RPS

Dunkellin River and Aggard Stream Flood Relief Scheme

Natura Impact Statement (NIS)

October 2014

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RPS

Dunkellin River and Aggard Stream Flood Relief Scheme

Natura Impact Statement

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1 INTRODUCTION

1.1 SCOPE

In March 2011, Galway County Council appointed RPS as environmental consultants for the Dunkellin River and Aggard Stream Flood Relief Scheme (the scheme).

In 2010 a study of the flooding on the Dunkellin River and the Aggard Stream (from Craughwell Village to Kilcolgan) was commissioned as a result of flooding that occurred in the area in November 2009. Galway County Council is now progressing with the scheme to design stage and propose to submit the scheme for planning approval to An Bord Pleanála (ABP) in line with Section 175 and 177AE of the Planning and Development Act 2000 as amended.

The scheme includes for flood relief works to be completed along the main channel of the Dunkellin River from Craughwell to Kilcolgan (over 11km) and along the Aggard Stream which runs from the townland of Cregaclare (near Ardrahan) to its outfall at the confluence of the Dunkellin and Craughwell Rivers (over 7.5km). A combination of river widening, deepening, culvert upgrade and replacement, bridge improvement and replacement and general channel maintenance make up the proposed measures for this scheme. The intention of the scheme is to provide optimum flood relief with minimal environmental impact whilst also controlling the overall capital investment required.

A summary of the scheme is set out in **Section 4** and **Appendix A** contains the scheme detail and relevant scheme drawings as generated by the scheme design consultants Tobin Consulting Engineers in a report entitled "*Dunkellin River and Aggard Stream Flood Relief Scheme – Description of the Proposed Works*", (Tobin Consulting Engineers, September 2014), (hereafter referred to as Tobin, 2014)

Figure 1.1 shows the extent of the Dunkellin River, Monksfield River and Aggard Stream catchment. In order to provide an overview of Natura 2000 sites in the area. **Figure 1.2** shows the location of all Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) within a 15km distance of the study area.

A Stage I Appropriate Assessment Screening Report has been prepared for the proposed Flood Relief Scheme (hereafter referred to as FRS). The Natura 2000 sites which do not lie within the Dunkellin/Kilcolgan River Surface Water catchment, or which were considered not to have a ground water connection to be effected by the proposed works were screened out at Stage I.

The Natura 2000 sites in proximity to the proposed FRS, include Rahasane Turlough SAC (Site Code: 000322), Galway Bay Complex SAC (Site Code: 000268), Rahasane Turlough SPA (Site Code: 004089), and Inner Galway Bay SPA (Site Code: 004031). The SACs and SPAs form a pan-European network of protected sites known as Natura 2000 sites and will be the focus of this report. **Appendix B** contains the NPWS Site Synopses for the relevant Natura 2000 Sites.

The Screening Report concluded that, on the basis of objective information, the scheme could not be excluded at the screening stage as it could not be determined whether or not the project would have significant effects on Natura 2000 sites, either individually or in combination with other plans or projects. Therefore the project should be subject to an appropriate assessment of its implications for the sites in view of the sites' conservation objectives. The full text of the Appropriate Assessment Screening Report is contained in **Appendix C**.

This document comprises the Natura Impact Statement (NIS) to facilitate the Appropriate Assessment of the project by the Competent Authority.

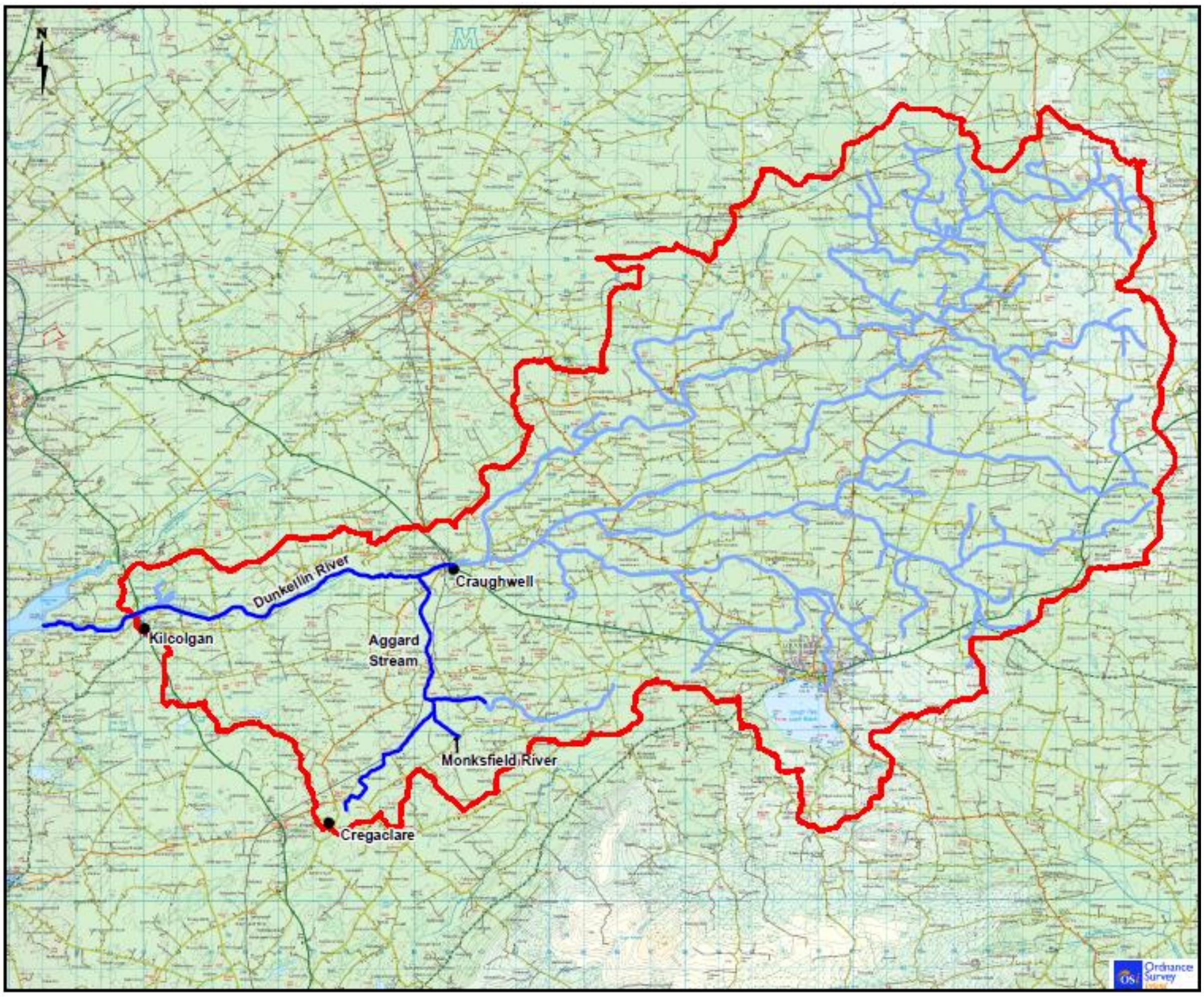
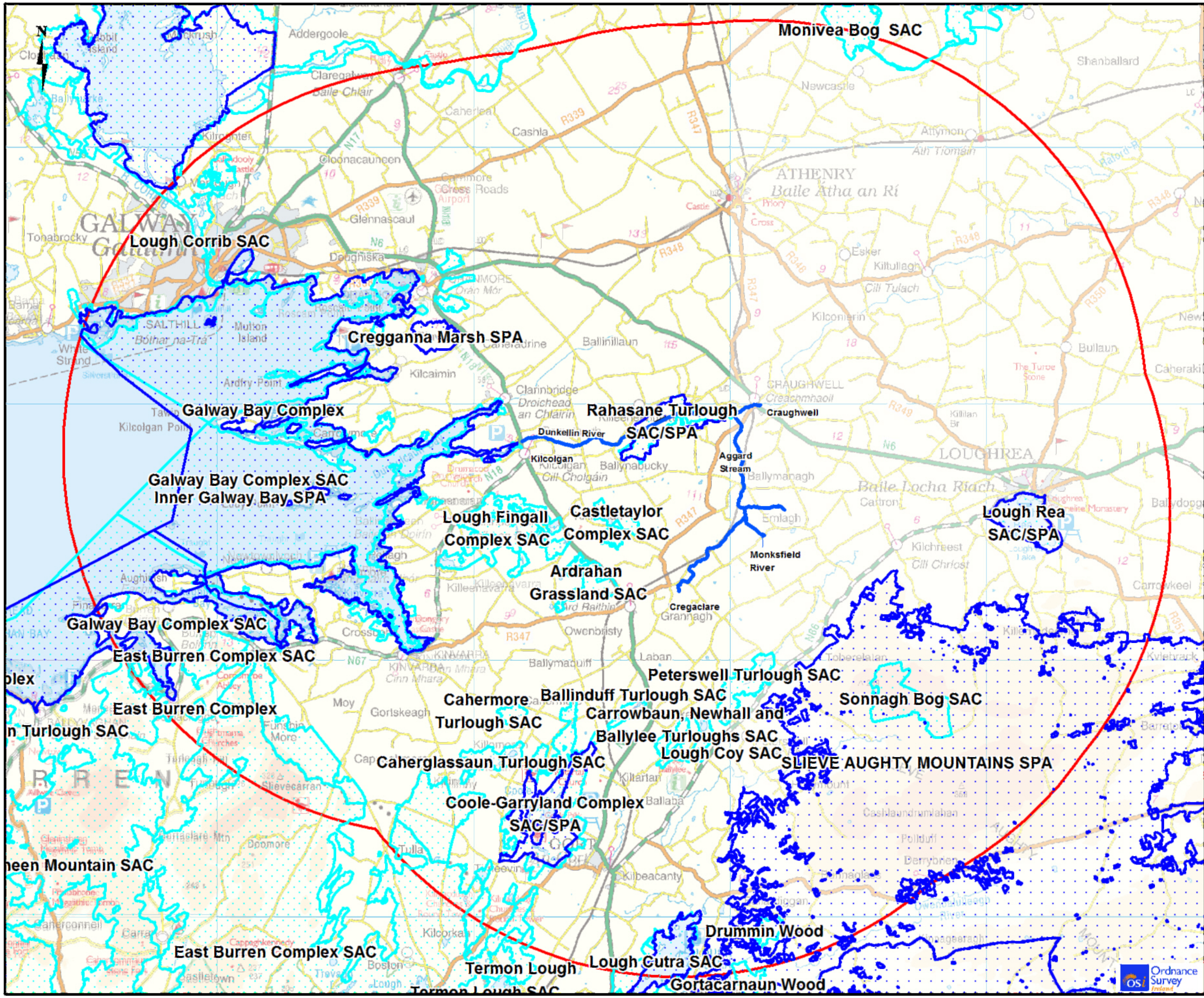


Figure 1.1 Extent of the Dunkellin River, Monksfield River and Aggard Stream Catchment.



Legend

- Dunkellin River, Aggard Stream & Monksfield River
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- 15km radius

Client

Galway County Council

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Dunkellin River and Aggard Stream Flood Relief Scheme; Environmental Consultancy Services

Title

Location of SACs and SPAs within a 15km Radius of the Study Area

Figure 1.2

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Notes

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1.2 CONSULTATION RESPONSES

As part of the iterative process the project team have carried out rigorous consultation with statutory bodies. This process has helped to inform the scope of assessments completed and shaped the scheme as presented in this document. Consultation responses are provided in full in **Appendix D** and are summarised below in **Table 1.1**.

Table 1.1 Summary of Consultations and Responses for the Dunkellin River FRS

Consultation Method	Details
Written Consultation	EIS Scoping letter issued to DAU, NPWS Regional Ecologist and IFI on 29th March 2011
	AA Screening issued to DAU and IFI on 26th August 2011
	AA Screening for SI works issued to DAU and NPWS Regional Ecologist on 16th March 2012
Meetings held	Meeting with NPWS on 16th September 2011
	Meeting with NPWS on 17th October 2012
Response to written consultations	
Stakeholder	**Response Received**
Development Applications Unit, Department of the Arts, Heritage and the Gaeltacht	The NPWS reference number for this project is **G2011/158** Any in-combination issues would need to be taken into account in the assessments
Inland Fisheries Ireland	Response letter from the Senior Environmental Officer on 19th April 2011 identified use of the OPW's Environment River Enhancement Programme (EREP) methods in which the natural features of the riparian and instream environment would be protected as far as possible. All potential receptor species should be identified such as salmon, brown trout, freshwater crayfish etc. The scheme should seek to enhance angling amenity. Normal constraints should apply regarding timing. Sediment transport which could affect the oyster fishery downstream should be minimised. An email from the Senior Environmental Officer on 7th September 2011 identified a number of issues relating to fisheries including issues relating to: the fish counter at Killeely Beg, potential EREP measures, the IFI zone, flood berms, the riparian zone and lamprey.
Issues raised at meetings	
Development Applications Unit, Department of the Arts, Heritage and the Gaeltacht	The need to establish upper levels of Rahasane Turlough The 1% average flood levels over one year would be required to determine the ecological impacts. Three specific areas of concern are the turlough, birds and the marine environment. Concern over what habitat types that may be affected by the proposed land spreading and queried the footprint or percentage cover of the land spreading. Any proposal for fish enhancement as part of the scheme needs to be clearly set out in the EIS and NIS. It is important to consider environmental damage, Annex I habitats and the hierarchy of protection. Important to consider other projects e.g. other flood and maintenance schemes e.g. Cregganna Marsh has a flock of geese that also use Rahasane Turlough.

2 METHODOLOGY

2.1 GENERAL

The assessment has been prepared in consultation with the public, statutory and other bodies/ individuals and in accordance with the following guidelines:

- DoEHLG (2010) *Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities*. Department of the Environment, Heritage and Local Government,

- European Communities (2000) *Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC*, Office for Official Publications of the European Communities, Luxembourg. European Commission,

- EC (2002) *Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC*, Office for Official Publications of the European Communities, Luxembourg. European Commission,

- EC (2007) *Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the commission*. European Commission,

- EC (2007) *Interpretation Manual of European Union Habitats*. Version EUR 27. European Commission,

- EPA (2002) *Guidelines on the information to be contained in Environmental Impact Statements*. Environmental Protection Agency,

- EPA (2003), *Advice Notes on current practice in the preparation of Environmental Impact Statements*. Environmental Protection Agency

- Fossitt, J., 2000. *A Guide to Habitats in Ireland*. The Heritage Council, Kilkenny,

- HA (2001) DMRB Volume 10 Section 4 Part 4 - Ha 81/99 - *Nature Conservation Advice In Relation To Otters*. The Highways Agency,

- IEEM (2006) *Institute of Ecology and Environmental Management Guidelines for Ecological Impact Assessment*,

- NPWS (2013) *The Status of EU Protected Habitats and Species in Ireland.* National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland,

- NPWS (2009) Threat Response Plan: Otter (2009-2011). National Parks & Wildlife Service, Department of the Environment, Heritage & Local Government, Dublin.

- NRA (2009) *Guidelines for the Assessment of Ecological Impacts of National Road Schemes* Rev. 2. National Roads Authority,

- Perrin, P.M., Barron, S.J., Roche, J.R., and O' Hanrahan, B. (2103). *Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0 (Draft).* Irish

Wildlife Manuals, National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

- Smith, G. F., O' Donoghue, P., O'Hora, K., Delaney, E., 2011. *Best Practice Guidance for Habitat Survey and Mappin*g. The Heritage Council, Kilkenny, and

- Consultation with the Public, Statutory and other bodies/ individuals.

The requirements of the following legislation informed the scope of the studies carried out;

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) and Directive 2009/147/EC (codified version of Directive (79/409/EEC) as amended) (Birds Directive) – transposed into Irish law as European Communities (Birds and Natural Habitats) Regulations 2011 and the Planning and Development Act 2000 (as amended),

- European Communities (Environmental Impact Assessment) Regulations, 1989 to 2006,
- European Communities (Environmental Liability) Regulations, 2008 (S.I. No. 547 of 2008),
- European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 84 of 1988), and
- Planning and Development Act, 2000 (as amended).

A desktop review was carried out of the scheme design, prepared by Tobin Consulting Engineers on behalf of Galway County Council: "*Dunkellin River and Aggard Stream Flood Relief Scheme – Description of the Proposed Works*", (Tobin Consulting Engineers, September 2014).

A full desktop study of available biological information pertaining to the study area was carried out and a number of ecological assessments were completed within the study area.

These studies include;

- Habitat Mapping,
- Botanical Surveys,
- Volant and Non-Volant Mammal Surveys,
- Kingfisher Surveys,
- Bat Surveys,
- Aquatic Ecology Surveys, and
- Salinity Modelling.

These surveys were carried out in 2011 and 2014 and a full description of the methodologies used in conducting these surveys is provided in **Section 6**.

2.2 APPROPRIATE ASSESSMENT METHODOLOGY

The Department of the Environment Heritage and Local Government guidelines (DOELHG, 2010) outlines the European Commission's methodological guidance (EC, 2002) and outlines the issues and tests at each stage. An important aspect of the process is that the outcome at each successive stage determines whether a further stage in the process is required.

The four stages are summarised diagrammatically in **Figure 2.1** below, and an outline of the steps and procedures involved in completing each stage follows. Stages 1-2 deal with the main requirements for assessment under Article 6(3). Stage 3 may be part of the Article 6(3) Assessment or may be a necessary precursor to Stage 4. Stage 4 is the main derogation step of Article 6(4).

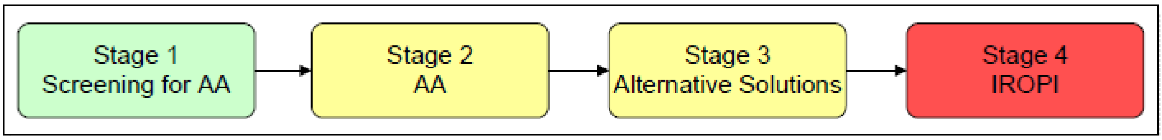


Figure 2.1 Four Stages of Appropriate Assessment

Stage 1: Screening for Appropriate Assessment

Screening is the process that addresses and records the reasoning and conclusions in relation to the first two tests of Article 6(3):

(i) whether a plan or project is directly connected to or necessary for the management of the site, and

(ii) whether a plan or project, alone or in combination with other plans and projects, is likely to have significant effects on a Natura 2000 site in view of its conservation objectives.

If the effects are deemed to be significant, potentially significant, or uncertain, or if the screening process becomes overly complicated, then the process must proceed to Stage 2 (AA). Screening should be undertaken without the inclusion of mitigation, unless potential impacts clearly can be avoided through the modification or redesign of the plan or project, in which case the screening process is repeated on the altered plan. The greatest level of evidence and justification will be needed in circumstances when the process ends at screening stage on grounds of no impact.

Stage 2: Appropriate Assessment

This stage considers whether the plan or project, alone or in combination with other projects or plans, will have adverse effects on the integrity of a Natura 2000 site, and includes any mitigation measures necessary to avoid, reduce or offset negative effects. The proponent of the plan or project will be required to submit a **Natura Impact Statement**, i.e. the report of a targeted professional scientific examination of the plan or project and the relevant Natura 2000 sites, to identify and characterise any possible implications for the site in view of the site's conservation objectives, taking account of in-combination effects. This should provide information to enable the competent authority to carry out the appropriate assessment. If the assessment is negative, i.e. adverse effects on the integrity of a site cannot be excluded, then the process must proceed to Stage 3, or the plan or project should be abandoned. The AA is carried out by the **Competent Authority**, and is supported by the Natura Impact Statement.

Stage 3: Alternative Solutions

This stage examines any alternative solutions or options that could enable the plan or project to proceed without adverse effects on the integrity of a Natura 2000 site. The process must return to Stage 2, as any alternative proposal must be subject to a Stage 2 Appropriate Assessment before it can be subject to the Article 6(4) test. If it can be demonstrated that all reasonable alternatives have been considered and assessed, the AA progresses to Stage 4.

Stage 4: Imperative Reasons of Overriding Public Interest (IROPI)/Derogation

Stage 4 is the main derogation process of Article 6(4) which examines whether there are imperative reasons of overriding public interest (IROPI) for allowing a plan or project that will have adverse effects on the integrity of a Natura 2000 site. The extra protection measures for Annex I priority habitats come into effect when making the IROPI case[1]. Compensatory measures must be proposed and assessed. The Commission must be informed of the compensatory measures. Compensatory measures must be practical, implementable, likely to succeed, proportionate and enforceable, and they must be approved by the Minister.

[1] IROPI reasons that may be raised for sites hosting priority habitats are those relating to human health, public safety or beneficial consequences of primary importance to the environment. In the case of other IROPI, the opinion of the Commission is necessary and should be included in the AA.

