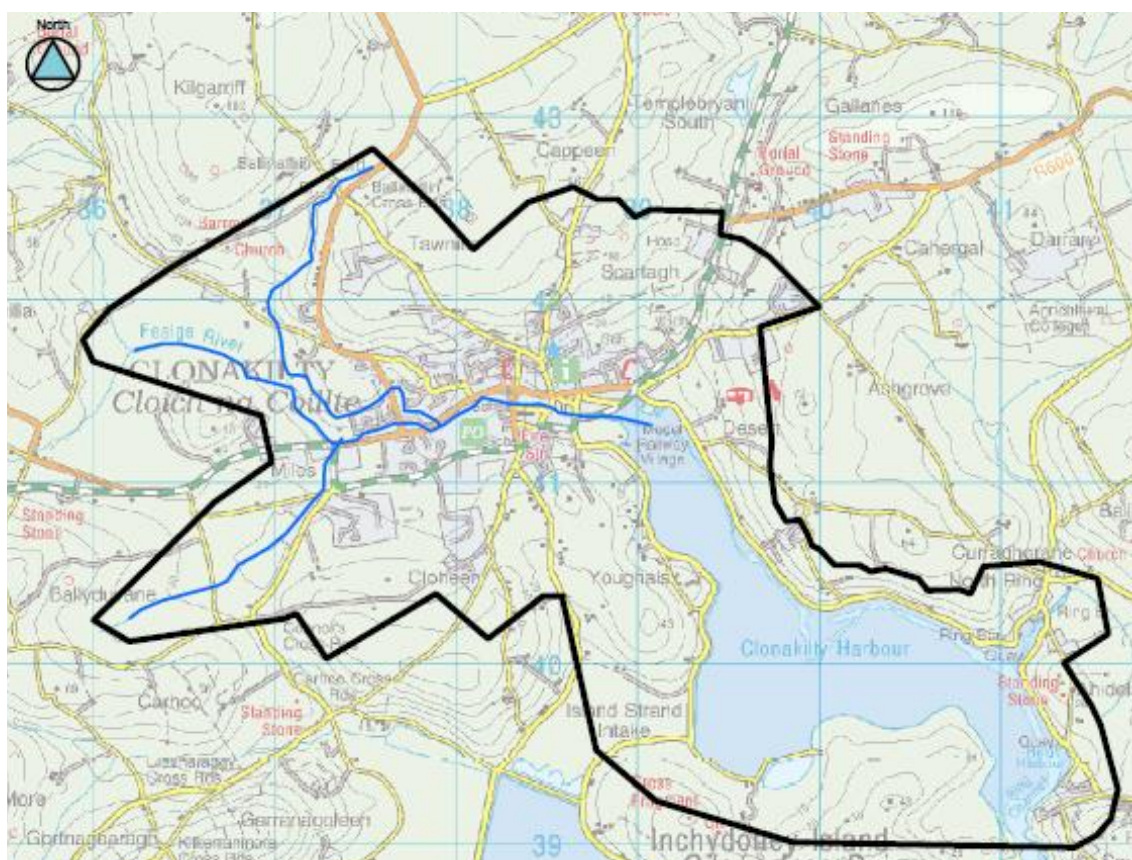
This report is split into three sections. The first section provides an overall picture of the Hydromorphology of the Feagle system, a second section presents the findings of the gravel survey, and a final section provides conclusions.

2 Existing Hydromorphological Condition

2.1 Overview

The Fealge River catchment is underlain by sandstones and mudstones and these are occasionally found as outcrops along the watercourses, most notably in the upper reaches. Superficial deposits of glacial till extend across the entire area and the watercourses are slowly reworking this material depositing newer, fluvially derived floodplain deposits as they do so.

Figure 2-1 Clonakilty Study Area and watercourses



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Landcover upstream of Clonakilty is agricultural with pasture forming the dominant farming practice. Urban areas are small and isolated with Clonakilty being the largest settlement along the Fealge River.

In its lower reaches the river is tidally influenced, this influence extends up through the urban area of Clonakilty up to the weir under Rossa Street.

River Basin Management Plans have been used to determine which water bodies could be potentially affected by the proposed flood alleviation works. The existing status of the river system through Clonakilty is in a 'moderate' condition (ecological and chemical), with an objective to be restored by 2021 to meet future WFD targets.