3 THE NATURA 2000 SITES POTENTIALLY IMPACTED BY THE PROPOSED DEVELOPMENT

The Dunkellin River at Rahasane is designated under Rahasane Turlough SAC/SPA. The proximity of the Natura 2000 Sites (Special Areas of Conservation (SAC's) and Special Protected Areas (SPA's)) which are located within a 15km radius of the proposed works are shown and **Figure 1.2**.

All but four of these Natura 2000 sites have been screened out for potential effects and therefore the Natura 2000 sites which are considered in this NIS include the following:

- Rahasane Turlough SAC,
- Rahasane Turlough SPA,
- Galway Bay Complex SAC, and
- Inner Galway Bay SPA.

The tables below provide details on the qualifying habitats and species of the aforementioned Natura 2000 sites. The information is obtained from the Natura 2000 Standard Data Forms for each site. These forms provide details of the Percentage Cover and Representivity of the qualifying habitats. The percentage cover for each habitat within the Natura 2000 site is described and the degree of Representivity gives a measure of 'how typical' a habitat type is. Representivity is ranked on a scale from A to D as follows;

- A - Excellent,
- B - Good,
- C – Significant, and
- D - Non-significant.

For species, the population significance is based on the relative size or density of the population in the site with that of the national population. Population Significance (p) is ranked on a scale from A to D as follows;

- A - 100>=p>15%,
- B - 15>=p>2%,
- C - 2>=p>0% and
- D - Non-significant population.

Details for the Natura 2000 sites, including site characteristics and qualifying features are set out in the following sections. The NPWS site synopses for the designated sites are provided in the AA Screening Report in **Appendix C.** The conservation objectives of the respective Natura 2000 Sites are discussed below.

3.1.1 Rahasane Turlough SAC (Site Code: 000322)

Rahasane Turlough is of major ecological significance as one of only two large turloughs which still function naturally. It is the most important turlough for birdlife in the country. It consists of two basins which are connected at times of flood but separated as the waters decline. The larger of these, the northern basin, takes the Dunkellin River westwards. Rahasane was formerly the natural sink of the Dunkellin River, but now an artificial channel takes some of the water further downstream.

There are no works proposed within the boundary of Rahasane Turlough SAC but there are works proposed immediately upstream and downstream of the site.

The sole qualifying interest of Rahasane Turlough SAC is 3180 Turloughs (which is a priority Annex I habitat) as detailed in **Table 3.1.**

Table 3.1 Rahasane Turlough SAC Annex I Habitats

Habitat code	Habitat name (SAC Qualifying Feature)	% Cover (approx.)	Representivity
3180	Turloughs*	93	A

*Priority Annex I habitat

3.1.2 Rahasane Turlough SPA (Site Code: 004089)

Rahasane Turlough SPA is of high ornithological importance and supports seven species of national importance. The Wigeon and Golden Plover populations are of particular note as they each represent approximately 4% of the national totals of these species. The occurrence of Greenland White-fronted Goose, Whooper Swan and Golden Plover is of importance as these species are listed on Annex I of the E.U. Birds Directive.

There are no works proposed within the boundary of Rahasane Turlough SPA but there are works proposed upstream and downstream of the site.

The qualifying Annex I bird species found within Rahasane Turlough SPA are provided in **Table 3.2** and the qualifying regularly occurring migratory species not listed on Annex I are provided in **Table 3.3**.

Table 3.2 Rahasane Turlough SPA Annex I Bird Species

Species code	Species name	Population significance
A038	Whooper Swan *(Cygnus Cygnus)*	C
A395	Greenland White-fronted Goose *(Anser albifrons flavirostris)*	C
A140	Golden Plover *(Pluvialis apricaria)*	B

Table 3.3 Rahasane Turlough SPA regularly occurring migratory birds not listed on Annex I

Species code	Species name	Population significance
A050	Wigeon (*Anas penelope*)	B
A052	Teal (*Anas crecca*)	C
A053	Mallard (*Anas platyrhynchos*)	C
A054	Northern Pintail (*Anas acuta*)	C
A056	Northern Shoveller (*Anas clypeata*)	C
A061	Tufted Duck (*Aythya fuligula*)	C
A142	Lapwing (*Vanellus vanellus*)	C
A149	Dunlin (*Calidris alpina*)	C
A156	Black-tailed Godwit (*Limosa limosa*)	B

Species code	Species name	Population significance
A160	Curlew (*Numenius arquata)*	C
A162	Redshank (*Tringa tetanus*)	C
A179	Black-headed gull (*Chroicocephalus ridibundus*)	C

3.1.3 Galway Bay Complex SAC (Site Code: 000268)

This large coastal site is of immense conservation importance, with many habitats listed on Annex I of the EU Habitats Directive, four of which have priority status (lagoon, *Cladium* fen, turlough and orchid-rich calcareous grassland). The examples of shallow bays, reefs, lagoons and salt marshes are amongst the best in the country. The site supports an important Common Seal colony and a breeding Otter population, both species that are listed on Annex II of the EU Habitats Directive, and six regular Annex I EU Birds Directive species.

The nearest point between proposed works and the boundary of Galway Bay Complex SAC is just upstream of the N18 Bridge which is approximately 170m from the SAC boundary.

The qualifying habitats found within the Galway Bay Complex SAC are provided in **Table 3.4** and the qualifying species are provided in **Table 3.5.**

Table 3.4 Galway Bay Complex SAC Annex I Habitats

Habitat code	Habitat name (SAC Qualifying Feature)	% Cover (approx.)	Representivity
1160	Large Shallow Inlets and Bays	81	A
1140	Mudflats and sandflats not covered by seawater at low tide	7	A
1170	Reefs	2	A
5130	*Juniperus communis* formations on heaths or calcareous grasslands	1	B
7230	Alkaline fens	1	B
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*)(*important orchid sites)*	1	B
3180	Turloughs*	1	B
7210	Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae**	1	B
1310	*Salicornia* and other annuals colonizing mud and sand	1	C
1410	Mediterranean salt meadows (*Juncetalia maritimi)*	1	A
1330	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	1	A
1220	Perennial vegetation of stony banks	1	B
1150	Coastal lagoons*	1	A

*Priority Annex I habitat

Table 3.5 Galway Bay Complex SAC Annex II Species

Species code	Species name	Population significance
1365	Common Seal *(Phoca vitulina*)	B
1355	Otter (*Lutra lutra*)	C

3.1.4 Inner Galway Bay SPA (Site Code: 004031)

Galway Bay SPA is a very large, marine-dominated, site situated on the west coast of Ireland. This large coastal site is of immense ornithological importance, with two wintering species having populations of international importance and a further sixteen species having populations of national importance. The breeding colonies of Sandwich Tern, Common Tern and Cormorant are also of national importance. Also of note is that seven of the regularly occurring species are listed on Annex I of the E.U. Birds Directive, i.e. Red-throated Diver, Black-throated Diver, Great Northern Diver, Golden Plover, Bar-tailed Godwit, Sandwich Tern and Common Tern.

The nearest point between proposed works and the boundary of Inner Galway Bay SPA is just upstream of the N18 Bridge which is approximately 170m from the SPA boundary.

The qualifying interest bird species found within Inner Galway Bay SPA are provided in **Table 3.6.**

Table 3.6 Inner Galway Bay SPA Qualifying Annex I Bird Species

Species code	Species name	Population significance
A001	Red-throated Diver *(Gavia stellata)*	C
A002	Black-throated Diver *(Gavia arctica)*	A
A003	Great Northern Diver *(Gavia immer)*	B
A140	Golden Plover *(Pluvialis apricaria)*	C
A157	Bar-tailed Godwit *(Limosa lapponica)*	B
A191	Sandwich Tern *(Sterna sandvicensis)*	B
A193	Common Tern*(Sterna hirundo)*	B

Table 3.7 Inner Galway Bay SPA regularly occurring migratory birds not listed on Annex I

Species code	Species name	Population significance
A017	Cormorant *(Phalacrocorax carbo)*	C
A046	Light-bellied Brent Goose *(Branta bernicla hrota)*	B
A048	Shelduck *(Tadorna tadorna)*	C
A050	Eurasian Wigeon *(Anas Penelope)*	C
A052	Teal *(Anas crecca)*	C
A056	Northern Shoveler *(Anas clypeata)*	B
A069	Red Breasted Merganser *(Mergus serrator)*	B
A137	Ringed Plover *(Charadrius hiaticula)*	B
A142	Lapwing *(Vanellus vanellus)*	B
A149	Dunlin *(Calidris alpina)*	C
A160	Curlew *(Numenius arquata)*	C
A162	Redshank *(Tringa totanus)*	C
A169	Turnstone *(Arenaria interpres)*	C
A179	Black Headed Gull *(Chroicocephalus ridibundus)*	C
A182	Common Gull *(Larus canus)*	C

3.1.5 Conservation Objectives of Natura 2000 Sites

The integrity of a Natura 2000 site (referred to in Article 6.3 of the EU Habitats Directive) is determined based on the conservation status of the qualifying features of the SAC as set out above.

European and national legislation places a collective obligation on Ireland and its citizens to maintain at favourable conservation status areas designated as SAC and SPA. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites. According to the EU Habitats Directive, favourable conservation status of a habitat is achieved when:

- its natural range, and area it covers within that range, are stable or increasing,

- 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,
- 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.

3.1.6 Site-Specific Conservation Objectives for the Natura 2000 Sites

3.1.6.1 Rahasane Turlough

Site specific conservation objectives have not yet been prepared for the Rahasane Turlough SAC. The following conservation objectives have been provided by the NPWS for Rahasane Turlough SAC.

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected (see **Table 3.1**).

A detailed conservation objective has however been prepared for Turlough habitat within Galway Bay Complex SAC with a conservation objectives backing document[2]. In order to inform an assessment of the potential for impacts on Rahasane Turlough it is considered appropriate to base potential targets on the existing targets detailed in the conservation objectives for Galway Bay Complex SAC. These targets are outlined in **Table 3.8** under a number of different attributes most of which are considered relevant in the maintenance of integrity of Rahasane Turlough. The target area has been adjusted to reflect the area of Rahasane Turlough (203.3ha) within the SAC boundary.

Table 3.8 Targets to Maintain the Favourable Conservation Status of '3180 Turlough' at Rahasane Turlough SAC

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable at c. ***203.3*** ha or increasing/changing subject to natural processes.	The upper limit of turlough habitat at Rahasane has been assessed by Goodwillie (2012) as being at 16.5 mOD. Maintenance of flood duration and extent at this level will maintain the turlough vegetation communities at Rahasane Turlough SAC.
Habitat distribution	Occurrence	No decline, subject to natural processes.	Turlough habitat is distributed throughout the two main basins, the main north basin and the smaller Rinn basin. Maintenance of turlough habitat over these areas will maintain habitat distribution.
Hydrological regime: flood duration, frequency, area, depth; permanently flooded area	Various	Appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat	**Hydrological regime: groundwater contribution** Maintain appropriate groundwater contribution necessary for the natural functioning of the habitat. **Hydrological regime: flood duration** Maintain hydrological regime within current range of variation for the natural functioning of the habitat. The extent of turlough habitat at Rahasane has been assessed by Goodwillie (2012) as being at 16.5 mOD

[2] NPWS (2013) *Galway Bay Complex SAC (000268) Conservation Objectives Supporting Document - Turlough Habitats*

Attribute	Measure	Target	Notes
			therefore flood duration levels at this altitude should be maintained. **Hydrological regime: flood frequency** Maintain current seasonal temporal patterns in flood frequency. **Hydrological regime: flood area** Maintain natural temporal pattern in flood area. **Hydrological regime: flood depth** Maintain natural temporal and spatial patterns in flood depths. **Hydrological regime: permanently flooded/wet areas** Maintain any areas of permanent or semi-permanent flooding or water-logging. The northern side of the main basin remains wet throughout the year which should be maintained.
Soil type: area	Hectares	Maintain variety, area and extent of soil types necessary to support current turlough vegetation and other biota	The maintenance of geology, morphology and hydrology will maintain soil type. Grazing pressure or other farming management could alter soil type locally.
Soil nutrient status: nitrogen and phosphorous	N and P concentration in soil	Maintain nutrient status appropriate to soil types	Changes in concentrations of supply of nutrients, through groundwater, surface water or land management practices, including channel improvement in the Aggard Stream, may alter the N and P concentration in turlough soil.
Physical structure: bare ground	Presence	No decline in wet bare ground, as appropriate	Maintenance of flood duration and any trampling by grazers will maintain bare ground. The location may change in response to grazing.
Chemical processes: calcium carbonate deposition and concentration	CaCO3 deposition rate/soil concentration	Maintenance of appropriate $CaCO_3$ deposition rates and concentration in soil	$CaCO_3$ deposition rates and concentration in soil may be affected by hydrological changes in the turlough and by drainage activities in the zone of contribution (groundwater catchment and surface water catchment). These will affect the CaCO3 concentration in the floodwater, or change biological communities, impacting the precipitation processes.
Water quality: nutrients; colour; phytoplankton; epiphyton	Various	Maintain appropriate water quality to support the natural structure and functioning of the habitat	**Water quality: nutrients** Maintain average annual TP concentration of ≤10µg l-1 TP, or ≤20µg l-1 TP, as appropriate. **Water quality: colour** Maintain appropriate water colour. **Water quality: phytoplankton biomass** Maintain appropriate chlorophyll a concentrations as follows: Annual mean/maximum chlorophyll a concentration <8µg l-1/<25µg l-1 **Water quality: epiphyton biomass** Maintain trace/ absent epiphyton as algal mats (< 2% cover).
Active peat formation	Flood duration	Active peat formation, where appropriate	There is no peat formation at Rahasane Turlough.
Vegetation composition: area of vegetation communities	Hectares	Maintain area of sensitive and high conservation value vegetation communities/units at each turlough	The Turlough Vegetation Communities in accordance with the system developed by Goodwillie, 1992, identified in the Galway Bay Complex SAC Conservation Objectives backing document for Turloughs as being sensitive and positive indicator communities include 2A, 2B, 3A, 3B, 4B, 6A, 6B, 7B and 8E. However further consultation with Roger Goodwillie has suggested that the communities listed below might be more appropriately considered to be sensitive with regard to nutrient enrichment and hydrology of Rahasane Turlough.

<table>
<tr><th>Attribute</th><th>Measure</th><th>Target</th><th>Notes</th></tr>
<tr><td></td><td></td><td></td><td><table><tr><th>Vegetation Community</th><th>Area (ha)</th></tr><tr><td>2B</td><td>10.2</td></tr><tr><td>3B</td><td>1.4</td></tr><tr><td>6A</td><td>25.0</td></tr><tr><td>9A</td><td>26.6</td></tr><tr><td>10A</td><td>11.4</td></tr><tr><td>10B</td><td>3.4</td></tr><tr><td>11B</td><td>14.25</td></tr></table></td></tr>
<tr><td>Vegetation composition: vegetation zonation</td><td>Distribution</td><td>Maintain vegetation zonation/mosaic characteristic of each turlough</td><td>Zonation as per mapping carried out by Goodwillie (1992) to be maintained. 17 vegetation communities to be retained with the same general distribution throughout the site.</td></tr>
<tr><td>Vegetation structure: sward height</td><td>Centimetres</td><td>Maintain a variety of sward heights across each turlough</td><td>Sward height is controlled by grazing. The current proposal will not significantly impact on sward height.</td></tr>
<tr><td>Typical species: terrestrial, wetland and aquatic plants, invertebrates, birds</td><td>Presence</td><td>Maintain typical species within Rahasane</td><td>Typical species: terrestrial, wetland and aquatic plants
Typical species are identified by cross-referencing the species listed in Goodwillie (1992) with those listed in Table 3 and Table 4 of NPWS (2013).</td></tr>
<tr><td>Fringing habitats: area</td><td>Hectares</td><td>Maintain marginal fringing habitats that support turlough vegetation, invertebrate, mammal and/or bird populations</td><td>Most areas outside of those habitats mapped by Goodwillie (1992) could potentially support vegetation, invertebrate, mammal and/or bird populations associated with the turlough. Therefore any changes in the other attributes listed in this table could lead to a decrease in area of fringing habitats.</td></tr>
<tr><td>Vegetation structure: turlough woodland</td><td>Species diversity and woodland structure</td><td>Maintain appropriate turlough woodland diversity and structure</td><td>Goodwillie (1992) states that the actual area of flooded woodland is too small to map at Rahasane Turlough. An increase would add to the biodiversity of the site.</td></tr>
</table>

3.1.6.2 Rahasane Turlough SPA

Site specific conservation objectives have not yet been prepared for the Rahasane Turlough SPA. The following generic conservation objectives have been provided by the NPWS for Rahasane Turlough SPA.

Objective: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (**Table 3.2 and 3.3**).

3.1.6.3 Galway Bay Complex SAC

Site specific conservation objectives have been prepared for the Galway Bay Complex SAC (NPWS, 2013).

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected (see **Table 3.4 and 3.5**).

The qualifying habitats which may be impacted by the proposed development include [1140] Mudflats and sandflats not covered by seawater at low tide and [1410] Mediterranean salt meadows, and species include Otter [1355] and Harbour Seal [1365]. The targets to maintain the conservation status of the qualifying habitats and species are provided in **Tables 3.9** and **3.10.**

Table 3.9 Targets to Maintain the Favourable Conservation Status of the Qualifying Habitats of Galway Bay Complex SAC

Objective	Target	Notes
To maintain the favourable conservation condition of Mudflats and sandflats not covered by seawater at low tide in Galway Bay Complex SAC, which is defined by the following list of attributes and targets.	**Target 1** The permanent habitat area is stable or increasing, subject to natural processes	This target refers to activities or operations that propose to permanently remove habitat from a site, thereby reducing the permanent amount of habitat area. It does not refer to long or short term disturbance of the biology of a site.
	Target 2 Conserve the following community types in a natural condition: - Intertidal sandy mud community complex; and Intertidal sand community complex estimated area of intertidal community complexes	The estimated areas of the communities within the Mudflats and sandflats not covered by seawater at low tide habitat given below are based on spatial interpolation and therefore should be considered indicative: • Intertidal sandy mud community complex – 513ha • Intertidal sand community complex – 232ha Significant continuous or on-going disturbance of communities should not exceed an approximate area of 15% of the interpolated area of each community type, at which point an inter-Departmental management review is recommended prior to further licensing of such activities. Proposed activities or operations that cause significant disturbance to communities but may not necessarily represent a continuous or on-going source of disturbance over time and space may be assessed in a context-specific manner giving due consideration to the proposed nature and scale of activities during the reporting cycle and the particular resilience of the receiving habitat in combination with other activities within the designated site.
The overall objective for 'Mediterranean salt meadows' in Galway Bay Complex SAC is to 'restore the favourable conservation condition' whilst the overall objective for 'Atlantic salt meadows' in Galway Bay Complex SAC is to 'restore the favourable conservation condition'.	(a) Area MSM Area - There is 8.184ha of MSM ASM Area - There is 9.832ha of ASM should be increasing, subject to natural processes ASM Range - (b) Range MSM Range - MSM range extends to the Kilcolgan River estuary in this area ASM range extends to the Kilcolgan River estuary in this area (c) Structure and Functions	**Physical structure: sediment supply** The target is to maintain the natural circulation of sediment and organic matter, without any physical obstructions. **Physical structure: creeks and pans** The target is to maintain creek and pan networks where they exist and to restore areas that have been altered. **Physical structure: flooding regime** The target is to maintain a flooding regime whereby the lowest levels of the saltmarsh are flooded daily, while the upper levels are flooded occasionally (e.g. highest spring tides). **Vegetation structure: zonation** The target is to maintain the range of coastal habitats, including transitional zones, subject to natural processes, including erosion and succession. **Vegetation structure: vegetation height** The target is to maintain structural variation within the sward. A general guideline is that there should be a sward ratio of 30% tall: 70% short across the entire saltmarsh. **Vegetation structure: vegetation cover** The target is to maintain 90% of the area outside of the creeks vegetated. **Vegetation composition: typical species & sub-communities** The target for this attribute is to ensure that a typical flora of saltmarshes is maintained, as are the range of sub-communities within the different zones.

Table 3.10 Targets to Maintain the Favourable Conservation Status of Qualifying Species of Galway Bay Complex SAC

Objective	Attribute	Target	Notes
To maintain the favourable conservation condition of Harbour Seal in Galway Bay Complex SAC, which is defined by the following list of attributes and	Access to suitable habitat	Species range within the site should not be restricted by artificial barriers to site use.	This target may be considered relevant to proposed activities or operations that will result in the permanent exclusion of harbour seal from part of its range within the site, or will permanently prevent access for the species to suitable habitat therein. It does not refer to short-term or temporary restriction of access or range.
	Breeding behaviour	Conserve the breeding sites in a natural condition.	This target is relevant to proposed activities or operations that will result in significant interference with or disturbance of (a) breeding behaviour by harbour seal within the site and/or (b) aquatic/terrestrial/intertidal habitat used during the annual breeding season.

Objective	Attribute	Target	Notes
targets			Operations or activities that cause displacement of individuals from a breeding site or alteration of natural breeding behaviour, and that may result in higher mortality or reduced reproductive success, would be regarded as significant and should therefore be avoided.
	Moulting behaviour	Conserve the moult haul-out sites in a natural condition.	These targets are relevant to proposed activities or operations that will result in significant interference with or disturbance of (a) moulting behaviour by harbour seal within the site and/or (b) aquatic/terrestrial/intertidal habitat used during the annual moult. Operations or activities that cause displacement of individuals from a moult haul-out site or alteration of natural moulting behaviour to an extent that may ultimately interfere with key ecological functions would be regarded as significant and should therefore be avoided
	Resting behaviour	Conserve the resting haul-out sites in a natural condition.	
	Disturbance	Human activities should occur at levels that do not adversely affect the harbour seal population at the site.	Proposed activities or operations should not introduce man-made energy (e.g. aerial or underwater noise, light or thermal energy) at levels that could result in a significant negative impact on individuals and/or the population of harbour seal within the site. This refers to both the aquatic and terrestrial/ intertidal habitats used by the species in addition to important natural behaviours during the species' annual cycle. This target also relates to proposed activities or operations that may result in the deterioration of key resources (e.g. water quality, feeding, etc.) upon which harbour seals depend. In the absence of complete knowledge on the species' ecological requirements in this site, such considerations should be assessed where appropriate on a case-by-case basis. Proposed activities or operations should not cause death or injury to individuals to an extent that may ultimately affect the harbour seal population at the site.
To restore the favourable conservation condition of Otter in Galway Bay Complex SAC, which is defined by the following list of attributes and targets	Distribution	No significant decline	Measure based on standard otter survey technique. FCS target, based on 1980/81 survey findings, is 88% in SACs. Current range in the west is estimated at 70% (Bailey and Rochford, 2006).
	Extent of terrestrial habitat	No significant decline. Area mapped and calculated as 262ha above high water mark (HWM); 14ha along river banks/around ponds	No field survey. Areas mapped to include 10m terrestrial buffer along shoreline (above HWM and along river banks) identified as critical for otters (NPWS, 2007)
	Extent of marine habitat	No significant decline. Area mapped and calculated as 2040ha	No field survey. Area mapped based on evidence that otters tend to forage within 80m of the shoreline (HWM) (NPWS, 2007; Kruuk, 2006)
	Extent of freshwater (river) habitat	No significant decline. Length mapped and calculated as 4km	No field survey. River length calculated on the basis that otters will utilise freshwater habitats from estuary to headwaters (Chapman and Chapman, 1982)
	Extent of freshwater (lake/lagoon) habitat	No significant decline. Area mapped and calculated as 21ha	No field survey. Area mapped based on evidence that otters tend to forage within 80m of the shoreline (NPWS, 2007)
	Couching sites and holts	No significant decline	Otters need lying up areas throughout their territory where they are secure from disturbance (Kruuk, 2006; Kruuk and Moorhouse, 1991)
	Fish biomass	No significant decline	Broad diet that varies locally and seasonally, but dominated by fish, in particular salmonids, eels and sticklebacks in

Objective	Attribute	Target	Notes
	available		freshwater (Bailey and Rochford, 2006) and wrasse and rockling in coastal waters (Kingston et al., 1999)
	Barriers to connectivity	No significant increase.	Otters will regularly commute across stretches of open water up to 500m e.g. between the mainland and an island; between two islands; across an estuary (De Jongh and O'Neill, 2010). It is important that such commuting routes are not obstructed

3.1.6.4 Inner Galway Bay SPA

Site specific conservation objectives have been prepared for the Inner Galway Bay SPA.

The overarching Conservation Objective for Inner Galway Bay SPA is to ensure that waterbird populations and their wetland habitats are maintained at, or restored to, favourable conservation condition. This includes, as an integral part, the need to avoid deterioration of habitats and significant disturbance; thereby ensuring the persistence of site integrity.

The site should contribute to the maintenance and improvement where necessary, of the overall favourable status of the national resource of waterbird species, and continuation of their long-term survival across their natural range.

Conservation Objectives for Inner Galway Bay SPA, based on the principles of favourable conservation status, are described below.

Objective 1: To maintain the favourable conservation condition of the waterbird Special Conservation Interest species listed for Inner Galway Bay SPA (**Table 3.6**).

Objective 2: To maintain the favourable conservation condition of the wetland habitat at Inner Galway Bay SPA as a resource for the regularly-occurring migratory waterbirds that utilise it (**Table 3.7**).

Specific targets for a number of attributes are listed for each qualifying interest of Inner Galway Bay SPA all of which need to be met in order to maintain the favourable conservation condition waterbird Special Conservation Interest species and wetland habitat.

The 2009/10 Waterbird Survey Programme which informed the Inner Galway Bay SPA Conservation Objectives involved counting waterbirds within a series of count sections (subsites) across the site. The Dunkellin River Estuary is located within subsite 0G485 - ‘Tyrone House & Morans’ and results of surveys at low and high tide are detailed in **Table 3.11** below.

Section 5.3.2 of the conservation objectives backing document for Inner Galway Bay SPA outlines waterbird distribution and analyses carried out for the survey results of the 2009/10 Waterbird Survey Programme. Counts for each subsite were ranked in succession from the highest to the lowest in terms of their relative contribution to each species’ distribution across all subsites surveyed. Rank positions were then converted to categories (see below) with the exception of those relating to the single high tide survey that are presented simply as rank numbers. The highest rank position/category for each subsite across any of the low tide count dates is presented in a subsite by species matrix. If there is a blank entry in a species row then that species was not counted during the survey, however this may not mean the species does not occur within OG485.

Subsite Rank Position - Categories

- Very High (V) Any section ranked as 1.
- High (H) Top third of ranking placings (where n = total number of count sections species was observed in)
- Moderate (M) Mid third of ranking placings (where n = total number of count sections species was observed in)
- Low (L) Lower third of ranking placings (where n = total number of count sections species was observed in).

Table 3.11 Ranking of Subsite OG485 Counts for Qualifying Species of Inner Galway Bay SPA

Species name	Low-tide	High-tide
Red-throated Diver *(Gavia stellata)*	-	-
Black-throated Diver *(Gavia arctica)*	-	-
Great Northern Diver *(Gavia immer)*	-	11
Golden Plover *(Pluvialis apricaria)*	-	-
Bar-tailed Godwit *(Limosa lapponica)*	-	-
Sandwich Tern *(Sterna sandvicensis)*	-	-
Common Tern*(Sterna hirundo)*	-	-
Common Gull *(Larus canus)*	-	-
Black Headed Gull *(Larus ridibundus)*	L	18
Turnstone *(Arenaria interpres)*	H	-
Red Shank *(Tringa totanus)*	L	-
Curlew *(Numenius arquata)*	M	-
Dunlin *(Calidris alpina)*	-	-
Lapwing *(Vanellus vanellus)*	H	-
Ringed Plover *(Charadrius hiaticula)*	-	-
Red Breasted Merganser *(Mergus serrator)*	-	15
Northern Shoveler *(Anas clypeata)*	V	-
Teal *(Anas crecca)*	H	11
Eurasian Wigeon *(Anas Penelope)*	M	20
Shelducks *(Tadorna tadorna)*	-	-
Light Bellied Brent Goose *(Branta bernicla hrota)*	-	-
Cormorant *(Phalacrocorax carbo)*	-	-

From the low-tide counts in **Table 3.11** it is clear that within the context of Inner Galway Bay SPA subsite OG485 is of very high importance for Northern Shoveler and of high importance for Teal, Lapwing and Turnstone. Other species which use the site include Great Northern Diver, Black Headed Gull, Redshank, Curlew, Red Breasted Merganser and Wigeon.

Activities and events identified to occur across Inner Galway Bay are shown in Appendix 9 of the '*Inner Galway Bay Special Protection Area (Site Code 4031) Conservation Objectives Supporting Document VERSION 1*', and are listed in terms of the subsites surveyed during the 2009/10 Waterbird Survey Programme.

4 PROJECT DESCRIPTION

4.1 LOCATION

The Dunkellin River has a total catchment area of 373 km^2 with a high density of tributaries and streams in the east, forming a main channel east of Craughwell Village. It flows west for approximately 11 kilometres from Craughwell and discharges to Dunbulcaun Bay at Roevehagh just north of Kilcolgan Village. The Aggard Stream flows from the south for approximately 7 kilometres where it joins the Dunkellin River, 1 kilometre west of Craughwell Village. **Figure 4.1** shows the extent of the study area.

Whilst the Dunkellin River drains significant areas of land to the east, northeast and south of Craughwell village (>200km^2), the particular reaches of river considered in this project are:

1. Approximately 11km of the Dunkellin River (also called the Craughwell River upstream of Rahasane Turlough) which runs in a westerly direction from 200 metres upstream of Craughwell Village to the sea at Kilcolgan.

2. Approximately 7.5km of the Aggard Stream which runs from the townland of Cregaclare (near Ardrahan) to its outfall at the confluence of the Dunkellin and Craughwell Rivers, approximately 1km south-west of Craughwell Village.

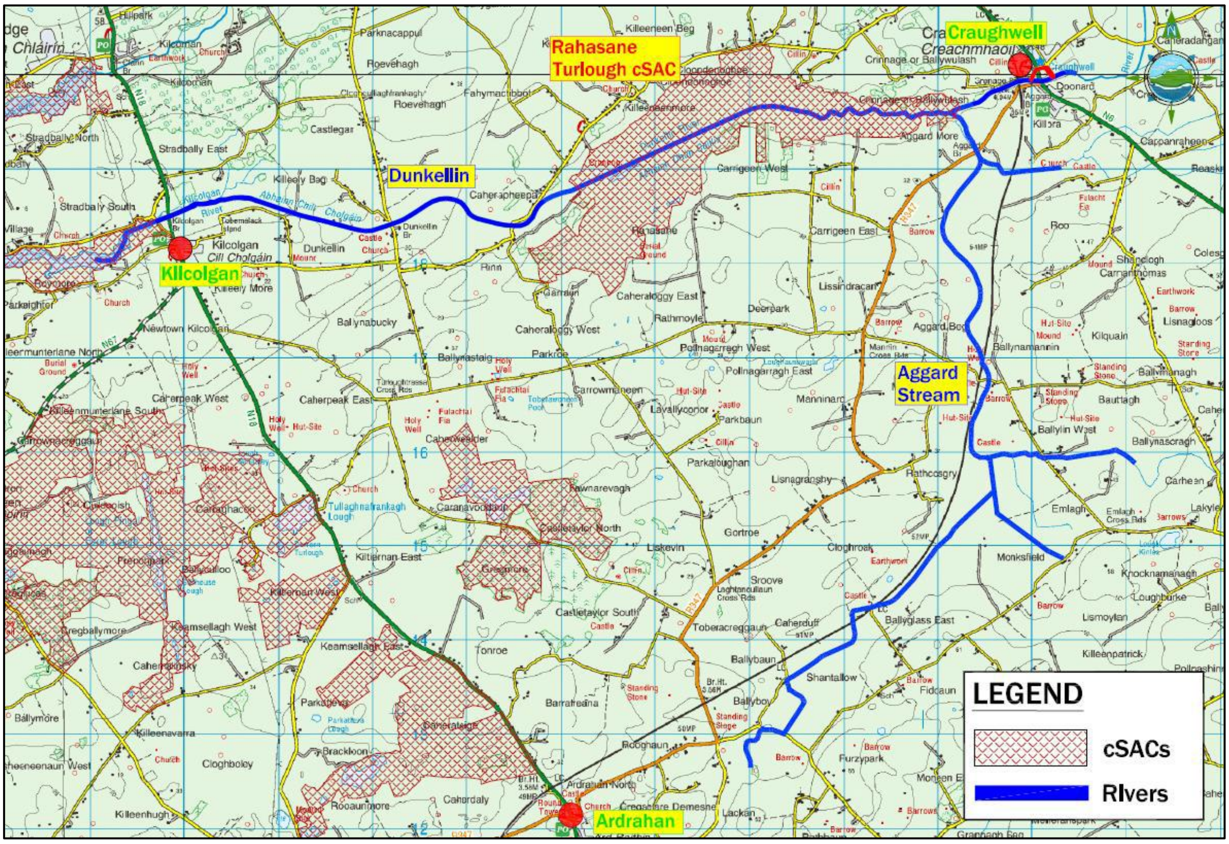


Figure 4.1 Extent of the Study Area Flood Relief Scheme – Dunkellin River

4.2 STUDY AREA AND ZONE OF INFLUENCE

The study area encompasses the course of the Aggard Stream from its source to its confluence with the Dunkellin River and the floodplain and surrounding lands of the Dunkellin River from just upstream of Craughwell Village to its discharge to Galway Bay just west of Kilcolgan.

The Zone of Influence (ZOI) extends beyond the study area to include those Environmental Resources and Receptors outside the study area that is likely to be affected by the biophysical changes caused by the project. As part of the assessment, the ecological areas and features (i.e. the ecological receptors) likely to be affected by the biophysical changes caused by the project, however remote from the proposed FRS are assessed.

4.3 NATURE AND EXTENT OF PROPOSED WORKS

The hydraulic models of the Strategic Schemes, combined with early public consultation, consultation with Galway County Council and the OPW, indicated that the particular selection of flood alleviation measures, as detailed here would produce the overall preferred scheme which would provide optimum flood relief with minimal environmental impact whilst also controlling the overall capital investment required.

The proposed measures strike a delicate balance at Rahasane Turlough SAC. Extreme floods would be passed through the turlough where possible, by limited excavations downstream of the turlough and adaptations at Rinn Bridge, which would deliberately minimise the predicted changes in water levels within the turlough so as to maintain the ecologically critical water level range.

Table 4.1 sets out the proposed flood alleviation measures over the study area and the following section details these measures. Drawings No. 6408-2201 to 6408-2204 which are presented in **Appendix A** show the proposed flood alleviation measures at each location in detail.

Table 4.1 Summary of the proposed flood alleviation measures for the main Craughwell River/Dunkellin River channel proposed for the Dunkellin River and Aggard Stream Flood Relief Scheme.

	Works Item No.	Description of Location	Proposed Works
Zone 1 250 Metres Upstream of Craughwell Village to Rahasane Turlough	**1**	**Main Channel (Craughwell Village)**	The main channel will be depended from 17.85Mod (35m u/s of the road bridge in Craughwell) to 14.66mOD (610 m d/s of the railway bridge).
	2	**R446 Bridge**	The channel will be deepened by approximately 0.6m at the R446 Road Bridge (underpinning of the bridge will be required).
	3	**Masonry Arch Pedestrian Bridge**	The channel will be deepened by approximately 0.6m at each arch (underpinning of the arches will be required).
	4	**Bypass Channel (Craughwell Village)**	The channel will be graded from an u/s level of 18.5mOD to a d/s level of 18mOD. (The bypass bridge will require underpinning to match proposed bed levels).
	5	**Railway Bridge**	The Channel will be deepened by up to 0.75m (underpinning/ scour protection of the railway bridge will be required).
Zone 2 Rahasane and Rinn Turlough Complex	**6**	**Works at Rahasane Turlough**	It is Not Proposed to Complete any Works within or adjacent to the main body of the Rahasane Turlough SPA / SAC.

Zone 3 Rinn Townland to the N18 at Kilcolgan	**7**	**Channel Works at Rinn**	A two stage channel typically 20m wide will be constructed from approximately 50m upstream of Rinn bridge to approximately 50m downstream of the bridge. Strictly out of channel maintenance works aimed at the removal of encroachment of terrestrial vegetation, removal of fallen/instream trees, with no dredging and no channelisation/arterial drainage works. Terrestrial vegetation along the river banks would be managed (i.e. trimming back of brambles and scrub) rather than being removed.
	8	**Works at Rinn Bridge**	Three flood eyes will be provided each measuring 3.1m wide x 2.1m deep.
	9	**Channel Works beginning upstream of Dunkellin bridge to Kilcolgan Bridge**	Maintenance works aimed at the removal of encroachment of terrestrial vegetation, removal of fallen/instream trees. Vegetation along the river banks would be managed (i.e. trimming back to 1.0m to 1.5m above high flood levels or top of bank) rather than being removed. Flood relief works will commence approximately 175m upstream of the Dunkellin bridge and consist of the construction of a two stage channel typically 20m wide.
	10	**Works at Dunkellin Bridge**	In conjunction with localised channel widening to facilitate the proposed bridge works (30m), the existing flood eyes shall be replaced with 2 new box culverts each measuring 13m wide x 2.3 m deep.
	11	**Channel Works from Dunkellin Bridge to Killeely Beg Bridge**	Two stage channel works will continue from Dunkellin Bridge to Kileely Beg Bridge with a typical channel with of up to 20m.
	12	**Works at Killeely Beg Bridge**	In conjunction with localised channel widening to facilitate the proposed bridge works (14m), a new bridge will be provided with an 18m span and a soffit level of 7.80mOD.
	13	**Salmon Counter**	The salmon counter will be relocated to a position upstream of Kileely Beg Bridge as part of the river enhancement works.
	14	**Channel Works from Killeely Beg Bridge to the N18 Bridge**	Two stage channel works will continue from Kileely Beg to the N18 Bridge with a typical channel width of up to 20m. From a distance of 400m upstream of the N18 Bridge the two stage channel will be tapered back to match existing channel widths.
	15	**Works at Kilcolgan & N18 Bridges**	No Works Proposed

4.3.1 Flood Alleviation Measure – Aggard Stream

The proposed works along the Aggard Stream will consist of minor culvert replacement works whereby existing blocked and undersized (600mm) piped crossings will be replaced with larger (1500mm) diameter precast concrete open jointed pipes. The proposed works will involve minor localised excavations within the existing stream. **Figure 4.2** shows the location of these culverts.

The works proposed for the Aggard Stream are minor in nature and consist of maintenance works aimed at the removal of encroachment of vegetation, removal of fallen trees and other obstacles (e.g. gates, minor obstructions, fences in the river poor culvert conveyance etc.), excessive silt deposits and that excavations not include for significant dredging and no channelization/arterial drainage works. Vegetation along the river banks would be managed (i.e. trimming back) rather than being removed, where at all possible.

Where required, silt removal will take place along the stream length. It is proposed to use the right hand bank (looking downstream) where possible to deposit any material removed in this process up to a maximum of 30m from the stream.

Details of the proposed works, locations of culvert replacement etc. are further detailed in **Appendix A, Section 3.5 and associated drawings (6408 - 2220, 6408 - 2221 and 6408 – 2222)**

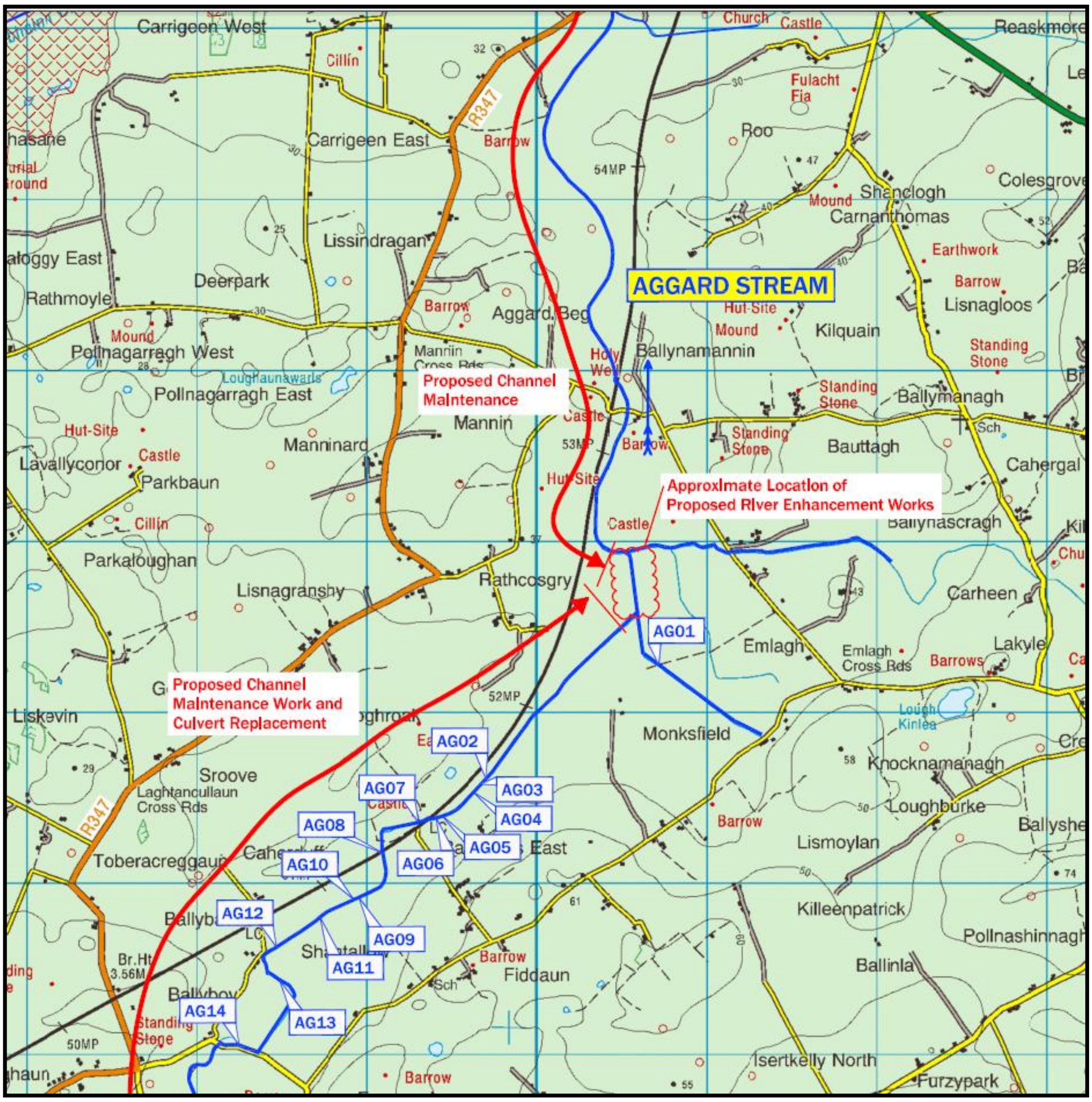


Figure 4.2 Location of 14 No. Culverts Proposed to be replaced along the Aggard Stream (Source Tobin, 2014)

4.3.2 Environmental River Enhancement Programme

An initial proposed river enhancement programme was proposed by the Inland Fisheries Ireland (IFI). This programme was based on general good practice recommendations having knowledge of the study area concerned and was subject to a detailed design stage. This programme is set out under **Appendix A, Appendix No. 3 (first section)**.