2.2 Hydromorphic Audit

The Fealge River is a geomorphologically varied watercourse with a strong sediment supply generated from the bedrock sections upstream which readily transport material entering the upper reaches, including reworked glacial till deposits (Figure 2-3) and local bank sediment sources. These sediments are accumulating temporarily as lateral, mid and transverse bars (Figure 2-2), which are dynamically stable (i.e. they are active but replenished from sediment upstream) where local hydraulic conditions allow and also more generally where the river widens to form a single thread plane bed-riffle-pool channel with a well connected floodplain.

Figure 2-2 Gravel deposition in the upper reaches



Figure 2-3 Sediment Supply



The Fealge River and its tributaries are generally single thread and relatively narrow until it reaching Clonakilty. Connectivity between the channel and floodplain is good in the upper

reaches, meaning during flood events fine sediment can be deposited on the floodplain and not within the channel, as occurs within the lower reaches (due to a lack of connectivity between the channel and floodplain). In some locations ad-hoc bank toe protection (Figure 2-4) exists, however, this has limited impact on lateral erosive processes due to it being localised in nature.

Figure 2-4 Small scale bank protection in the upper reaches



The channel floodplain and corridor becomes more confined through urbanised areas (due to floodplain pressures and development) as a result of flood embankments and buildings adjacent to the channel (Figure 2-5). These pressures have led to accumulation of fine sediment in some areas, due to lower in channel energy levels (in areas where gradient has been reduced) than would normally be expected.

Figure 2-5 Urban Constrictions and temporary flood defences



The bed of the channel is comprised of a mixture of cobbles, gravels and sands throughout the catchment. In some locations in the upper reaches constrictions and barriers in the channel have led to increased deposition, particularly of sands and gravels upstream of bridges (Figure

2-6). In some areas gravels appear to have been removed from the channel, presumably for flood protection.

Figure 2-6 Gravel deposition upstream of bridge as a result of constriction



In other areas reaches are more degraded due to hydromorphic pressures (such as historic re-alignment) particularly through the urban areas. In Clonakilty the channel widens and the gradient is low (partly due to several weirs) which encourages channel conditions to change resulting in fine sediment accumulation, influenced from both fluvial and tidal sources. Evidence suggests that some fine sediment enters the channel upstream as a result of livestock poaching and localised bank erosion.

The downstream reaches of the Fealge River are tidal (from Rossa Street downstream). The Fealge discharges into the south-west of Clonakilty Bay alongside The Croppy Road, with a second smaller watercourse joining from the north-east at Facksbridge. Much of the tidal harbour area has been modified, however, limited evidence of excessive fine sediment deposition (Figure 2-7) was seen, suggesting existing flows have the ability to transport these and are flushed back out to sea during fluvial dominated flows and as part of the tidal cycle.

Figure 2-7 Lateral fine sediment deposition in the lower tidally influenced reaches



2.3 Summary of existing hydromorphic conditions

The existing morphology throughout the Fealge River system is diverse and the bed of the channel remains sandy and gravelly, operating naturally to move coarse sediment, supplied largely from glacial deposits being reworked from bank erosion and the bedrock dominated upper reaches which act to supply sediment entering the river in the upper reaches, downstream via a series of temporary in-channel bar stores. The majority of bars within the channel are stable and are replenished with sediment from upstream.

Several barriers exist to sediment transport (such as bridges and weirs) which are currently managed to prevent flooding. Within the urban areas the channel has been modified historically as the urban area has expanded. This has resulted in a loss of floodplain and a confined channel. Nevertheless, evidence of coarse sand and gravel deposition within these confined sections was strong. This suggests higher flow events through these areas are low energy which give way for deposition.

2.4 Barriers to fish passage

Throughout the surveyed reach several weirs exist which could act as a barrier to fish migration. Weirs and structures in the channel are generally linked with negative impacts on the physical and ecological condition of the river. Firstly, structures can significantly alter the depth of water and velocity of flow, leading to over deepened impounded reaches upstream and altering the habitat characteristics. Secondly, structures affect the rivers ability to transport sediment downstream, again altering habitat characteristics. Finally, structures in the channel impact upon the biological connectivity of the river, preventing fish and invertebrate passage.