Further to this a detailed river enhancement programme was proposed by the IFI which took into consideration the detailed design measures being proposed as part of the scheme. Details on these enhancement measures and how they are to be incorporated into the proposed flood relief scheme are set out in **Appendix A, Appendix No. 3 (second section)**.

4.3.3 Salinity Modelling

A comparative study was carried out to examine the impact if any of the scheme on shellfish in the receiving marine waters. The objective of completing this modelling was to conclude if the scheme could cause decreases in salinity in the receiving shellfish waters that would prove detrimental to the shellfish population in times of flood such as the 2009 event.

The modelling demonstrated that, for this event, the salinity levels at the shellfish beds would experience minimal effects due to the scheme. Refer to **Appendix E** of the **EIS** for further details and a copy of the full report in this regard.

4.4 CONSTRUCTION STAGE TECHNIQUES AND APPROACHES

A combination of channel deepening, underpinning of bridge structures and channel widening are proposed as measures for the scheme. This section provides a general description of the construction techniques and approaches that will be taken in order to complete these measures.

4.4.1 Channel Deepening and Work on Structures

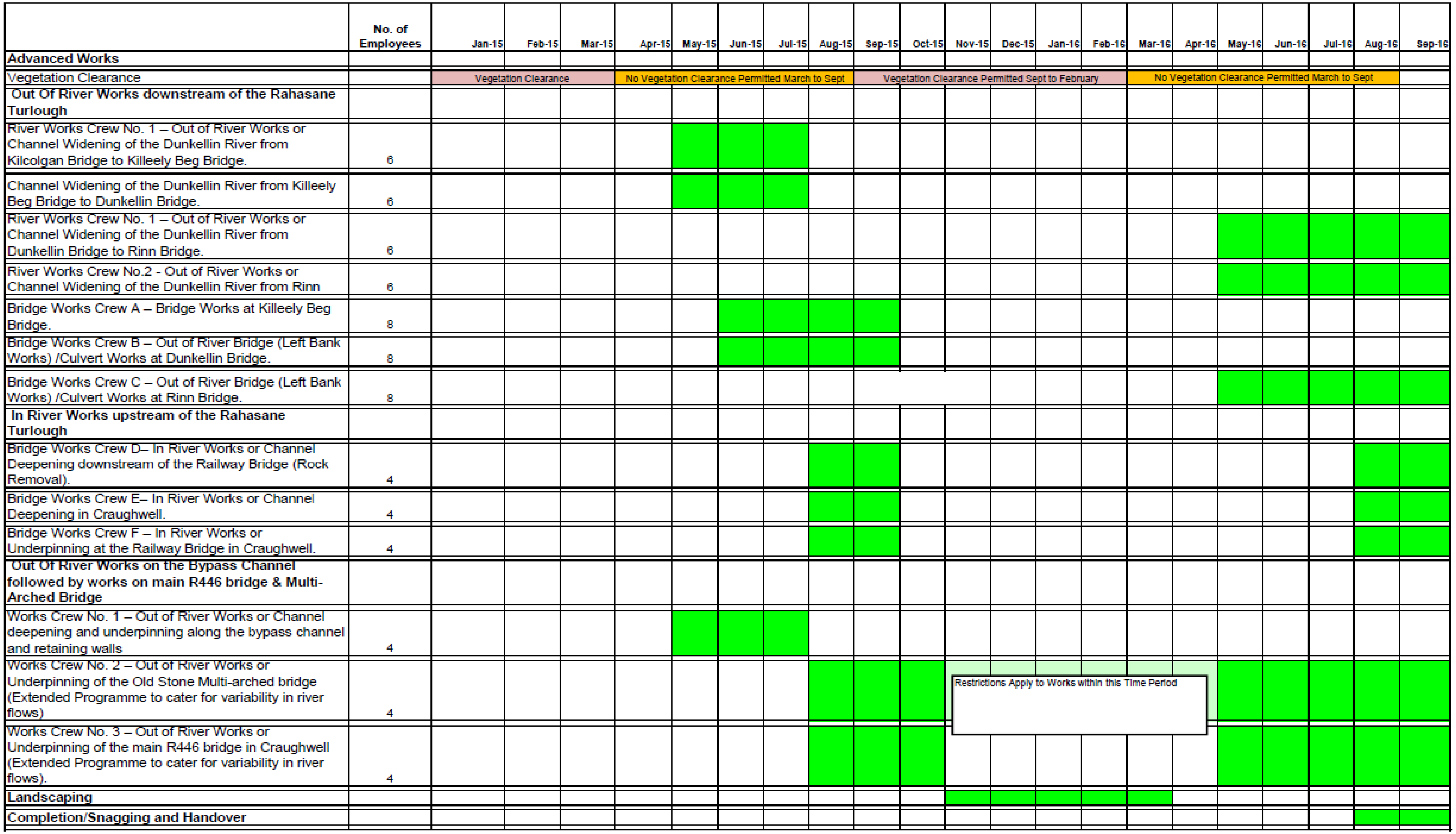
A combination of channel deepening, underpinning of bridge structures, channel widening and culvert replacement are proposed as measures for the scheme. The proposed construction methods at specific locations have been set out in **Appendix A, Section 3.2, Section 3.3 and Section 3.4**.

Some of the flood alleviation measures proposed will require instream works while others will require excavation of the river bank. Works including instream works, underpinning of structures, flow diversion and bank excavations have the potential to impact on the water quality of the river whereby silt and other construction debris may enter the water column. The risk of this occurring in the case of bank excavation can be reduced or eliminated by operating in dry conditions along the river bank. In the case of instream works and flow diversion, the timing of these works is of vital importance.

There are a number of constraints on the phasing and methods of construction works. The most significant constraint is that in general in-river or instream work is only permitted between May and September each year, however, further working restrictions may also be put in place to facilitate the populations of crayfish along the Dunkellin River.

The restrictions on certain construction activities have resulted from the recommendations of a number of statutory bodies which were consulted during the early scoping stage of the planning process. These include Inland Fisheries Ireland (IFI) and the NPWS. The timing restrictions are required to ensure that fish migration is not impeded during spawning seasons and that works do not impact on the crayfish populations that seek refuge within river banks during the winter months.

A construction works programme has been devised for the Dunkellin River and Aggard Stream Flood Relief Scheme and this is presented in **Figure 4.3.** The programme clearly respects the environmental sensitivities of the receiving environment and the recommendations of consultees. It should be noted that this is an outline programme of works only and may be subject to alterations subject to the timing of planning approvals, the final detailed design stage programme and following the appointment of a works contractor. Further details are set out in **Appendix A, Section 5.**



Estimated Max Number of Employees on Site	44

Figure 4.3 Outline Construction Programme (Source: Tobin, 2014)

4.4.2 Excavation and Spoil Management

It is anticipated that approximately 70,000m³ of overburden, rock and riverbed will be removed from the river and its surroundings as a result of channel deepening and widening as part of the scheme. It is envisaged that different techniques will be adopted with regard to the reuse or disposal of excavated material. However, the overall intention will be to reuse the excavated material as side slope protection, creation of flood embankments, creation of bankside spoil embankments and the creation of extended spoil heaps where initial treatment will require removal of topsoil, spreading of excavated material and reinstatement of the topsoil, undertaken with a view to minimising the transport of material off-site.

Suitable lands have been identified for land spreading and are shown in the scheme drawings in **Appendix A**. The lands were identified having consideration for environmental constraints including sensitive habitats, archaeology and views. This approach would also be undertaken with a view to minimising the transport of material off-site. Further details on how the volume of the material was calculated are detailed in **Appendix A, Table 6-1**.

4.4.3 Ancillary Works and Construction Site Access

It is envisaged that the construction of the scheme will require the following ancillary works:-

i) Site compound at Killeely Beg Bridge,
ii) Site compound at Dunkellin Bridge,
iii) Site compound at Rinn Bridge,
iv) Provision of an access point into the Dunkellin River at Killeely Beg Bridge,
v) Provision of an access point into the Dunkellin River at the Dunkellin Bridge,
vi) Provision of an access point into the Dunkellin River at Rinn Bridge,
vii) Temporary access road to Killeely Beg Bridge to facilitate the movement of large precast bridge beams, and
viii) Site compound at Craughwell Village.

As noted above, it is envisaged that there will be four main site compounds which include short term staff welfare facilities in addition to plant and materials storage for the proposed works.

An access point to the proposed river works will be required at the three main locations detailed above. It is envisaged that these will consist of a temporary surface which will be provided along the river bank to allow vehicles to enter and travel to the proposed excavation sites. It is envisaged that this track will be formed from stone excavated from the proposed works and will be constructed ahead of the excavation plant as work progresses.

4.4.4 Emergency Procedure for Flood Events Occurring During Construction

With flooding events having occurred in January 2005 and November 2009, the likelihood of a flood event occurring during construction could be considered to be relatively high.

Although the proposed channel works are designed to provide flood relief, their construction may cause a temporary flow restriction along the channel particularly where bridge underpinning works are proposed. The contractor must therefore ensure that the risk of flooding is not increased as a result of the proposed works. Whilst rainfall in the catchment can result in significant flows in the Dunkellin River, advance warning of such flood events is possible and the contractor will be required to monitor both long and short term weather forecasts so that machinery and personnel can be prevented from entering the channel during periods of peak flow. Monitoring of the flow in the upstream catchment may be used as an aid to predict high flow events.

Works in Craughwell and reduction of flooding risk can be facilitated by phasing of the proposed works and no machinery shall be left in the river overnight or outside of normal working hours.

4.4.5 Operational/Maintenance Stage Requirement

When fully implemented, the scheme will provide a defence against the 1 in 100 year flood event with allowance also made for future drainage works upstream of Craughwell and climate change.

However, as part of the Dunkellin Drainage District for which Galway County Council have a statutory maintenance responsibility, the Dunkellin River channel and Aggard Stream will require regular maintenance to prevent vegetation becoming overgrown thus increasing the risk of future flooding.

Galway County Council proposes to undertake a 5 year maintenance programme with activities being carried out as follows:

- Light trimming of vegetation, and
- Non-invasive cleaning of the river to remove excess debris which may have gathered in the river.

4.5 HYDRAULIC IMPACT OF THE SCHEME

4.5.1 Changes to Surface Water Profile within Rahasane Turlough SAC for a Defined Range of Flows

The proposed alterations to the Dunkellin River and its bridges have the potential to alter the flow regime of Rahasane Turlough SAC.

Figure 4.4 of the **Tobin 2014 Report** in **Appendix A**, shows the predicted surface water profile along the length of Rahasane Turlough SAC when the November 2009 flood event (which has been estimated to be a 1 in 122 year return event). **Figure 4.5** of the Report shows Rahasane Turlough when a 2 year return flood event is applied to the model of the preferred scheme.

The diagrams illustrate that there are no changes expected in the water surface profile through Rahasane Turlough for any magnitude of flood.

Figure 4.6 of the **Tobin Report** (**Appendix A**) shows the predicted surface water profile at a cross sectional location within Rahasane Turlough SAC when the November 2009 Flood event, the 5th percentile and the 10th percentile flow events are applied to the model. It is demonstrated that there will be an almost undetectable change in the water levels in the turlough for these events.

In summary, it is predicted that, both average wet weather flows and very high flood flows will give rise to similar water levels on the turlough.

There are no predicted changes in peak water levels, resulting from flood events similar to the November 2009 occurrence. There is no estimated reduction in plan area for the November 2009 event.

4.5.1 Impact on Flow Velocities

The potential Impact on Flow Velocities is discussed in full in **Appendix A, Section 4.3.**

The scouring action of flood waters has the potential to impact on the water quality of the Dunkellin River and Rahasane Turlough SAC and Galway Bay SAC. Channel velocities play a significant part in the volume of sediment carried in suspension.

Examination of the channel velocities in the mathematical model (HEC-RAS) for the existing channel and Preferred Scheme scenario shows that expected changes in flow velocities is minimal.

4.5.2 Impact on Flow Volumes

The potential impact on Flow Volumes is discussed in full in **Appendix A, Section 4.4.**

The proposed alterations to the Dunkellin River and its bridges have the potential to alter the flow regime of the river system. The impact, of the proposed works, on the November 2009 flood event and the predicted hydrographs were also examined at this stage of the proposed scheme.

The time to peak (Tp) is estimated to be reduced from 95 hours to 93 hours. It is expected that implementation of the Preferred Scheme will result in a marginal increase (less than 1%) in the rate at which water is discharged to Galway Bay during a similar November 2009 flood event and on balance the volume of flood water passing Killeely Beg Bridge will not change significantly.

5 EXISTING ENVIRONMENT

5.1 GEOLOGY, HYDROLOGY & HYDROGEOLOGY

The Geological Survey of Ireland (GSI) website was consulted for available geological/hydrogeological information and the Office of Public Works (OPW) and Environmental Protection Agency (EPA) websites were consulted for information relating to hydrology.

5.1.1 Bedrock Geology

The bedrock geology of the area is predominately limestone. Undifferentiated Visean Limestone is the main type of limestone underlying the Dunkellin River in the study area. The Visean limestone is a pure bedded limestone which means it has high calcium carbonate content. The bedrock geology of the area to the south of the Dunkellin River is comprised of the Castlequarter Member of the Tubber Formation, the Burren Formation and the Lucan Formation. The Castlequarter Member of the Tubber Formation consists of monotonous light to medium grey shelf limestone topped by a dolomite bed. The Burren Formation consists mainly of pale grey clean skeletal limestone and the Lucan Formation consists of dark limestone and shale.

5.1.2 Quaternary Geology

The main subsoils type within the study area is limestone till with subsoil thickness ranging from 0 to 20m in the region. The area around Rahasane Turlough is comprised chiefly of lake sediments and outcrops of karst rock are scattered throughout the study area. Most places in Rahasane contain silty clay with shell fragments up to or more than 3m in thickness and soil is well exposed around swallow holes. Locally in the main basin there are signs of marl but peat is absent everywhere.

5.1.3 Hydrogeology

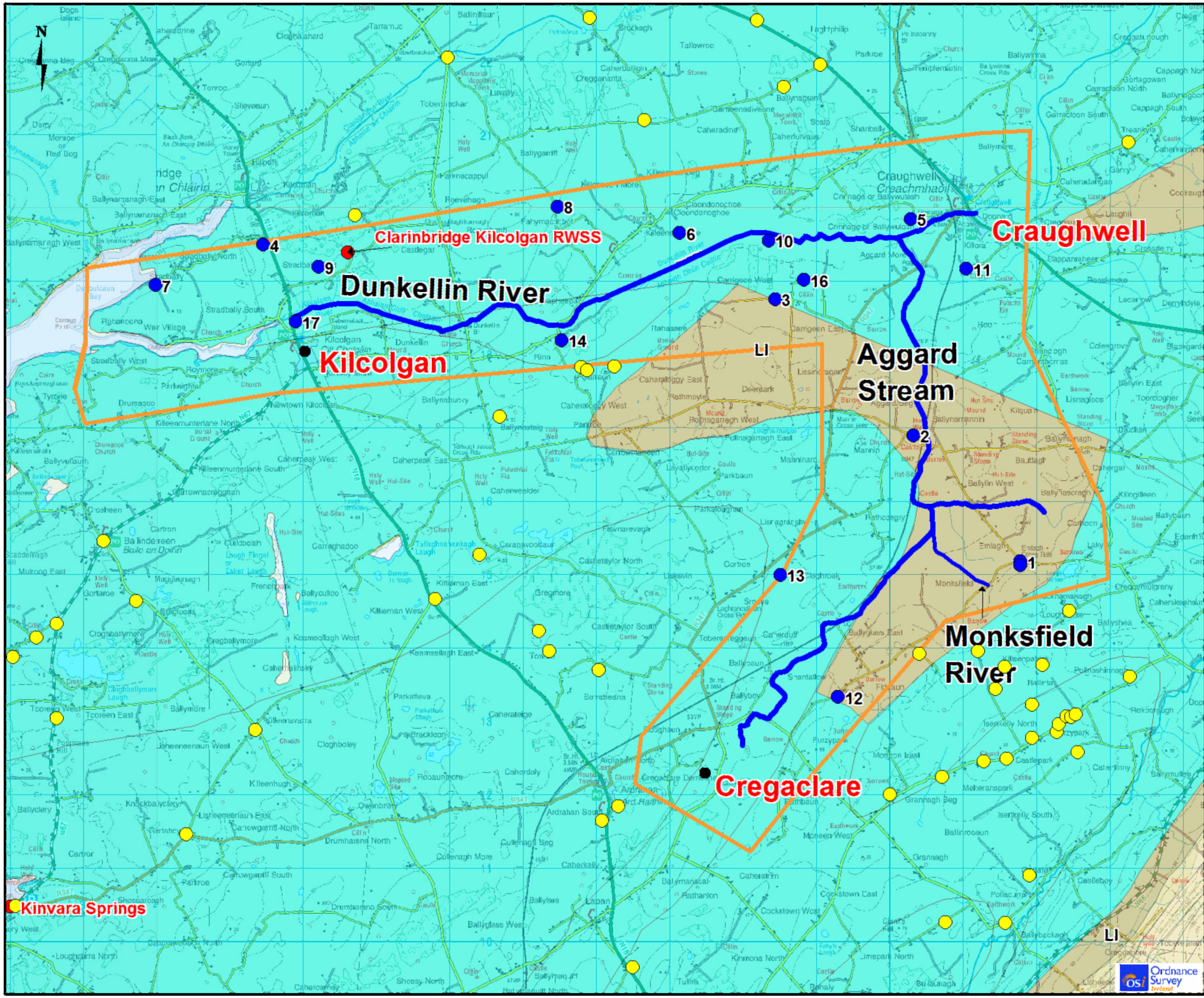
The rock underlying the majority of the study area is classified by the GSI as **Rkc** which is Regionally Important Karstified Aquifer with a conduit karst flow system. A segment of rock underlying the Aggard Stream is classified as **Ll** which is a Locally Important Aquifer which is moderately productive in local zones. The aquifer classification in the study area is shown on **Figure 5.1.**

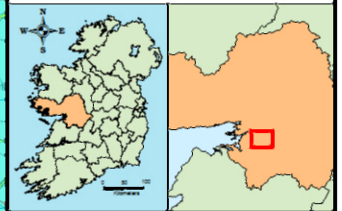
The GSI records show that there are a number of Group Water Supplies (GWS) located in the region shown in **Table 5.1**. There are also a number of individual household groundwater supplies throughout the area however a full register of such supplies in not available. The GSI records include the large spring abstraction for the Clarinbridge-Kilcolgan Regional Water Supply. This is no longer used as a source of public water supply (EPA 2011) however there remains a significant spring overflow which can be viewed as a major groundwater discharge point from the aquifer.

Table 5.1 Group Water Supplies in the Region

Water Supply Name	Type	Abstraction (m3/d)
Rinn GWS	Borehole	218*
Castletaylor - Adrahan GWS	Borehole	136
Caherdine/Caherdevan GWS	Borehole	70
Roevehagh GWS	Spring	102
Ganty - Craughwell GWS	Borehole	31
Carrigeen GWS	Borehole	34
Lisnagransby GWS	Borehole	58
Ballyglass/Fiddane GWS	Borehole	8
Kiltiernan/Kilcolgan GWS	Borehole	147*

*This represents borehole yield as opposed to actual abstraction





Legend

- Dunkellin River, Aggard Stream & Monksfield River Study Section
- Regionally Important Aquifer - Karstified (Rkc)
- Locally Important Aquifer (LI)
- EPA groundwater monitoring sites
- Buffer zone
- GSI groundwater wells within 1km buffer zone
- GSI groundwater wells outside 1km buffer zone

Client

Galway County Council

Project

Dunkellin River and Aggard Stream Flood Relief Scheme; Environmental Consultancy Services

Title

Aquifer Map

Figure 5.1

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The vulnerability of the aquifer underlying the Dunkellin River is classified by the GSI as Extreme. A significant proportion of this is described as rock near the surface or karst. The majority of the aquifer surrounding the Aggard Stream is classified by the Geological Survey of Ireland as “High Vulnerability” with small intermittent areas of “Extreme Vulnerability” and “Extreme (rock near the surface or karst)”. There are 20 No. karst features located within a 1km buffer zone detailed in **Table 5.2.**

Table 5.2 Karst features within 1km Buffer Zone

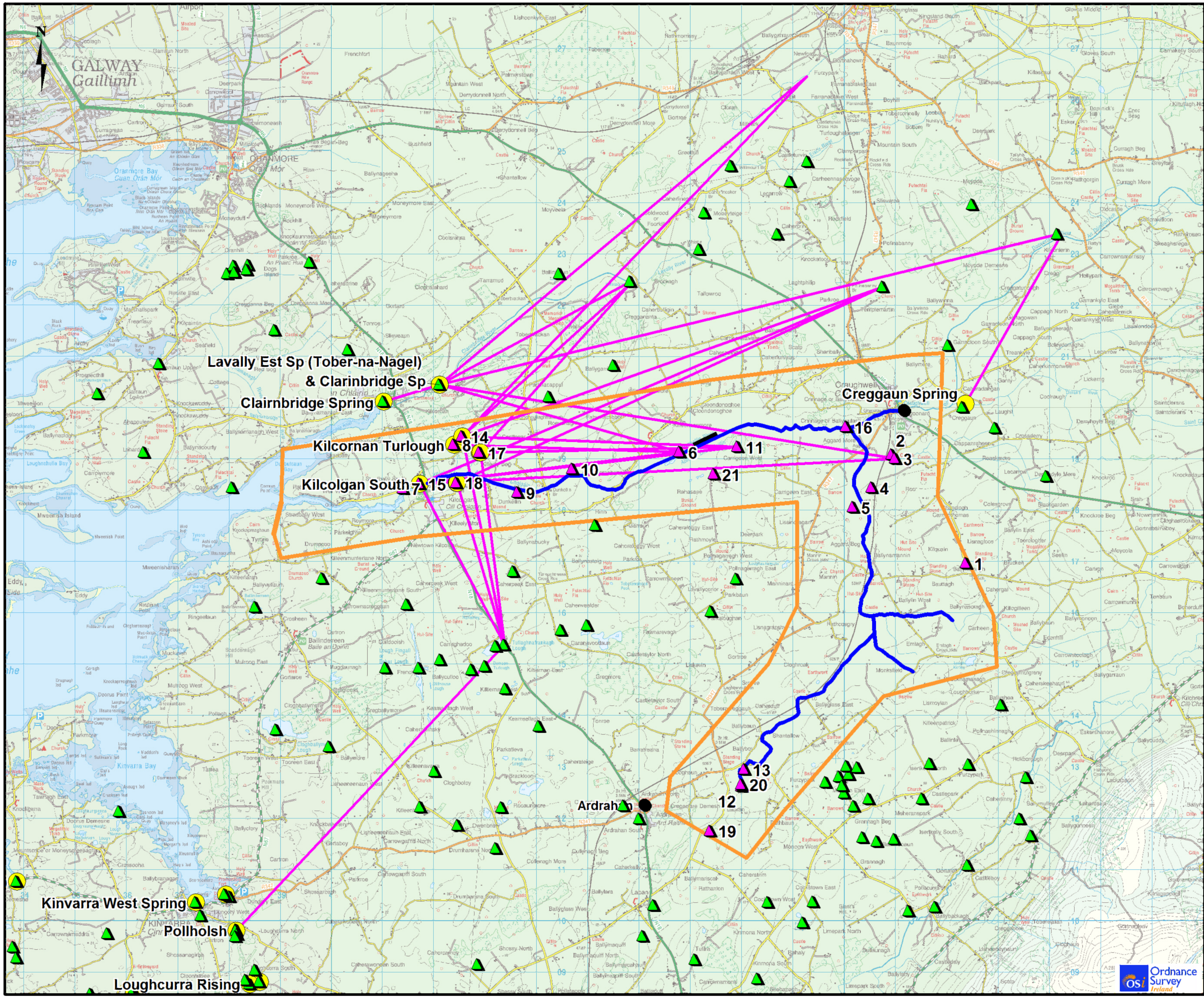
Feature No	Type	Name	Townland
1	Cave	N/A	Ballymannagh
2	Cave	N/A	Killora
3	Turlough	Killora Turlough	Killora
4	Cave	N/A	Roo
5	Turlough	Aggard	Aggard Beg
6	Turlough	N/A	Killeeneen More
7	Cave	N/A	Stradbally South
8	Turlough	N/A	Kilcornan
9	Turlough	N/A	Castlegar
10	Turlough	Dunkellin	Roevehagh
11	Turlough	Rahasane	Rahasane/ Carrieen West
12	Swallow Hole	NCregaclare	Lackan
13	Spring	N/A	Lackan
14	Spring	Kilcolgan East	Kilcornan
15	Spring	Kilcolgan West	Stradbally
16	Swallow Hole	N/A	Crinnagh
17	Spring	Killeely Beg Spring	Killeely Beg
18	Spring	Tobernalack	Killeely More
19	Turlough	N/A	Lackan
20	Turlough	N/A	Lackan

Two other significant karst features have been identified outside the study area to the north-west at Clarinbridge- Lavally Estate Spa and Clarinbridge Spring.

Tracer tests carried out by the GSI show that a number of karst features in the area are interconnected (**Figure 5.2**). Of particular interest to this study, the tests show definite interconnection of karst features to the south and east of the river channels with those in the north west of the study area. Karst features 2 (Cave), 3 (Turlough), 6 (Turlough) and 11 (Turlough-Rashane) as well as other karst features several kilometres to the south of the study area all show connectivity to karst features north west of the Dunkellin River channel, namely Lavally Estate Spa, Clarinbridge Spring, 7 (Cave) 8 (Turlough),14 (Spring),15 (Spring),17 (Spring) and 18 (Spring).

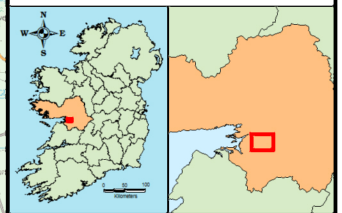
Groundwater investigations undertaken by Drew (1986) note “*permanent or semi-permanent springs in the Dunkellin catchment are those which provide much of the baseflow discharge for the Aggard River (Manning Springs and Aggard Springs) both with a relatively constant discharge. There are also a series of springs close to Dunkellin-Raford channel that become operative only during high water conditions. These include the major spring near Rahasane House which contributes a flow of c.0.5 cumecs to the turlough, a series of medium spring on the north side of the Dunkellin Turlough and, much the largest, the springs upstream of Rahasane Turlough*.”

The recent assessment of the turlough hydrology by Tobin Consulting Engineers (2012) estimate the average input of the Rahasane House Spring to the turlough water balance is $0.24m^3/s$, which is of the same order to that estimated above.



Legend

- Dunkellin River, Aggard Stream & Monksfield River Study Section
- Karst Features
- 1km Buffer Zone
- Karst Features Outside 1km Buffer Zone
- Tracer Lines
- Tracer Output Sites



Client

Galway County Council

Project

Dunkellin River and Aggard Stream Flood Relief Scheme

Title

Karst Features & Tracer Lines

Figure 5.2

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5.1.4 Groundwater Dependant Terrestrial Ecosystems (GWDTE)

Groundwater dependent terrestrial ecosystems (GWDTE) are wetlands which critically depend on groundwater flows and/or chemistries and are included in the register of protected areas established under Regulation 8 of the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003).

Rahasane Turlough is the most important turlough for birdlife in the country. In a relatively recent national survey, it was also rated very highly for its vegetation, and supports two rare species listed in The Irish Red Data Book; i.e. *Viola persicifolia* and *Rorippa islandica*. Turloughs are a rare habitat type and are given priority status under Annex I of the European Habitats Directive. Drainage is a major threat to turloughs.

Rahasane was formerly the natural sink of the Dunkellin River, but now an artificial channel takes some of the water further downstream. The turlough consists of two basins which are connected at times of flood but separated as the waters decline. Water escapes the artificial channel to sweep around the northern basin, and again in the west, where it flows into an active swallow-hole system. The main swallow holes here are constantly changing and reach up to 5m in diameter and 2-3m deep. Some minor collapses are found elsewhere in the turlough[3], as well as a small number of more permanent pools.

There is surface flow monitoring directly up and downstream of the turlough at the gauges No 29010, 29007 and 29002. An analysis of the hydrographs from these gauges shows this section of the river which flows though the turlough fluctuates between a losing and gaining stream (with respect to groundwater) throughout the year. There are groundwater monitoring wells present in the area which were installed during a previous flood alleviation study. There has been no ongoing monitoring of groundwater or surface water levels on a regular basis within the turlough.

The other turloughs within the study area are all considered GWDTEs including Dunkellin Turlough, Castlegar Turlough, Killora Turlough, Aggard Turlough, Killeeneen Turlough, Kilcornan Turlough and the turloughs at Lackan. The available information on the hydrogeology of these features is not as good as that available for Rahasane Turlough. Information on the hydrogeological connections with other karst features is provided by the GSI.

5.1.5 Surface Hydrology

The Dunkellin River and its tributaries, rise at a number of locations to the east of Craughwell, and drain a number of population centres, including Woodlawn (Raford or Dooyertha River) and New Inn (Craughwell River), Cappataggle and Lough Rea (St Cleran's River) to name a few. Flows from each of the upper catchment areas, combine to form the main channel reach at Craughwell Village, where the discharge is recorded at a gauging station (Station No. 29007) on the main R446 (formerly N6) Road Bridge.

The Dunkellin River has a total catchment area of 373 km^2 with a high density of tributaries streams in the east, forming a main channel east of Craughwell Village. It flows west for approximately 11 kilometres from Craughwell and discharges to Dunbulcaun Bay at Roevehagh just north of Kilcolgan Village. The Aggard Stream and the Monksfield River flow from the south for approximately 7 kilometres where it joins the Dunkellin River 1 kilometre south west of Craughwell Village.

There are two EPA water quality monitoring stations located on the Dunkellin River from Craughwell to Kilcolgan that have been surveyed in 2009. Old Road Bridge monitoring point (29K010400) had a Q4 rating (good) in 2009 and Dunkellin Bridge (29K010600) had a Q3-4 rating (moderate) in 2009.

[3] Minor collapses were noted on the Turlough basin during the 2014 vegetation surveys between the townlands of Aggard More and Carrigeen East.

5.1.6 Flooding

A search of the Office of Public Works National Flood Hazard Mapping website, www.floodmaps.ie, was performed to obtain information on flooding history in the vicinity of Dunkellin River study area. This information may be useful in the appropriate assessment process given the high occurrence of watercourses in the study area. Any potential for water pollution may be increased in the case of flood events.

There is a history of flooding in the Dunkellin River catchment including the most notable flood events of recent times in November 2009 and January 2005. **Figure 5.3** shows the numerous flooding events that have been recorded by the OPW in the study area. **Images 5.1-5.4** show aerial views of flood events.

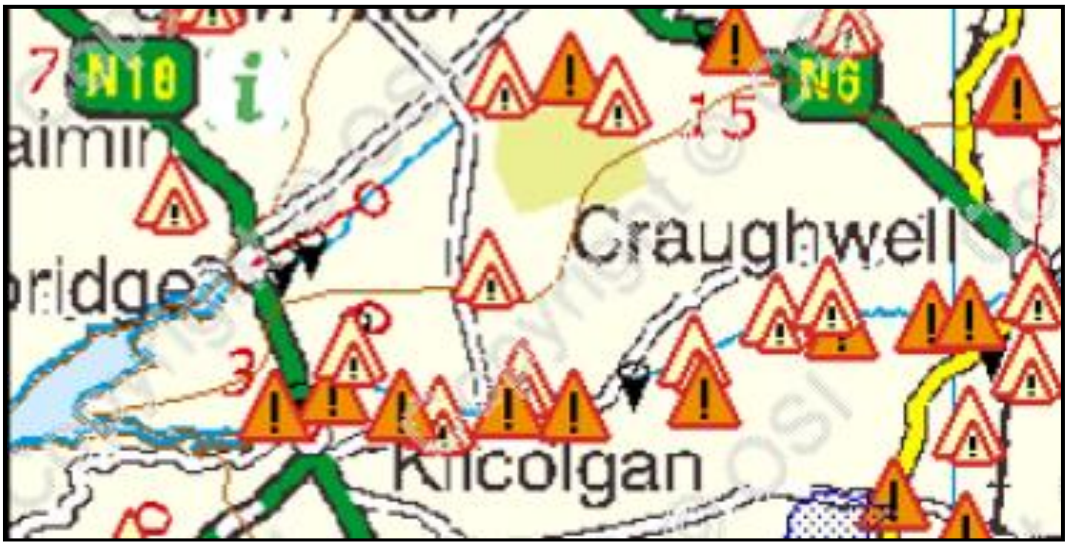


Figure 5.3 Extract from OPW Flood Hazard Map within the Dunkellin River catchment (www.opw.ie)

Image 5.1 Flooding in Craughwell at the Main R446 crossing on 20th Nov 2009 (Source Tobin, 2014)

Image 5.2 Flooding at Dunkellin Bridge on 23rd Nov 2009 (Source Tobin, 2014)

Image 5.3 Flooding in townland of Killeely Beg on 23rd Nov 2009 (Source Tobin, 2014)

Image 5.4 Rahasane Turlough downstream of Craughwell on 23rd Nov 2009 (Source Tobin, 2014)

A detailed flood model was developed for the system which has taken into consideration flood relief design standards, estimated return period for the November 2009 event, climate change and future flow scenarios and sets out the flood modelling methods used for the scheme and assesses the potential impact of the proposed scheme on the existing hydrological environment of the Dunkellin River and Aggard Stream.

Potential for impacts on the hydrological features and function of same were further explored by the scheme design consultants – Tobin Consulting Engineers – in terms of potential impact on the surface water profile, changes to flow velocities and volumes as a result of the proposed works. Details of this assessment are presented in **Appendix A** of this document. The following conclusions have been made:

- The post works water surface profile associated with Mean Annual Flow is in most cases contained within the main channel downstream of the Rinn Bridge,
- There are no changes expected in the water surface profile through Rahasane Turlough for any magnitude of flood,
- Examination of the channel velocities in the mathematical model (HEC-RAS) for the existing channel and the scheme scenario shows that expected changes in flow velocities is minimal, and
- It is expected that implementation of the scheme will result in a marginal increase (less than 1%) in the rate at which water is discharged to Galway Bay during a similar November 2009 flood event and on balance the volume of flood water passing Killeely Beg Bridge will not change significantly.

6 ASSESSMENT OF QUALIFYING HABITATS AND SPECIES

6.1 ASSESSMENT OF QUALIFYING HABITATS

The habitats within the study area were surveyed in 2011 and 2014. They are based on detailed walkover surveys and an interpretation of the aerial photography. The habitats recorded are classified in accordance with the guidelines set out in '*A Guide to Habitats in Ireland*' (Fossitt, 2000), which classifies habitats based on the vegetation present and management history. Links with Priority and Non-Priority Annex I habitats of the Habitats Directive (92/43/EEC) is also described as per the *Interpretation Manual of European Union Habitats - EUR27*. The Interpretation Manual is a scientific reference document published by the European Commission for the interpretation of Priority and Non-Priority Annex I habitat types of the Council Directive 92/43/EEC. This manual incorporates descriptive sheets for Priority and Non-Priority Habitats, which establishes clear, operational scientific definitions of habitats, using pragmatic descriptive elements (e.g. characteristic plants) and taking into consideration regional variations. The *Status of EU Protected Habitats and Species in Ireland* (NPWS, 2013) was also consulted which provides details on the status of listed habitats and species and also provides lists of typical species for these habitats in Irish context.

Those habitats found outside the Natura 2000 sites within the study area are discussed in greater detail in **Chapter 10 of the Environmental Impact Statement (EIS)** for the project.

The habitats within Rahasane Turlough were also classified in accordance with the *Turloughs over 10ha: Vegetation Survey and Evaluation*, internal report to the National Parks and Wildlife Service by Rodger Goodwillie in 1992, referred to in the rest of this document as Goodwillie (1992). In Goodwillie (1992), thirty-two turlough vegetation communities were recorded; seventeen of these were recorded within Rahasane Turlough. Vegetation community surveys were completed for this project in 2011 and 2014.

In 2011, the survey of vegetation communities within Rahasane Turlough was curtailed due to extensive flooding during the surveying period. In 2014, an initial site walkover survey of the turlough basin was completed in late April. This was undertaken to gain an overview of the current distribution and extent of those habitats and vegetation communities in Rahasane Turlough and how these correspond to those communities mapped by Goodwillie (1992). However this site walkover survey proved inconclusive as much of the Turlough basin had dried out, evidenced by complete water drawdown in turlough wetland vegetation communities such as 8A (*Polygonum amphibium*), 9A (Temporary pond) and 10A (*Oenanthe aquatica*) (Goodwillie, 1992). In addition, vegetation growth and cover was not satisfactorily advanced to allow for confident and conclusive plant identification and hence vegetation community identification and classification.

In early June 2014, a vegetation community survey was completed within Rahasane Turlough. This survey sought to verify those vegetation communities mapped and described by Goodwillie (1992). To this end, a series of relevés were taken along nine longitudinal transects. These transects correspond to topographical lidar information and run perpendicular to the Dunkellin River; i.e. running in a general north to south plane across the turlough basin. Along each of these transects, a series of relevés or quadrats were taken. The location for each relevé was dictated by discrete changes in the turlough basin's topography, sourced from the baseline topographical lidar surveys of the turlough (See **Figure 6.1**). Where a number of relevés were located within close proximity to one another and there was no discernible change in the vegetation community or plant species composition, representative relevés were taken. Additional relevés were also taken along transects where a notable or discernible change of plant species composition occurred within a vegetation community or indeed a change of vegetation community. In some cases, relevés could not be taken due to water depths and unsafe ground conditions, especially nearer the Dunkellin River and the large channel located within the turloughs northern basin. In this case, notes were taken on the relevant cover and abundance of plant species within these areas in addition to features such as water depth, vegetation height and substrate composition.

2 m x 2 m relevé samples were taken from each relevé point. A ten figure grid reference was obtained for each relevé point and was used to relocate the relevé (on average captured to 1 metre accuracy with a handheld GPS unit) during the field walkover surveys. Cover in vertical projection for all species was recorded on the Domin scale (Kent and Coker 1992), as were other general environmental parameters; i.e. water height, vegetation height, % forb, % grass, % bare ground and poaching. A digital photograph was also captured for each relevé taken in addition to a general note detailing environmental variables, conditions and threats of the relevé area and its immediate surrounds.

Along the nine transects, one hundred and sixty six relevés were surveyed within Rahasane turlough. The species list for relevé is provided in **Appendix E**. **Table 6.2** provides details on Turlough vegetation community classification.

The turlough habitat within Rahasane Turlough is the only qualifying Annex I habitat of this SAC. There are no Annex II species selected as qualifying features for Rahasane Turlough SAC and five bird species listed on Annex I of the E.U. Birds Directive are identified as the qualifying species of Rahasane Turlough SPA.