3 Gravel Condition Survey

3.1 Overview

Salmonid fish spawn on sections of silt free gravel, generally between October and January. Female fish excavate shallow depressions in the gravel (which are known as Redds). In these depressions the fish lay their eggs which are then fertilised by male trout. The exact preferences for spawning habitat vary slightly between species and life stages, gravels of around 16-64mm and water depths of around 0.25 to 0.4m. Successful Redds will be located in areas of the river which remain wet throughout the entire incubation period with sufficient velocities over and through the gravels to ensure that the Redd remains free of fine sediment and so maintaining oxygen supply to the incubating eggs.

Traditional Redd surveys are generally undertaken in January or February (at the end of the Spawning season) where the Redds can be easily identified as oval depressions of clean gravel, sometimes in contrast to the surrounding gravel. However, due to project constraints, an understanding of the spawning habitat in the Feagle was required by autumn 2014. Therefore, a full Redd survey could not be carried out, however, a gravel condition survey has been undertaken to assess the suitability of gravels within the river channel for spawning. The survey focussed on the size and depth of the gravel, the location of the gravel in the context of river geomorphology, whether the gravel contained fine sediment, and the depth and velocity of the water over the gravel.

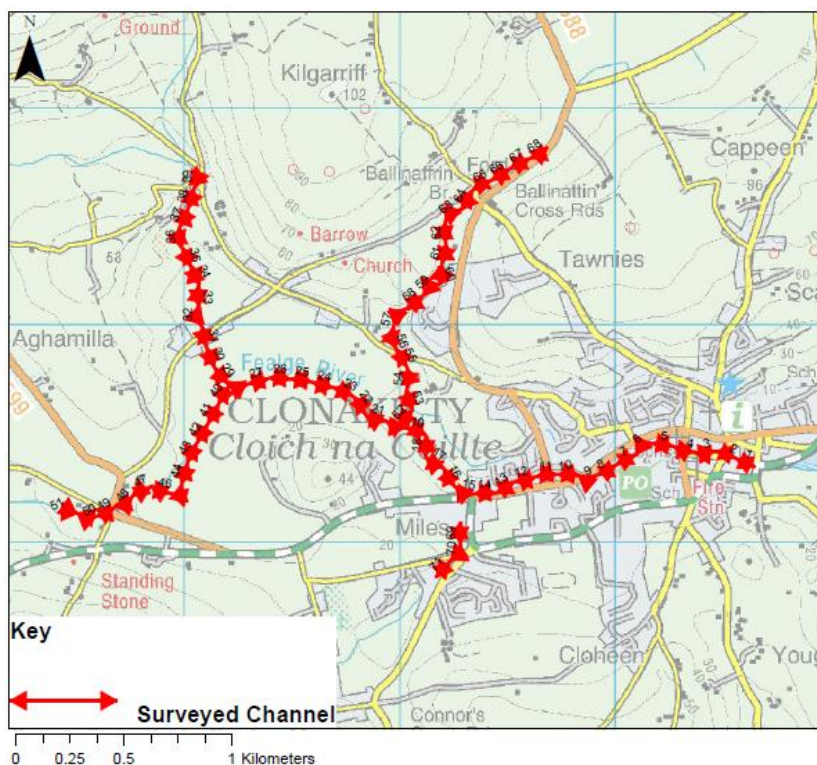
A summer gravel habitat survey is further constrained by the presence of instream vegetation which obscures the substrate of the river from view and changes the flow patterns. The antecedent conditions prior to the gravel survey were dry, with low flows present in the river. Many of the gravel features observed in the July walkover in the river contained some sand or silt, which would limit the effectiveness of the gravel to keep any eggs oxygenated. It would be expected that under higher, autumn flows, these gravels would be cleaned to some extent improving the oxygenation of the incubating eggs.

3.2 Existing gravel condition survey

A gravel condition habitat survey has been carried out to identify the existing habitat units along the Feagle River. The survey is based on 100m river reach sections extending from upper Feagle catchment to the estuary at Clonakilty.

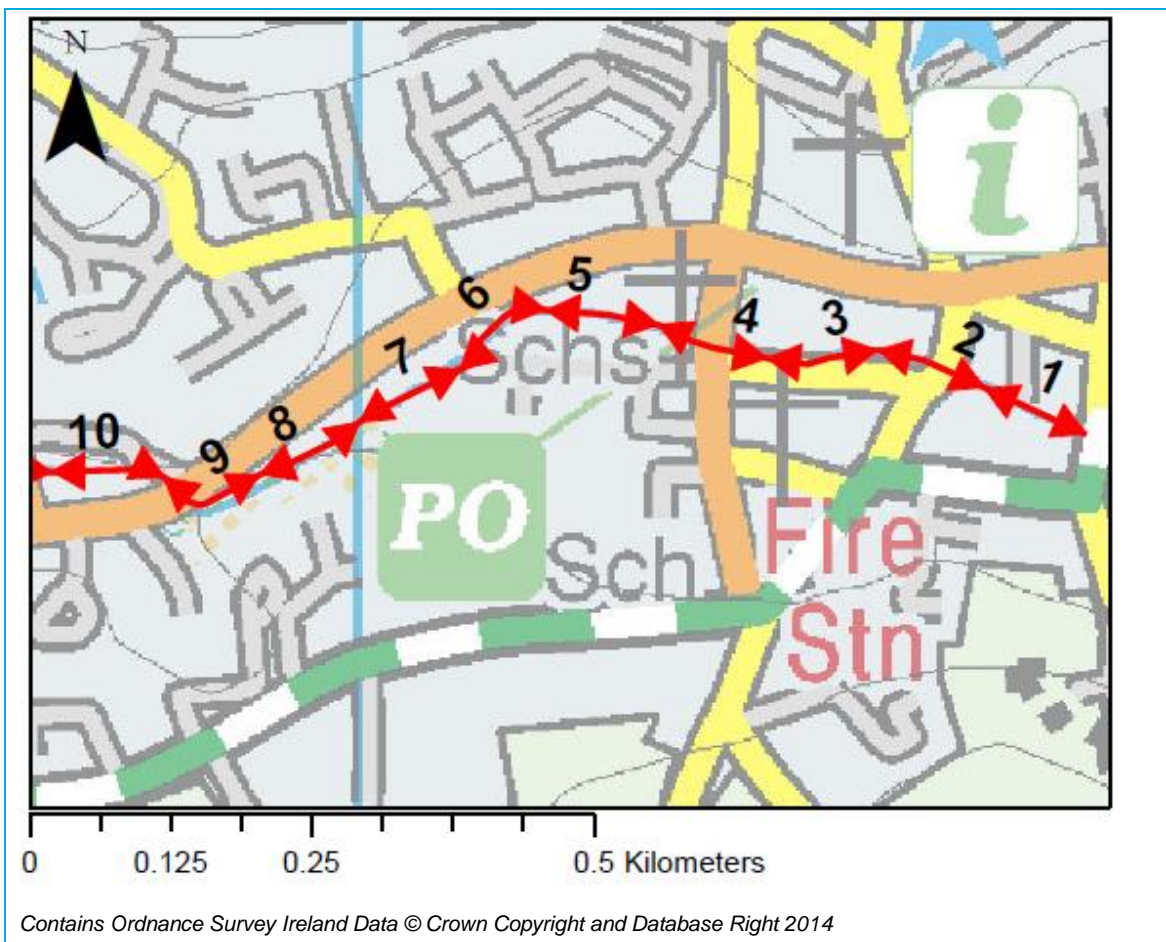
The survey identifies the existing channel substrate condition and assesses its suitability for spawning.