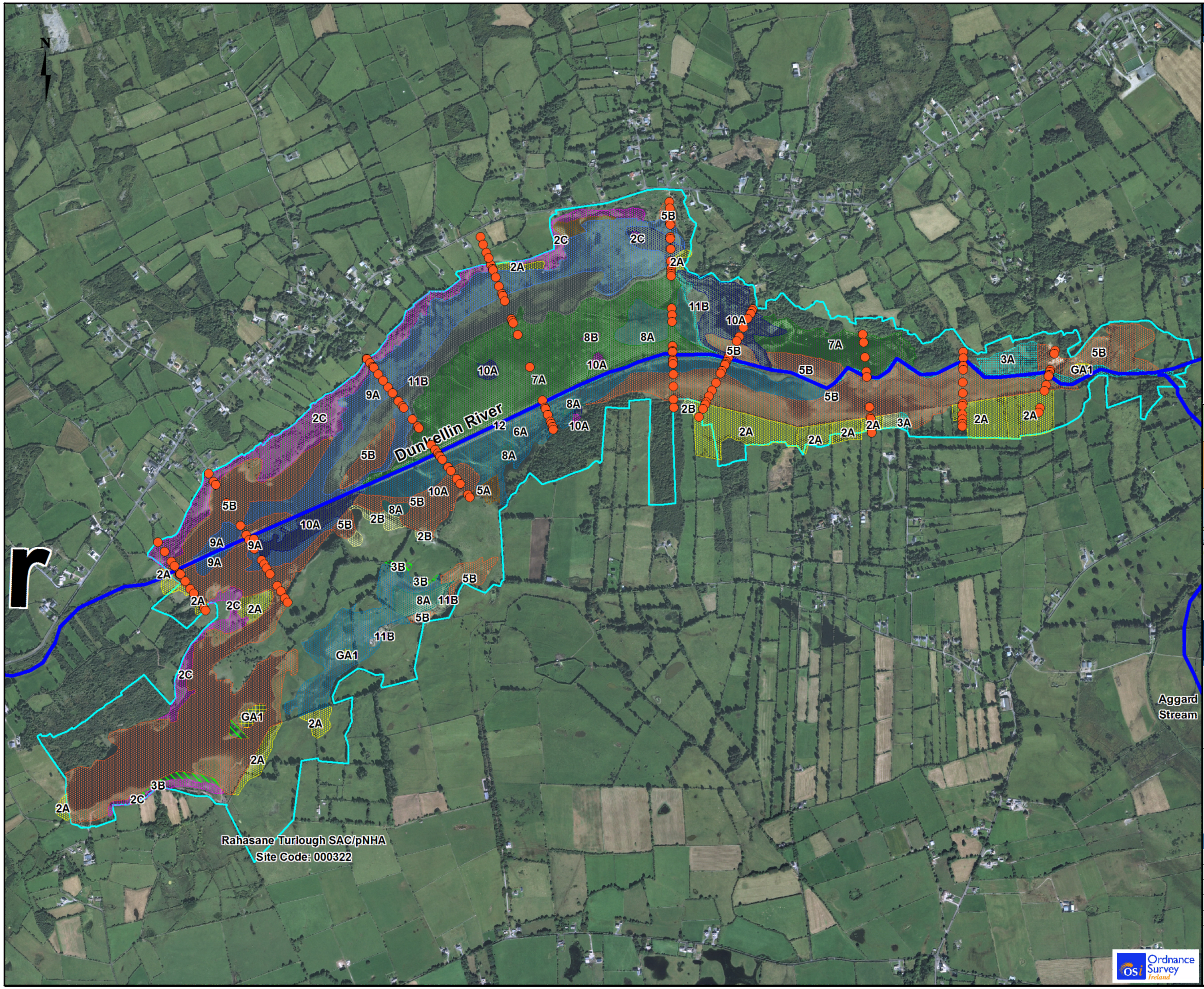
The only Annex I habitat found in the vicinity of the proposed flood relief works therefore is the Priority Annex I habitat Turloughs (3180).

The scheme works between Craughwell and Kilcolgan will be undertaken on the banks of the Dunkellin River however there will be no works within Rahasane Turlough SAC/SPA. Measures proposed outside the boundaries both upstream and downstream of Rahasane Turlough may impact indirectly on Annex I Turlough habitat and Annex I Bird species within the SAC/SPA boundary.

Article 10 of the Habitats Directive also refers to features of the landscape outside designated sites which are of major importance for wild flora and fauna, as the follows:

‘Member States shall endeavour, where they consider it necessary, in their land-use planning and development policies and, in particular, with a view to improving the ecological coherence of the Natura 2000 network, to encourage the management of features of the landscape which are of major importance for wild fauna and flora.

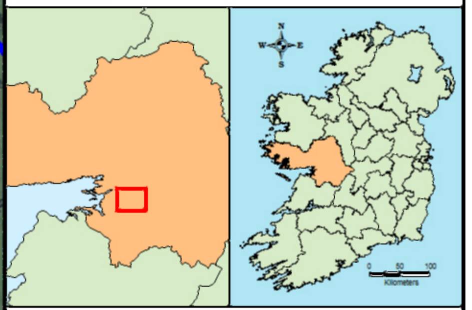
Such features are those which, by virtue of their linear and continuous structure (such as rivers with their banks or the traditional systems for marking field boundaries) or their function as stepping stones (such as ponds or small woods), are essential for the migration, dispersal and genetic exchange of wild species.’



Legend

Rhasane Vegetation Communities

- 2A Lolium grassland
- 2B Poor grassland
- 2C Limestone grassland
- 3A Tall herb
- 3B Sedge heath
- 5A Dry weed
- 5B Potentilla reptans (species poor)
- 6A Dry Carex nigra
- 7A Polygonum amphibium (grassy)
- 8A Polygonum amphibium
- 8B Wet annuals
- 9A Temporary Pond
- 10A Oenanthe aquatica
- 11B Peaty Pond
- Releve Locations
- SAC Boundary



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Galway County Council

Project

Dunkellin River and Aggard Stream Flood Relief Scheme

Title

Vegetation Communities within Rahasane Turlough

Figure 6.1

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Notes

2. All levels are referred to Ordnance Datum, Malin Head.

6.1.1 Qualifying Interests of Rahasane Turlough

This section provides a description of the turlough habitat at Rahasane Turlough SAC which may be affected by the scheme. The only qualifying interest of Rahasane Turlough SAC is the Annex I habitat [3180] Turloughs.

6.1.1.1 Turloughs [3180]

There a number of turloughs within the study area. Rahasane Turlough is however the only turlough designated as a SAC or SPA. Castlegar Turlough and Dunkellin Turlough, which are both downstream of Rahasane Turlough, are not designated as Natura 2000 sites but are hydrologically linked to Rahasane Turlough.

An extract from the National Conservation Status Turloughs [3180] from the Article 17 Species Conservation Status Assessments (NPWS 2013) is provided in **Table 6.1** below.

Table 6.1 National Conservation Status Turloughs [3180] (from the Article 17 Species Conservation Status Assessments (NPWS 2013)

Criteria	Assessment	Qualifier
Range	Favourable	N/A
Area	Favourable	N/A
Specific structures and function	Inadequate	Stable
Future Prospects	Inadequate	Stable
Overall Assessment	Inadequate	
Overall Trend	Stable	

All areas within the normal limit of flooding are considered as part of the turlough habitat. The upper limit of flooding is deduced from the upper limit of the epiphytic or epilithic moss *Cinclidotus fontinaloides* which can often be found clinging to rock surfaces. The lower flooding limit is indicated by *Fontinalis antipyretica* or sometimes by a tufaceous crust (Skeffington *et al*., 2006).

Wet grassland usually dominates turloughs and can include Creeping Bent (*Agrostis stolonifera*), small sedges (*Carex nigra* and *C. panicea*), Silverweed (*Potentilla anserina*), Meadowsweet (*Filipendula ulmaria*), Creeping Buttercup (*Ranunculus repens*), Marsh Pennywort (*Hydrocotyle vulgaris*) and Amphibious Bistort (*Polygonum amphibium*).

Goodwillie (1992) identified seventeen of the thirty-two turlough vegetation communities within Rahasane Turlough. Vegetation community surveys completed for this project in 2011 and 2014 found slight variation in the vegetation communities identified in 1992 when compared to 2014. Further discussion of the past (1992) and current distribution and coverage of Turlough vegetation communities at Rahasane are discussed in **Table 6.2** and in **Section 6.1.2** and displayed in **Figure 6.1**.

The 'Galway Bay Complex SAC (site code 268) Conservation objectives supporting document-Turloughs' (NPWS, 2013) outline that the following communities, identified within Rahasane Turlough, can be considered positive indicator communities: 2A, 2B, 3A, 3B, 6A and 6B. Consultation with Roger Goodwillie has resulted in the list of the sensitive communities of Rahasane Turlough being refined to include: 2B, 3B, 6A, 9A, 10A, 10B and 11B.

Table 6.2 Turlough vegetation communities identified at Rahasane Turlough by Goodwillie (1992)

Turlough Vegetation Community Types (Goodwillie 1992)	Vegetation Community Type General Descriptions[4]	Area within Rahasane (Ha) 1992	Area within Rahasane (Ha) 2014
2A *Lolium* grassland	This community is found on the more eutrophic fields around Turlough margins. Such sites may be naturally rich, especially if there is limestone near the surface, or they may be fertilized and grazed. The main species in terms of coverage are usually *Agrostis stolonifera*, *Scorzoneroides autumnalis* and *Plantago lanceolata* but at times *Trifolium repens*, *Festuca rubra*, *Lolium perenne* or *Calliergon cuspidatum* may be almost as common. Poa species are important in many places, both *P. pratensis* and *P. trivialis*, but often *Bellis perennis*, *Ranunculus acris* and *R. repens* are more conspicuous. Late in the season *Cynosurus* and locally *Cirsium arvense* invite attention because of their size and persistence. *Cerastium fontanum* and *Odontites verna* are practically restricted to this community. The community was usually recognised by the presence of *Lolium*, *Festuca rubra*, *Trifolium repens*, *Bellis*, *Cirsium arvense* and *Poa* spp. It is especially common in the drier turloughs in good land, for example Belclare and Peterswell.	Stretches on the flooded edges of agricultural fields (5.4)	This grassland habitat is located on the northern and southern extremities of the turlough basin. Coverage has expanded since the 1992 surveys with areas of 2B and 2C now corresponding to 2A and the Fossitt 2000 category GA1 (19.05)
2B Poor grassland	This would seem to be the more natural type of fringing grassland at the higher levels of a turlough where there has been no management as pasture and the soil is naturally damp. *Trifolium repens*, *Potentilla anserina* and *Agrostis stolonifera* are the main species with a substantial amount of *Filipendula ulmaria*, *Carex hirta*, *Ranunculus repens* and often of *Calliergon cuspidatum*, *Poa trivialis* and *Schedonorus arundinaceus* also. As in the last community there is often *Lolium* in small quantity along with *Scorzeroides autumnalis*, *Taraxacum officinale* and *Plantago lanceolata*. *Phleum pratense* is often noticeable in its native form (ssp. bertolonii) while *Elymus repens* locally forms colonies. The community was recognised by the presence of *Schedonorus arundinaceus*, *Carex hirta*, *Phleum*, *Filipendula* and *Potentilla anserina*. It is the most widespread of the vegetation types, occurring in more than 80% of turloughs. Since it usually forms a fringe it seldom covers a lot of ground and the larger sites have the greatest area (e.g. Ballinturly).	Stretches on the flooded edges of agricultural fields (8.4)	Like 2C, this habitat has contracted in coverage since the 1992 surveys. Many of those fields located along the southern boundary of the Turlough basin have been improved and now resemble 2A vegetation community (1.7)
2C Limestone grassland	A dwarf, grazed grassland is frequently found around limestone pavement or on other shallow calcareous soils. It appears very species-rich but in fact covers a more defined habitat than, for example, 2B so has a lower number of species altogether. *Festuca rubra* and *Agrostis stolonifera* are the most frequent grasses, often with some *Lolium* and *Cynosurus cristatus*. *Trifolium repens*, *Galium verum*, *Potentilla anserina*, *Plantago lanceolata* and *Carex panicea* and/or *C. flacca* are also important species though *Bellis perennis*, *Achillea millefolia*, *Lotus corniculatus* and *Centaurea nigra* are more noticeable. Because of the western location of most turloughs *Plantago maritima* is quite frequently found in this	In places with outcropping limestone this is the predominant vegetation (22.5)	Located throughout the northern and to a lesser extent, southern extremities of the Turlough basin. In some instances, the 2C vegetation community has been

[4] Follows Goodwillie (1992)

Turlough Vegetation Community Types (Goodwillie 1992)	Vegetation Community Type General Descriptions[4]	Area within Rahasane (Ha) 1992	Area within Rahasane (Ha) 2014
	community and it may also be enriched with certain limestone specialities like *Campanula rotundifolia*, *Pimpinella minor*, *Daucus carota*, *Thymus polytrichus* or, in the Burren, *Filipendula vulgaris*. Its occurrence is limited to dryish, shallow soils on or close to limestone outcrops. Normally it is found as a narrow band around the margins of a turlough but in a few cases, as at Killtullagh and Rahasane, it covers extensive areas.		slightly improved through sustained grazing and possible fertilisation. In most instances this vegetation community is in transition towards the 2A community (18.09)
3A Tall herb	This is a distinct habitat rather than plant community and is recorded to be able to compare habitat diversity between turloughs. It contains widely different vegetation depending on the level of rock exposure involved. On the floor of a basin it often includes *Cladium*, *Carex elata* and sometimes *Frangula alnus* which are clearly in contact with groundwater throughout the year. At mid-level *Rhamnus*, *Carex flacca*, *Galium boreale* and *Leontodon hispidus* are frequent, with *Rubus caesius*, *Schoenus nigricans* or occasionally *Thalictrum flavum*. At higher levels *Sedum acre*, *Lotus corniculatus* and *Plantago* spp. are characteristic, with *Calluna*, *Vicia cracca*, *Antennaria dioica* and, in the Burren, *Euphorbia exigua*.	Along the north shore east of Shanbally Castle, narrow fields of Iris (2.0)	At Rahasane, this vegetation community includes dense yellow iris growth on the northernmost reaches of Transect 9 in addition to localised pocket of reed canary grass dominated wetland near the southern boundary (2.4)
3B Sedge heath	Sedge heath is usually short, sheep-grazed vegetation on quite level ground near the top edge of the turlough basin. The soil is peaty but dries out in the summer months except for local seepages. In some cases the community covers old cultivation ridges and it seems likely that some leaching takes place. The plant cover is made up of sedges, especially *Carex panicea* and *C. flacca*, with *Festuca rubra*, *Succisa*, *Lotus corniculatus*, *Scorzoneroides autumnalis* (and *L. taraxacoides*), *Potentilla erecta* and usually *Calliergon cuspidatum*. *Deschampsia cespitosa*, *Schedonorus arundinaceus*, *Danthonia decumbens*, *Molinia caerulea* and *Nardus stricta* are found with lower frequency while *Carex hostiana*, *C.nigra* and *C. pulicaris* occur in places. Sedge heath is the most species-rich community of any of those described since, in different places; it is subject to both leaching and calcareous seepage. It has elements of limestone grassland with *Plantago maritima*, *Prunella*, *Ranunculus acris*, *Bellis perennis* and *Potentilla reptans* as well as fen species like *Cirsium dissectum*, *Briza media* and *Parnassia palustris*. The community was recognised usually by the presence of *Deschampsia*, *Carex flacca*, *Danthonia*, *Nardus* or *Leontodon taraxacoides*.	Along the southern edge where it grows as a fringe below the more calcicole community (1.4)	Not surveyed during the June 2014 surveys (1.4)
5A Dry weed	Disturbed soil occurs in most grazed turloughs either in field entrances, on the shores at flood level or around swallow holes. It thus may include soil and rock substrates but seldom marl which occurs at lower levels. The plant community varies with the site and its history so that there is no pre-eminent species: *Potentilla anserina*, *Agrostis stolonifera*, *Phalaris arundinacea* and *Rumex* spp often	On the north shore, where trampling is intense and some animals are over-wintered (1.6)	Located to the north of the Dunkellin River between Transects 4 and 5. In June 2014, this area

Turlough Vegetation Community Types (Goodwillie 1992)	**Vegetation Community Type General Descriptions[4]**	**Area within Rahasane (Ha) 1992**	**Area within Rahasane (Ha) 2014**
	cover the most ground but *Stellaria media*, *Polygonum amphibium*; *P. aviculare* and *P. persicaria* are also frequent. The *Rumex* species include *R. crispus*, *R. obtusifolius* and *R.conglomeratus* and on level sites they are often the most conspicuous plants. They are characteristic of a Dry *Carex nigra* community. (q.v.) that is being subjected to overgrazing and is breaking down. *Phalaris*, *Carex hirta*, *P.amphibium*, *Myosotis scorpioides*, *Potentilla reptans* and *Rorippa palustris* are important near swallow holes.		supported 9A vegetation community. 5A community likely to colonise when water levels recede. Other isolated pockets that correspond to this habitat are dotted around the turlough basin but are not large enough to be mapped discretely (1.6)
5B *Potentilla reptans* (sp. Poor)	This is a distinctive community covering large areas of drift filled turloughs where superficial drainage is quite good, for example in the Rahasane southern basin. It consists of *Carex nigra*, *Potentilla anserina*, *Agrostis stolonifera* with a constant presence of *P.reptans*, *Mentha aquatica* and *Ranunculus repens*. *P.reptans* itself is much outweighed by *P.anserina* but its leaves can usually be found with little searching even if it flowers rather seldom. The vegetation is usually closely grazed, frequently by sheep, and the *Phalaris* and *Carex hirta* which are often present are much reduced in height. This community often grades into Wet *Carex nigra* below and the other *P.reptans* community (4B) above. It is the main location for *Viola persicifolia* with some *V.canina* while in certain turloughs it includes *Teucrium scordium* and *Taraxacum sect. palustris*. MacGowran (1985) states that the water table is 1m or less below the surface in the summer months and that the community is flooded for up to 30 weeks. In the field the community was identified by *P.reptans* and *Carex nigra* with significant amounts of *Phalaris* and *Mentha aquatica*.	In very large expanses at both ends of the turlough. Covers the majority of the southern basin and extends around the nearby edges of the main basin (84.5)	As in 1992, occurs in large expanses both to the north and south of the Dunkellin River. Remains one of the characteristic habitats of Rahasane turlough. Traversed by transects 1, 2, 6, 7, 8 & 9 (84.5)
6A Dry *Carex nigra*	There are extensive stands of *Carex nigra* towards the base of many turloughs where they approach the long-lasting pools or permanent ponds. In terms of cover *Potentilla anserina*, *Agrostis stolonifera* and *Ranunculus repens* may be the dominant plants but there is usually abundant *C.nigra* and often *C.hirta* and *Phalaris arundinacea*. *Mentha aquatica*, *Filipendula* and *Rumex crispus* are widespread along with *Lotus corniculatus* and *Scorpidium revolvens*. Despite its name there are places in which *C.nigra* is rare or absent, perhaps in response to nutrient enrichment or trampling by cattle. Here *P.anserina* and *A.stolonifera* may cover almost all the ground. The substrate for this community seems generally to be mineral rather than peaty and some of the purest stands grow on marl and clay.	In the central southern section and as well as in the southern turlough, which locally contains *V. persicifolia* (25.0)	Large continuous area located immediately south of the Dunkellin River, traversed by transects 2, 3,4, 5 and 6 (25.0)
6B Wet *Carex nigra*	This community is more widespread than the last in most areas and is characteristic of a turlough that retains some dampness into the summer with the water table just below the surface. The substrate is a peaty silt or even well-humified peat. *Carex nigra* is frequent as in 6A and often it covers more ground than in that community. It is joined by *Potentilla anserina*, *Ranunculus repens* and *Agrostis*	(0.8)	Restricted distribution of this vegetation community within Rahasane Turlough

Turlough Vegetation Community Types (Goodwillie 1992)	Vegetation Community Type General Descriptions[4]	Area within Rahasane (Ha) 1992	Area within Rahasane (Ha) 2014
	stolonifera but also by a suite of 'wetter' species like *Eleocharis palustris*, *Hydrocotyle vulgaris*, *Galium palustre*, *Caltha palustris* and *Senecio aquaticus*. In places *Glyceria fluitans*, *Phalaris arundinacea* and *Myosotis scorpioides* enter the picture with a little *Polygonum amphibium* locally. The species list is longer than in 6A: partly this is because more information was collected, partly because the community grows on a broader range of habitats, involving seepage water on the sides of turloughs as well as static groundwater at the base. This brings about stands where *Molinia*, *Carex disticha*, *Potentilla palustris* or *Veronica scutellata* occur and link the community with the next vegetation-type, Peaty *Carex nigra*. In calcareous circumstances *Carex lepidocarpa* and *Scirpus fluitans* link it with the wetter Marl pond (9A). A particular type of this community with *Lysimachia vulgaris*, *Sparganium emersum* etc. among rather sparse *C.nigra* is present in the lengthy flooding conditions of Glenamaddy turlough.		(<1.0)
7A Polygonum amphibium (grassy)	As befits its name *Polygonum amphibium* has a great range within turlough vegetation. It occurs on the fringes of some basins, around swallow holes on the mid-slopes and in permanent ponds at the bottom. It is most common in channels and long-lasting pools where moving water concentrates nutrients and allows eutrophic vegetation even in an oligotrophic basin. The present community is characteristically green and luxuriant and is made up of *P.amphibium* scattered through a dense mat of *Agrostis stolonifera*, *Potentilla anserina*, *Myosotis scorpioides* and *Ranunculus repens*. Locally *Alopecurus geniculatus* and *Carex vesicaria* are frequent while *Galium palustre*, *Eleocharis palustris* and *Phalaris arundinacea* are more constantly found. The other sedges are *C.nigra* and *C.hirta* in small quantity. *Fontinalis antipyretica* and *Drepanocladus* spp are found in some stands but they are apt to get swamped by the blanket of grasses. The substrate generally seems to be silty though there may be peat below the surface.	Between the natural and artificial rivers (38.9)	Large section located between the Dunkellin River and the artificial channel. Traversed by transects 3,4, 5 and 6 (38.9)
8A Polygonum amphibium	As noted above (7A) *P. amphibium* sometimes occurs in dense patches in long-lasting pools and channels associated with water movement. This community consists of the purer stands of the species which occurs with, but usually dominates, *Agrostis stolonifera*, *Fontinalis antipyretica* and *Eleocharis palustris*. More aquatic species are also present, *Glyceria fluitans*; *Apium inundatum*, *Rorippa amphibian* and *Calliergon giganteum* are the most frequent. The community was recognised by the abundance of the dominant species.	Between the natural and artificial rivers (7.1)	Largest section of this habitat traversed by Transects 5 & 7, north of the Dunkellin River (7.1)
8B Wet annuals	A community based on *Polygonum* spp is characteristic of lower sites in many turloughs, growing in bare places where water lies into early summer or where the turf is broken by animal damage. *P.persicaria*, *P.aviculare* and *P.hydropiper* are common with a little *P.minus* in wetter places and *P.arenastrum* in drier ones. *Stellaria media* is frequent also. All these plants grow in other communities also but there is a suite of more restricted ones: *Filaginella uliginosa*, *Rorippa islandica*, *R.palustris*, *Chenopodium rubrum* and *Juncus bufonius* are the most distinctive. Since the community is an open one many other 'weed' species can get a foothold and *Chamomilla suaveolens*, *Atriplex patula* and *Capsella bursa-pastoris* are sometimes	Between the natural and artificial rivers, within 7A community, containing *Rorippa islandica* (0.1)	Not noted during the 2014 surveys. Likely that this community was inundated by 9A or 10A habitats (0.1)

Turlough Vegetation Community Types (Goodwillie 1992)	Vegetation Community Type General Descriptions[4]	Area within Rahasane (Ha) 1992	Area within Rahasane (Ha) 2014
	found. This community grows on silt or clay, often over peat, with a skin of algae that develops in spring. Such sites may be reflooded at any time by wet weather and the water table is never far below the surface. Some of them, e.g. Lough Gash, remain too soft to walk on in places, right through the growing season.		
9A Temporary pond	In most turloughs water lies into the summer in certain places, whether these are natural or artificial drinking ponds. This community grows in the more eutrophic of such sites, often on a surface of poached mud. The sites dry out eventually in the summer but by that time they carry too dense a vegetation for many annuals to become established. The main species are *Agrostis stolonifera*, *Glyceria fluitans*, *Myosotis scorpioides* and *Eleocharis palustris* but the more distinctive ones include *Veronica catenata*, *Ranunculus trichophyllus*, *Apium inundatum* and *Rorippa amphibia*. These channel and pond areas often abut both wetter and drier habitats so that species like *Potamogeton natans* and *Alisma plantago-aquatica* may grow beside *Potentilla anserina* or *Rumex crispus* in a mosaic that is difficult to classify.	The north side of the river (51.3) recalculated and true figure 29.6	Expansive area to the north of the Dunkellin River with isolated pockets located to the south (29.6). Traversed by transects 2, 3, 4 and 5
10A Oenanthe aquatica	*Oenanthe aquatica* is a feature of many waterbodies in the drift-filled turloughs of the north Midlands. It grows in water that is shallow for most of the spring and summer but dries out eventually in most years. The vegetation is mostly about 50cm high but the *Oenanthe* stands out above this if it is not damaged by cattle. The community includes much *Sparganium emersum*, *Rorippa amphibia*, *Polygonum amphibium* and *Glyceria fluitans*. *Fontinalis* is abundant and there is often *Ranunculus trichophyllus*, *Alisma plantago aquatica* and *Eleocharis palustris*. The deeper water maintains *Potamogeton natans*, *P.crispus* and *Equisetum fluviatile* while the shallows may have *Hippuris*, *Veronica catenata*, *Apium inundatum* and even *Potentilla anserina* and *Ranunculus repens* at times. At Carrowkeel turlough this community contained *Bidens tripartita* and *Alisma lanceolatum*: at Lough Gash both *Bidens* species. The substrate is soft mud, rich in organic material and without any accumulation of marl. Occasionally the peat forms a scraw.	At the end of the main water track in shallows which dry out occasionally (11.4)	Located to the north of the Dunkellin River, traversed by Transects 5 & 6. Isolated pockets remain between Transects 3 and 4 and to the south of the Dunkellin River, immediately north-east of Transect 2 (11.4)
10B Ditch	Many turlough have streams flowing into them for most of the year and there also may be moving water in artificial drains and ditches. This habitat brings in a range of species that are not found elsewhere in turloughs though they are of widespread occurrence outside. The community is identified by *Apium nodiflorum* and *Nasturtium officinale* agg. with *Berula erecta*, *Veronica beccabunga* and, more rarely, *V.anagallis-aquatica*. There is much *Glyceria fluitans*, *Myosotis scorpioides*, *Polygonum amphibium* and *Alisma plantago-aquatica*, with *Sparganium erectum* and *S.emersum* scattered at intervals. The habitat varies from peaty to mineral and the most consistent feature is the presence of moving water. In overall area the community covers very little ground but it forms a significant linear feature in many turloughs, for example Rahasane.	Bands along the main channel of the river, with *B. erecta*, *A. nodiflorum*, and *P. amphibium* occurring (3.4)	No discernible change
11B Peaty pond	Standing water in turloughs is found either where there has been peat cutting in the past or where natural ponds persist all through the year. The community was at first divided into two types on the basis of substrate but there were so many intermediates that this could not be	A fully aquatic community including *R. circinatus* and *P. pectinatus,*	Comprises a large channel to the north of the Dunkellin River.

Turlough Vegetation Community Types (Goodwillie 1992)	Vegetation Community Type General Descriptions[4]	Area within Rahasane (Ha) 1992	Area within Rahasane (Ha) 2014
	maintained. It covers little ground overall and is modified sometimes by cattle treading and excavation. The basic community consists of *Equisetum fluviatile*, *Menyanthes trifoliata* and *Alisma plantago-aquatica* with such species as *Potamogeton natans*, *Sparganium emersum* and *S.erectum*, *Polygonum amphibium*, *Carex rostrata* and *Glyceria fluitans* mixed in depending on habitat conditions. There are traces of the small *Potamogeton* community (see below) and usually much floating *Lemna* (including all four species). *Callitriche obtusangula* is the commonest member of this genus. Around the shore *Carex nigra* and *Polygonum amphibium* take over, sometimes with patches of the Wet annual community (8B).	along channel to north of the site (14.25)	Supports an aquatic vegetation community and in places an emergent aquatic macrophyte community (14.25)
12 Open water	This community consists of submerged or floating-leaved plants found in the deeper areas of permanent water that exist in some turloughs. Potamogeton spp are an important segment: *P.natans*, *P.berchtoldii* and *P.crispus* are the most frequent though there is a little *P.pectinatus* and *P.pusillus* locally. *Polygonum amphibium* also plays a part in this community as it does in most others. *Elodea canadensis* and *Zannichellia palustris* are present in a few sites with *Myriophyllum spicatum*, *Sparganium emersum* and *Chara* spp. more frequent. Both *Nymphaea alba* and *Nuphar luteum* are rare, the former in the more oligotrophic sites, e.g. Carran.	Main river channel through the site with some pondweeds (5.4)	The Dunkellin River and a body of open water connecting the large channel corresponds to this vegetation community. The river supports abundant emergent macrophytes with consistent occurrences of floating and submerged pondweeds (*Potamogeton* spp.) (5.4)

Image 6.1 Overview of 5b turlough vegetation community (2011 surveys)

Image 6.2 Close-up of 5b turlough vegetation community (2011 surveys)

6.1.2 Assessment of Changes in Rahasane Turlough Vegetation Communities between 1992 and 2014

Distribution and coverage of vegetation communities within Rahasane Turlough as mapped by Goodwillie (1992) and following the June 2014 vegetation surveys are presented in **Figure 6.1**. **Figure 6.1** also displays the location and distribution of nine transects and the one hundred and sixty six relevés surveyed within Rahasane turlough in June 2014.

The majority of those habitats mapped in 1992, especially within the turlough basin proper, correspond to conditions present at Rahasane Turlough in June 2014. The June 2014 site surveys were preceded by a relatively prolonged period of inclement weather. This in turn resulted in a rise in flood levels in the turlough, especially within the northern basin; i.e. north of the Dunkellin River. As a result, turlough vegetation communities such as 8A, 9A and 10A covered relatively large expanses of the northern basin with water heights ranging from 20cm to 80cm. These areas and their constituent vegetation communities are heavily influenced by flood waters from a large back channel (mapped as 11B, peaty pond) which takes the overflow from the Dunkellin River.

South of the Dunkellin River, vegetation communities mapped by Goodwillie (1992) also correspond to current distribution, spread and classification of these habitats. Within the turlough basin, dominant vegetation communities include *Potentilla reptans* – species poor (5A) and Dry *Carex nigra* (6A). As mapped by Goodwillie (1992), there are localised pockets of wetland vegetation communities such as temporary pond (9A) and *Oenanthe aquatica* (10A) near the Dunkellin River as well as areas occurring near the turloughs southern boundary wall.

The turlough commonage area is delineated from privately owned lands by large stone walls that support varied coverages of the epilithic moss *Cinclidotus fontinaloides*. It is those habitats adjoining these boundaries that have undergone the most notable changes. Changes in vegetation communities have not been stark, mostly from 2C Limestone grassland and 2B Poor grassland vegetation communities to the 2A *Lolium* grassland vegetation community. These changes are more than likely attributable to intensification in grazing regimes and stocking numbers and/or seasonal fertilisation of the grassland sward.

North of the Dunkellin River, a sizeable area of 2C occurs along the turlough's northern boundary. As described by Goodwillie (1992), these habitats are typically associated with limestone outcrops and support tightly grazed swards. In most instances these areas occur in mosaic with 'open scrub' habitats comprising hawthorn, blackthorn, hazel and young ash trees. Indeed, in some areas, scrub growth is so pronounced that it can be mapped discretely from the adjoining grassland habitat. Much of those areas mapped as 2C, support vestiges of limestone grassland, especially nearer the areas of outcropping rock. However the remaining areas have been continually improved through sustained grazing and possible fertilisation of the sward. To this end, this vegetation community represents a habitat in transition from the 2C toward the 2A vegetation community.

The 5B *Potentilla reptans* (sp. poor) turlough vegetation community occupies the largest vegetation community within Rahasane Turlough at approximately 84.5ha. This occurs on both sides of the Dunkellin River on the more elevated and consequently more intensively grazed parts of the site. South of the Dunkellin River, the 5B vegetation community occurs alongside a contiguous area of '6A Dry *Carex nigra*'. These habitats are slightly wetter underfoot and support frequent occurrences of sedges such as *Carex nigra* and *Carex hostiana*.

The northern bank of the Dunkellin River supports large blocks of the 7A *Polygonum amphibium* (grassy) vegetation community comprising 38.9 ha. This is a relatively diverse habitat with assemblages of macrophytes, grasses, sedges and wetland forbs. The 8A community occurs alongside 7A and differs in terms of increased water levels in addition to a reduction of grasses and an increase of *Polygonum amphibium*.

The 9A temporary pond vegetation community comprises a sizeable area of the northern basin, fringing the 11b Peaty pond vegetation community. This supports water depths of up to 60cm and a co-abundance of aquatic grasses and macrophytes. Similarly, a sizeable area of the 10A *Oenanthe aquatica* vegetation community fringes the open waterbody located to the north of the Dunkellin River. This habitat does not support abundances of *Oenanthe aquatic*a but does support luxuriant macrophyte growth exceeding heights of 50cm.

The vegetation community 11B Peaty pond (large channel to the north of the Dunkellin River) and 12 Open water (Dunkellin River) are associated with those relatively large and deep waterbodies and watercourses on site. Both communities support fringing aquatic macrophytes in addition to submerged and floating aquatics such as pondweeds (*Potamogeton* spp), crowfoot (*Ranunculus* spp.) *Cladophora* spp. and *Fontinalis* spp. moss.

The vegetation communities recorded at Rahasane Turlough in June 2014 are shown in **Images 6.3 – 6.18**.

Image 6.3 *Lolium* grassland (2A) located along the northernmost section of Transect 1

Image 6.4 Temporary pond (9A) located on Transect 3, to the north of the Dunkellin River

Image 6.5 Tightly grazed and moderately poached *Potentilla reptans* (species poor) (5B) vegetation community located to the south of the Dunkellin River, along Transect 2

Image 6.6 Close up of Dry *Carex nigra* (6A) vegetation community along Transect 4, south of the Dunkellin River

Image 6.7 Interface of *Lolium* grassland 2A and 9A vegetation community at Transect 4

Image 6.8 Deep water and sparse macrophyte growth associated with 10A community / channel at Transect 6

Image 6.9 Luxuriant macrophyte growth within 10A Oenanthe aquatica vegetation community along Transect 6

Image 6.10 Intersection of 8A and 7A vegetation communities along Transect 5

Image 6.11 7A *Polygonum amphibium* (grassy) plant community situated on transects 3,4 & 5 immediately north of the Dunkellin River

Image 6.12 9A Temporary Pond community located immediately south of the Dunkellin River on Transect 2

Image 6.13 Localised area of tightly grazed, semi-improved Limestone grassland 2C located near the southern margins of Transect 2

Image 6.14 Close up of 5B community (*Potentilla reptans* species poor)

Image 6.15 8A *Polygonum amphibium* vegetation community located to the south of the Dunkellin River between transects 3 and 4

Image 6.16 8A *Polygonum amphibium* vegetation community located on Transect 5, north of the Dunkellin River

Image 6.17 Improved grassland located to the south of Transect 7 (and south of the Turlough boundary wall)

Image 6.18 Expansive Dry Carex nigra vegetation community between Transects 4 and 5, south of the Dunkellin River

- **Invertebrate Communities**

Aquatic Macroinvertebrates and Waterbeetle Records from Rahasane Turlough, H15, southeast Galway are provided in **Appendix F** and a summary of the species recorded is described below.

Waterbeetles

A number of specialists have sampled the waterbeetle community at Rahasane, e.g., Bilton (1988), O'Connor (2001), Waldron (2003/ 2004). Using Biltons 1989 records, Foster *et al*. (1992) found that Rahasane Turlough fell within Community Type Group F of their classification system. Group F is generally described as "turloughs and more permanent, large, shallow, water bodies on base-rich substrata", with characteristic species including the "moss dweller" community of the turloughs (Foster *et al*., 1992). Waldron collected a number of species characteristic of turloughs including the "moss dweller" species, *Graptodytes bilineatus*, listed as Near Threatened on the Irish Waterbeetle Red List (Foster et al., 2009). *G. bilineatus* is likely to be vulnerable to disturbance and sensitive to alterations in flooding (Sheehy Skeffington *et al*., 2006). Other species characteristic to turloughs were *Agabus nebulosus*, *Hygrotus quinquelineatus, and Hygrotus impressopunctatus*. Each of these species are considered as Least Concern in the Irish Red List (Foster *et al*., 2009), although *H. quinquelineatus* is "nationally notable B" in Great Britain (Foster *et al*., 1992). O'Connor's records of 2001/2002 produced an MQS of 6, ranking Rahasane as below average compared to other Group F sites (Foster *et al*., 1992). Again, the characteristic turlough species *Agabus nebulosus, Hygrotus quinquelineatus, Hygrotus impressopunctatus* were recorded.

In summary, though Rahasane Turlough is occupied by commonly occurring species that are found as part of other waterbeetle community types, it does support a number of characteristic turlough species, including the "Near Threatened" *G. bilineatus*.

Waterbugs

During sampling undertaken in 2000, Rahasane Turlough had a diverse coroxid community comprised of common species indicative of temporary and permanent waters (Tobin & McCarthy, 2004).

Fairy Shrimp

The freshwater fairy shrimp, *Tanymastix stagnalis*, was first recorded in the smaller, southeastern basin at Rahasane in 1974 (Young, 1976) and has since been found at other locations (Ecofact, 2008). As a slow moving invertebrate, it requires seasonal or temporary pools, such as turloughs, in order to escape predation (Porst, 2006). It is well adapted to exploit temporarily flooded environments, with the ability to hatch, grow and produce eggs within a very short time-frame, e.g., < 15 days in August 1974 (Young, 1976).

Terrestrial Beetles of Water Dependent Habitat

Terrestrial invertebrate communities of turloughs are also primarily governed by the flooding regime of a particular turlough (e.g., Regan, 2005; Moran *et al*., 2012). Regan (2005) sampled the terrestrial carabid and staphlinid beetle communities of Rahasane, which ranked it eighth out of eleven turloughs in terms of conservation importance based on the carabid community. Found at Rahasane during that study were the carabid *Bembidion bipunctatum*, a British Red Data Book nationally scarce species (Hyman & Parsons, 1992), and the silphid beetle *Thanatophilus dispar* (superfamily: Staphylinoidea), a Red Data Book Endangered species (RDB1) in Britain.

6.1.3 Qualifying Habitats of Galway Bay Complex SAC

The lands and main channel within the vicinity of the Kilcolgan Road Bridge are tidal. Downstream of Dunkellin Bridge, the Dunkellin River continues to follow a well-defined canalised channel, with gradients of between 1 in 300, and widths ranging from 10 to 30m, until it reaches the sea at Kilcolgan.

The hydraulic model extends to approximately 125m downstream from the N18 Bridge crossing at Kilcolgan within the tidal reach. The downstream boundary used in the hydraulic model is a high tide of 2.9 mOD.

The Galway Bay Complex SAC extends up the Dunkellin/Kilcolgan River estuary as far as the N18 Bridge at Kilcolgan village. The qualifying habitats for this SAC are listed in **Table 6.3** and an assessment is provided as to whether they exist in the Dunkellin River estuary. The estuarine habitats were not mapped for this NIS as it was considered that as there were no works proposed downstream of the N18 Bridge that existing mapping as included in the document '*Galway Bay Complex SAC (site code 268) Conservation objectives supporting document -coastal habitats*' (NPWS, 2013) provided sufficient detail on qualifying habitats.

Details on the area, habitat extent, range, habitat distribution and other attributes for each coastal habitat listed as a qualifying interest of Galway Bay Complex SAC are included in the aforementioned document. The Saltmarsh Monitoring Project (SMP) by McCorry (2007) and McCorry and Ryle (2009) assessed the extent of saltmarsh habitats based on sub-sites. Kilcolgan River estuary is included within the sub-site Tyrone House-Dunbulcaun Bay. The site report and habitat map which includes Kilcolgan River Estuary is included in Appendix IX of the aforementioned document and describes habitats between Clarinbridge in the north and Kilcolgan Bridge in the south.

This site is described as the only estuary type saltmarsh present in Galway Bay and there are complex transitions to brackish and freshwater habitats, particularly near the head of the Kilcolgan River estuary.

Figure 6.2 shows the extent of saltmarsh Annex I habitat within the Dunkellin/Kilcolgan River estuary. This shows that immediately downstream of the Kilcolgan Bridge there is some saltmarsh CM1 not classified as Annex 1 habitat while further downstream there are mosaics of MSM, ASM and non-Annex 1 saltmarsh.