Figure 3-1 Gravel condition habitat survey overview








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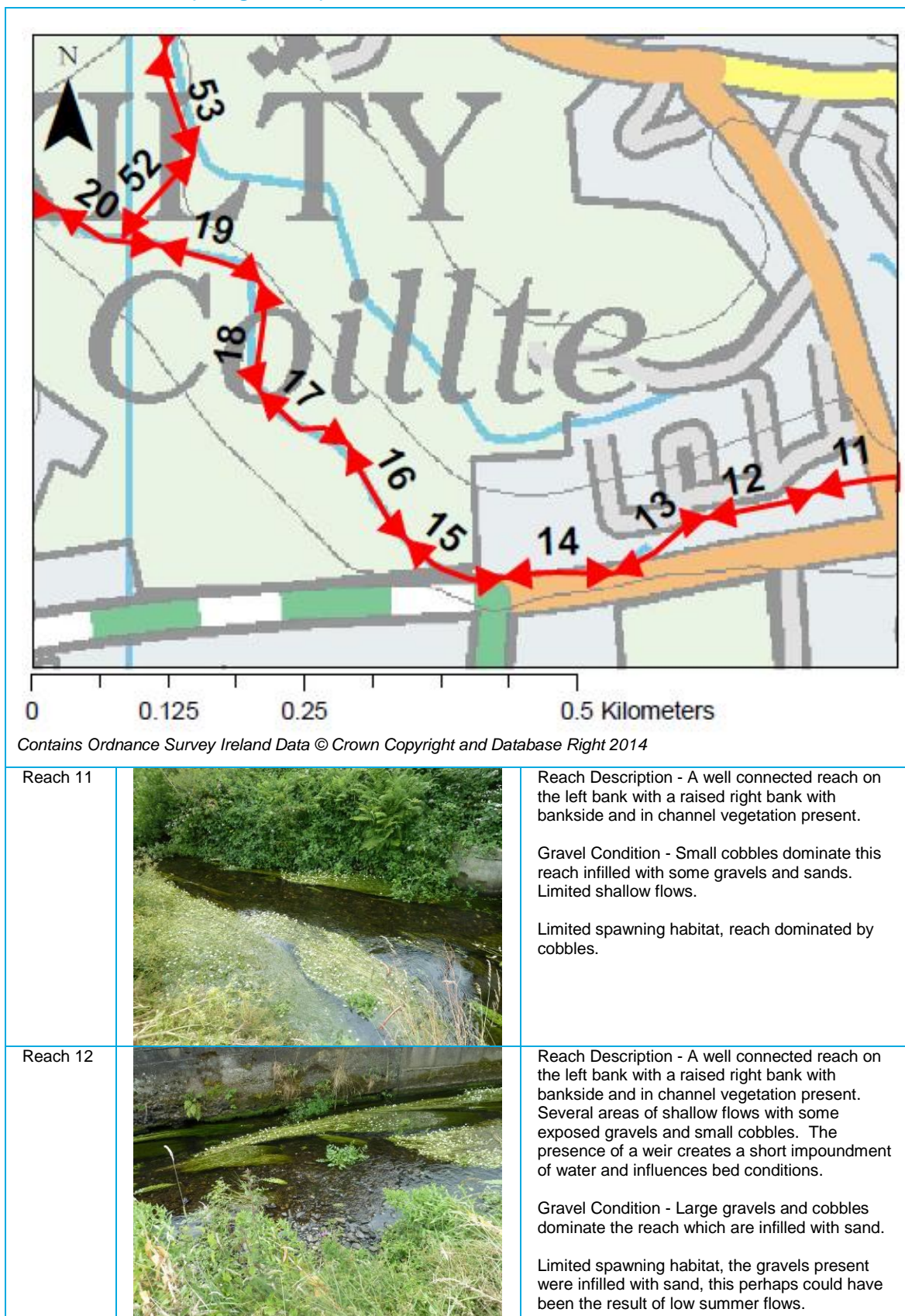
3.2.1 Reaches 1 to 10 (Fealge River)








Reach 1		<p>Reach Description - Tidal dominated reach with high walls alongside the channel. Limited bankside vegetation and deep in most places.</p> <p>Gravel Condition - The reach is dominated by fine sediment, mixed sands, gravels and some cobbles. Small gravel and sand bars exist in protected pockets adjacent to the bridge, however these were covered in in channel weeds at the time of survey.</p> <p>Unlikley to be used as spawning habitat by salmonid fish. Significant numbers of adult trout observed under the road bridge.</p>
Reach 2		<p>Reach Description - Weir impounded reach confined by high walls and buildings. Limited bankside vegetation.</p> <p>Gravel Condition - The reach is dominated by fine sediment, with some sands and gravels. Some small areas of deposition exist in protected pockets where levels are shallower.</p> <p>Spawning habitat limited by the deposition of fine sediment.</p>
Reach 3		<p>Reach Description - Reach confined by high walls and buildings. Limited bankside vegetation. Varied channel depths with deeper and shallower areas.</p> <p>Gravel Condition - Cleaner sands and gravels on the channel bed, along with the development of a gravel and sand bar on the inside channel bend.</p> <p>The point bar pictured may provide spawning habitat if wetted under higher winter flows. The sediment for the remainder of the reach is too corase.</p>
Reach 4		<p>Reach Description - Confined reach surrounded by walls and raised roads, with limited in channel vegetation. Shallow flow conditions.</p> <p>Gravel Condition - The bed is dominated by cobbles interspersed with some gravels and sands. Some lateral deposition of larger gravels and cobbles is evident.</p> <p>Very limited spawning habitat, reach dominated by cobbles.</p>
Reach 5		<p>Reach Description - Confined reach which is deep in most places, surrounded by walls and raised roads, with limited in channel vegetation.</p> <p>Gravel Condition - The bed is dominated by cobbles with limited gravels present.</p> <p>Very limited spawning habitat, reach dominated by cobbles.</p>

Reach 6		<p>Reach Description - The channel remains confined, however more bankside vegetation is present outside of the urban area.</p> <p>Gravel Condition - Evidence of old cobble channel lining which has been eroded. Some gravels and sands present, but cobbles dominate the reach.</p> <p>Very limited spawning habitat, reach dominated by cobbles.</p>
Reach 7		<p>Reach Description - The channel remains confined and exhibits pool - riffle sequences (deeper and shallower areas).</p> <p>Gravel Condition - Cobbles and larger sized gravels dominate the reach which are in filled with sands.</p> <p>Very limited spawning habitat, reach dominated by cobbles.</p>
Reach 8		<p>Reach Description - The channel remains confined and exhibits pool - riffle sequences (although larger and deeper pools dominate the reach).</p> <p>Gravel Condition - Cobbles and larger sized gravels dominate the reach which are in filled with sands.</p> <p>Very limited spawning habitat, reach dominated by cobbles.</p>
Reach 9		<p>Reach Description - The channel becomes less confined at the bridge crossing and consequently exhibits shallower flows.</p> <p>Gravel Condition - Gravels dominate this reach which are infilled with sands. Some cleaner gravels were present within stronger flow paths.</p> <p>Very localised patch of spawning habitat in a reach dominated by cobbles.</p>
Reach 10		<p>Reach Description - A generally well connected reach on the left bank with a raised right bank.</p> <p>Gravel Condition - Gravels and sand dominate this reach. Limited areas of clean gravels were noted due to the strong presence of sand.</p> <p>Deposition of sand in this reach limits the quality of the spawning habitat, some areas of cleaner gravels were observed where the instream vegetation constricts flow. Character of this reach will be different without the instream vegetation.</p>

3.2.2 Reaches 11 to 20 (Fealge River)



Reach 13		<p>Reach Description - Dominated by pool riffle sequences and sands, gravels and cobbles. Reach contains a significant amount of in channel vegetation.</p> <p>Gravel Condition - Gravels and sand dominate the reach, however there are no areas containing clean gravels.</p> <p>No suitable spawning gravels in this reach.</p>
Reach 14		<p>Reach Description - Modified reach containing pool and riffle sequences with some areas of shallow flows.</p> <p>Gravel Condition - The stronger flows in this reach a riffle locations result in small areas of clean gravels (although some sand is contained under the surface gravel layer).</p> <p>The areas of suitable gravels are very small within this constrained reach, spawning habitat limited.</p>
Reach 15		<p>Reach Description - Heavily vegetated banks and shaded river reach.</p> <p>Gravel Condition - Potential for some clean gravels in higher flows, but large amounts of fines and gravels contained within the channel during summer conditions.</p> <p>Difficult to determine quality of habitat, gravels may well be cleaner during elevated flows during the autumn spawning season.</p>
Reach 16		<p>Reach Description - Heavily vegetated banks and shaded river reach.</p> <p>Gravel Condition - Potential for some clean gravels in higher flows, but large amounts of fines and gravels contained within the channel during summer conditions.</p> <p>Difficult to determine quality of habitat, gravels may well be cleaner during elevated flows during the autumn spawning season.</p>
Reach 17		<p>Reach Description - Heavily vegetated banks and shaded river reach.</p> <p>Gravel Condition - Potential for some clean gravels in higher flows, but large amounts of fines and gravels contained within the channel during summer conditions.</p> <p>Difficult to determine quality of habitat, gravels may well be cleaner during elevated flows during the autumn spawning season.</p>