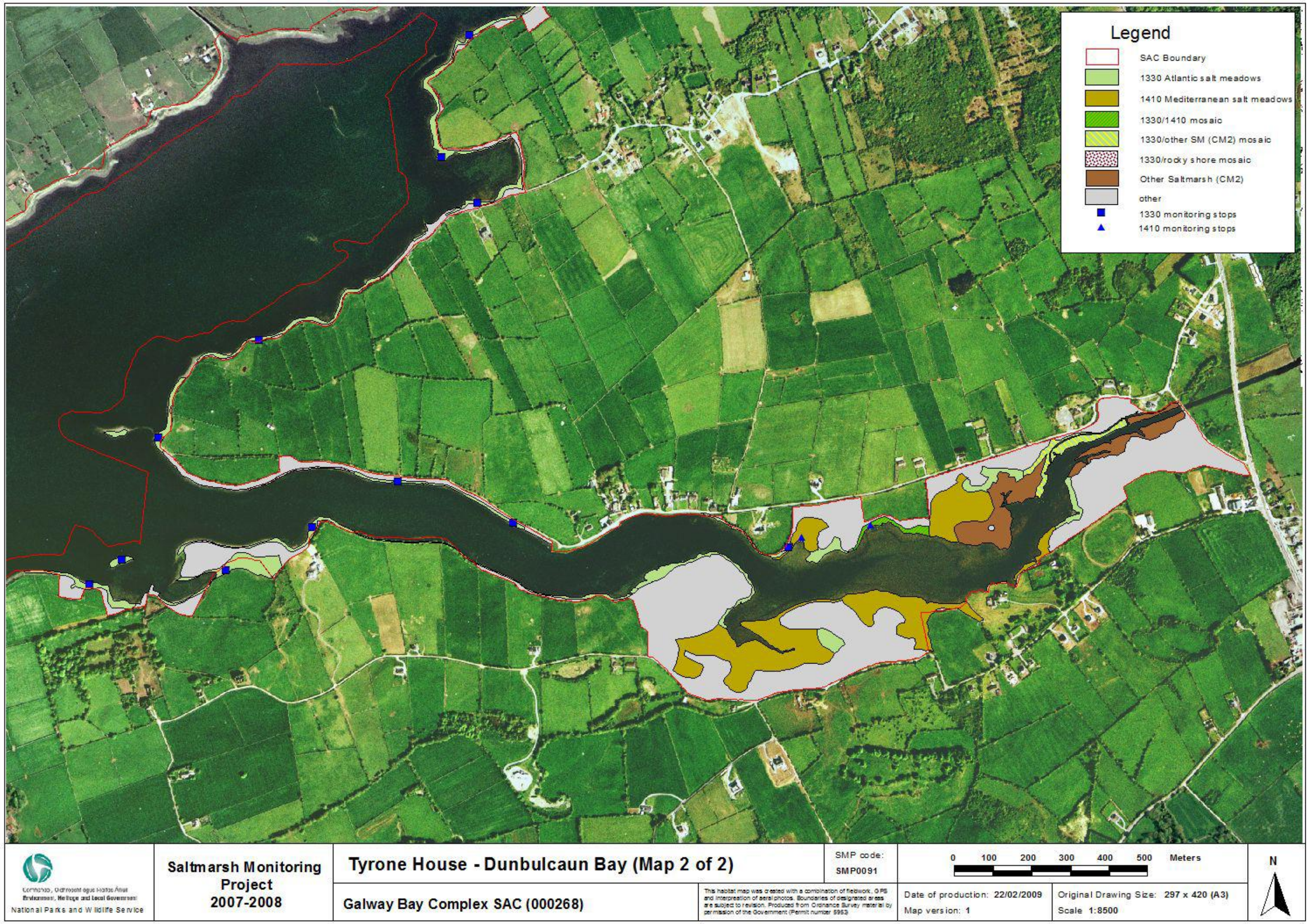


Figure 6.2 Extent of Coastal Annex I habitats (taken from NPWS, 2013)

Table 6.3 Qualifying Habitats of Galway Bay Complex SAC

Habitat name (SAC Qualifying Feature)	Notes	Need for further assessment
1160 Large Shallow Inlets and Bays	This habitat is identified as extending to the outer edge of Kilcolgan Bay therefore impacts are considered highly unlikely.	No
1140 Mudflats and sandflats not covered by seawater at low tide	This habitat extends almost as far as the N18 Bridge in Kilcolgan	Yes
1170 Reefs	The nearest identified reef is approximately 2km downstream of the N18 Bridge therefore impacts are considered highly unlikely	No
5130 Juniperus communis formations on heaths or calcareous grasslands	There are no nearby records for this habitat and no pathway between the works and this habitat has been identified therefore impacts are considered highly unlikely.	No
7230 Alkaline fens	There are no nearby records for this habitat and no pathway between the works and this habitat has been identified therefore impacts are considered highly unlikely.	No
6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia) (*important orchid sites)*	There are no nearby records for this habitat and no pathway between the works and this habitat has been identified therefore impacts are considered highly unlikely.	No
3180 Turloughs*	Ballinderreen Lough is the nearest turlough to the proposed works (~5km) therefore impacts are considered highly unlikely	No
7210 Calcareous fens with Cladium mariscus and species of the Caricion davallianae*	This habitat has been recorded in Ballinderreen Lough and it is considered there is no pathway for impacts therefore impacts are considered highly unlikely.	No
1310 Salicornia and other annuals colonizing mud and sand	Not identified from within Kilcolgan estuary therefore impacts are considered highly unlikely.	No
1410 Mediterranean salt meadows (Juncetalia maritimi)	These salt meadow habitats are found within Kilcolgan estuary	Yes
1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae)		Yes
1220 Perennial vegetation of stony banks	None of this habitat identified from Kilcolgan estuary therefore impacts are considered highly unlikely	No
1150 Coastal lagoons*	This habitat has not been identified in Kilcolgan estuary therefore impacts are considered highly unlikely.	No

*Priority Habitats

In addition to the qualifying Annex I habitats of Galway Bay Complex SAC further intertidal and subtidal surveys were undertaken in 2009 and 2010 resulting in mapping which identifies two marine communities within Kilcolgan estuary (Aquafact, 2010a; Aquafact, 2010b; RPS, 2012). These are:

- ‘Sandy mud to mixed sediment community complex’ and
- ‘Shallow sponge-dominated reef community complex’.

6.2 ASSESSMENT OF QUALIFYING SPECIES

The species subject to assessment within this NIS is limited to those which are qualifying interests of the Natura 2000 sites listed in **Tables 3.1 to 3.7**. There are no qualifying species listed for Rahasane Turlough however it is considered that an attribute which contributes to maintaining the favourable conservation status of Rahasane Turlough SAC is the presence of typical species, including positive indicator species and characteristic species. Typical plant species are outlined in **Table 6.2** above.

6.2.1 Qualifying Species of Galway bay Complex SAC

6.2.1.1 Otter

Otter are a qualifying species of Galway Bay Complex SAC and are listed on Annex II and Annex IV of the EU Habitats Directive and also on the Wildlife Act (1976, amendment 2000). Annex II species require the designation of protected areas by Member States (Special Areas of Conservation) as set out in Article 3, 4 and 6 of the Directive. Annex IV species require strict protection measures by Member States in accordance with Article 12 of the Directive, the Eurasian Otter is also listed on Appendix 1 of CITES and Appendix II of the Bern Convention. The Irish population is also listed in the '*Irish Red Data Book 2: Vertebrates*' (Whilde, 1993) as being of international importance.

The conservation objective is to restore the favourable conservation condition of Otter in Galway Bay Complex SAC. The boundary of Galway Bay Complex SAC extends as far as the N18 Kilcolgan Bridge and therefore this bridge is taken as the geographical limit for assessment of otter populations which are the qualifying interest for the SAC. The assessment of potential impacts on otter upstream of the N18 Bridge is therefore not be considered further under this NIS, however is assessed in detail in the EIS for this project.

There are existing records from the NPWS online database of otter at Dunkellin River near Rinn Bridge.

Otters are largely solitary, territorial and nocturnal animals and in many areas their distribution is scarce. They are rarely found far from water and tend to occupy linear home ranges along watercourses and coasts. In general, however, otters exploit a narrow strip of habitat at the aquatic – terrestrial interface (O'Neill, 2008). The extent of otter habitat in Ireland has been estimated on the basis of four classes of water bodies: rivers, streams, lakes and coast (high water mark). In addition to the aquatic habitat, a 10m riparian buffer (both banks) is considered to comprise part of the otter habitat as discussed in the Threat Response Plan for otter prepared by the National Parks and Wildlife Service (NPWS, 2009).

They require suitable bankside vegetation as cover for their burrows or rest sites. Underground shelters are called *holts* and above ground sites are called *couches*. Otters may dig their own holts but they very often make use of other structures ranging from enlarged rabbit holes and cavities amongst tree roots to rock piles and manmade structures.

Otters mark their home ranges by depositing their droppings termed "spraints", at distinct landmarks such as grassy mounds, large rocks or ledges under bridges. These favoured sites are known as seats and are usually found at important locations i.e. access points to the water, good fishing grounds. Other signs, such as footprints, fish remains, slides, etc. are also recorded.

Although there are no seasonal requirements for otter surveying, dense vegetation in areas along the riverbanks may reduce success in the identification of otter holts and couches. In addition spraints may also have been washed away following a period of heavy rain fall or flooding.

6.2.1.2 Otter Survey Findings

The entirety of the main channel of the Dunkellin River and Aggard Stream were surveyed for signs of otter presence or absence. A total of approximately 30km of channel bank, including both sides of the watercourses, were surveyed as part of the terrestrial ecological surveys carried out by RPS in spring/summer 2011. In addition, holts and signs of otter activity were searched for in the banks of the rivers and islands within the watercourses during aquatic surveys during the same period. A further survey specifically for otter was carried out in the winter of 2011. Otter signs were also searched for during a site walkover on the 29th April 2014.

Otter slides and spraints were recorded during site surveys at two locations IM50597, 19820 and IM43484 18438, shown on **Figure 6.1.**

The conservation status of Otter (*Lutra lutra*) in Ireland is provided in **Table 6.4**.

Table 6.4 Conservation Status of Otter (*Lutra lutra*) (from The Article 17 Species Conservation Status Assessments (NPWS 2013)

Criteria	Assessment	Qualifier
Range	Favourable	N/A
Population	Favourable	N/A
Habitat	Favourable	N/A
Future Prospects	Favourable	N/A
Overall Assessment	Favourable	
Overall Trend	Favourable	

6.2.1.3 Common Seal

The Galway Bay Complex SAC *Conservation objectives supporting document -coastal habitats*' (NPWS, 2013) provides details on Harbour Seal in Galway bay. Harbour seal feeds on a wide variety of fish, cephalopod and crustacean species. For individual harbour seals of all ages, intervals between foraging trips in coastal or offshore waters are spent resting ashore at terrestrial or intertidal haul-out sites or in the water.

Outside the breeding and moulting seasons (i.e. from October to April), the location and composition of haul-out groups and individual seals may be different to those normally observed during breeding or moulting. Current information on resting locations selected by harbour seals in Galway Bay Complex SAC outside the breeding and moulting seasons is comparatively limited. Known and suitable habitats for resting by the species are broadly within the following areas: Lough Atalia, Oranmore Bay, Kinvarra Bay, Aughinish Bay, Poulnaclogh Bay, Ballyvaghan Bay and on Tawin Island and Glasheen Island.

The conservation status of Harbour Seal (*Phoca vitulina*) in Ireland is provided in **Table 6.5**.

Table 6.5 Conservation Status of Harbour Seal (*Phoca vitulina*) (from The Article 17 Species Conservation Status Assessments (NPWS 2013)

Criteria	Assessment	Qualifier
Range	Favourable	N/A
Population	Favourable	N/A
Habitat	Favourable	N/A
Future Prospects	Favourable	N/A
Overall Assessment	Favourable	
Overall Trend	N/A	

6.2.2 Qualifying Bird Species of Rahasane Turlough SPA

'Birds of Conservation Concern in Ireland: 2008-2013' is a report which was prepared by BirdWatch Ireland and RSPB Northern Ireland in 2008 outlining an agreed list of priority bird species for conservation action on the island of Ireland. These Birds of Conservation Concern in Ireland are published in a list known as the BoCCI List. In this BoCCI List, birds are classified into three separate lists (Red, Amber and Green), based on the conservation status of the bird and hence conservation priority. The Red List birds are of high conservation concern, the Amber List birds are of medium conservation concern and the Green List birds are not considered threatened. Specific criteria are used to classify a bird into one of these three categories.

Species are Red-listed if:

- Their population or range has declined dramatically in recent years.
- Their breeding population has undergone large and widespread declines since 1800.
- They are of global conservation concern.

Species are Amber-listed if:

- Their population or range has declined moderately in recent years.
- They are rare breeders.
- Their breeding or wintering population is localised or of internationally important numbers.
- They have unfavourable conservation status in Europe.

Species are Green-listed if:

- They do not meet Red or Amber-listing criteria.

Birds specifically listed as special conservation interests for Rahasane Turlough SPA were identified using waterbird data collected during the five years of 1995/96 – 1999/2000. This is the baseline period which is used for the majority of the wintering waterbird sites of the SPA network. Monthly I-WeBS data from Rahasane Turlough for the period 2008/09 to 2012/13 were used to give recent five-year mean peak values for all species listed on the Natura 2000 data form. **Table 6.6** below list the various count data for bird species. The percentage change of these values from the baseline data are also presented alongside the all-Ireland change in the relevant population estimates during the period from 1994/95-1998/99 to 1999/00-2003/04. Although the all-Ireland time period and the baseline time period do not precisely coincide they do give an indication of population changes at the national scale.

Table 6.6 Rahasane Turlough and National mean peaks for Annex I and Migratory species at Rahasane.

Species	5 year mean peak 1995/96 -1999/2000	5 year mean peak 2008/09 – 2012/13	Percentage change at Rahasane	All-Ireland population estimates percentage change 1994/95-1998/99 to 1998-2010
Whooper Swan *(Cygnus Cygnus)*	165	138	-16.37 %	29%
Greenland White-fronted Goose*(Anser albifrons flavirostris)*	157*	62	-60.51%	-20%
Golden Plover *(Pluvialis apricaria)*	6613	4360	-34.07%	2.1%
Wigeon (*Anas penelope*)	3430	3500	2.04%	-7.7%
Teal (*Anas crecca*)	307	834	171.66%	-1.3%
Mallard (*Anas platyrhynchos*)	142	339	138.73%	-20.4%

Species	5 year mean peak 1995/96 -1999/2000	5 year mean peak 2008/09 – 2012/13	Percentage change at Rahasane	All-Ireland population estimates percentage change 1994/95-1998/99 to 1998-2010
Northern Pintail (*Anas acuta*)	19	99	421.05%	-25.2%
Northern Shoveller (*Anas clypeata*)	28	187	567.85%	-15.4%
Tufted Duck (*Aythya fuligula*)	32	64	100%	-12%
Lapwing (*Vanellus vanellus*)	2220	1826	-17.75%	-19.5%
Dunlin (*Calidris alpina*)	864	181	-79.06%	-25.7%
Black-tailed Godwit (*Limosa limosa*)	437	580	32.72%	1.6%
Curlew (*Numenius arquata)*	197	122	-38.08%	-10.5%
Redshank (*Tringa tetanus*)	134	56	-58.21%	5.6%
Black-headed gull (*Chroicocephalus ridibundus*)	280	163	-41.79%	-

***five year mean peak for the period 1994/95 to 1998/99**

The above analysis shows marked declines in the site estimates of the three Annex I species Whooper Swan, Greenland White-fronted Goose and Golden Plover from 16% to 61% when compared to the baseline dataset for the five year period 1995/96 – 1999/2000. These recorded declines were cross checked with trend data at the all-Ireland scale in order to see if such declines were in agreement with national population changes. **Table 6.6** and **Figure 6.3** clearly show differences between species in trends between the site level and the national level. While Whooper Swan and Golden Plover declines at Rahasane do not reflect a national increase in population, Greenland White-fronted Goose declines are in agreement with national declines. The Whooper Swan and Golden Plover declines may indicate possible pressure from one or more source impacting the waterbirds of the site, an insufficiency of bird data to accurately quantify the waterbird populations of the site or a combination of both.

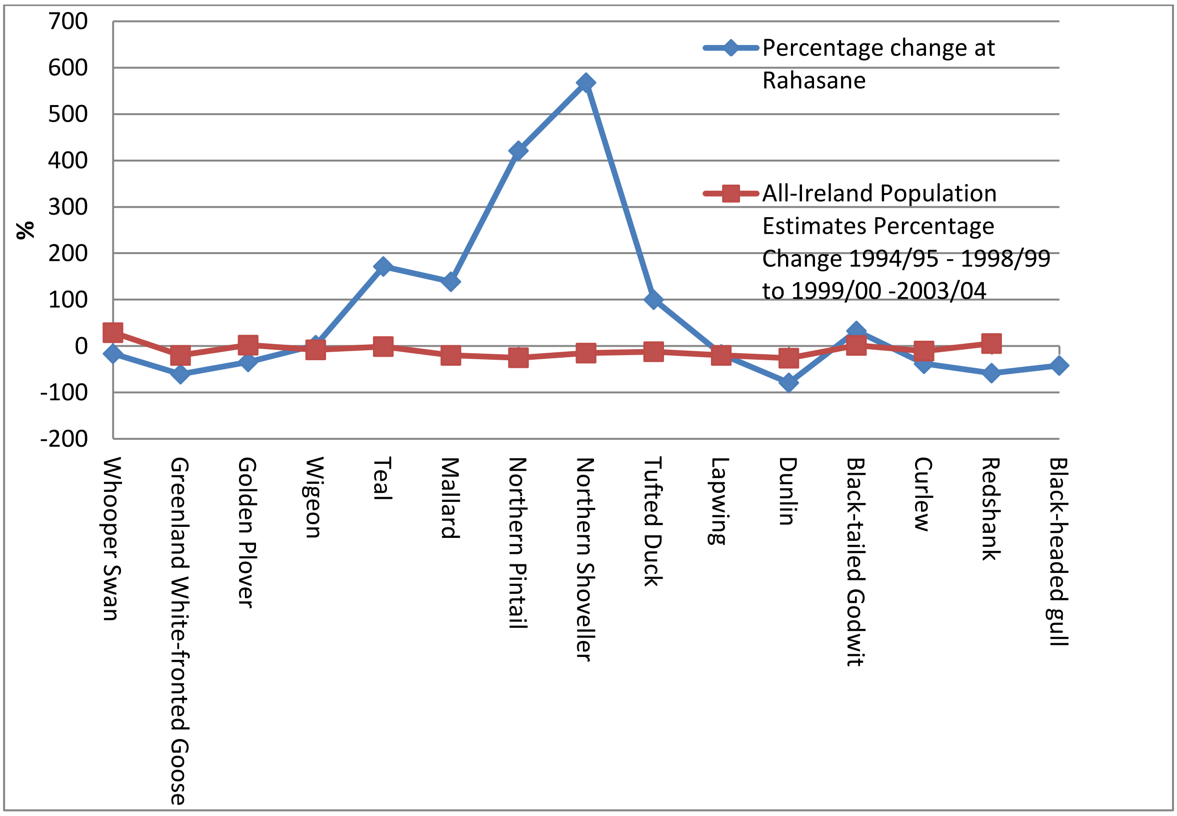


Figure 6.3 Chart Illustrating current Trends in Annex I and Migratory Species at Rahasane since the five year period 1995/96 – 1999/2000 and the All-Ireland population estimates percentage change 1994/95 -1998/99 to 1999/00 – 2003/04

6.2.3 Birds listed on Annex I of the Birds Directive

6.2.3.1 Whooper Swan (*Cygnus cygnus)*

Whooper Swan is listed as a qualifying feature for Rahasane Turlough SPA. The species is listed on Annex I of the EU Birds Directive and remains Amber-listed on the revised BoCCI listing[5]. Ireland hosts more than 20% of the European wintering population and the majority breed at ten or less sites. This species winters on lakes, marshes, lagoons and sheltered inlets, with birds also increasingly found in agricultural fields. Their diet includes aquatic vegetation within 1m of the surface as well as roots, shoots, leaves, rhizomes and tubers in tillage and grassland. The population occurring in Ireland breeds in Iceland. Ireland hosts 61% of this population during the winter. They arrive in September/October and remain until March/April. They are relatively widespread although less common in the south and southeast. 6% increase in non-breeding population between 2005 and 2010(5). 2.8% annual increase between 1994/95 and 2003/04(4). The all-Ireland population is currently estimated at 15,158.

Results from the 2010 International Swan Census, conducted on 16th/17th January 2010, show that the population in Galway had increased by 37% from 2005 numbers, while total number of flocks increased by 46% from 2005. The overall Irish population increased by 6% while the number of flocks decreased by 1%. Whooper Swans were reported from many new locations largely owing to frozen conditions. Rahasane Turlough was not identified as an internationally or nationally important population as a result of this survey. Again, frozen conditions meant that preferred habitats were often unavailable and proportionately high numbers were recorded on dry improved pasture compared with previous years. However after a decline in 2009/2010, high numbers were recorded in January 2011 on Rahasane Turlough, indicating that the turlough held over 1% of the international population. Overall, data from censuses carried out in 2000, 2005 and 2010 for this species indicate that the percentage of the population which uses unimproved Turlough habitat has gradually declined.

6.2.3.2 Greenland White-fronted Goose (*Anser albifrons flavirostris*)

The Greenland White-fronted Goose is listed under Annex I of the EU Birds Directive and is Amber-listed on the BoCCI. This species is listed as a qualifying feature for Rahasane Turlough SPA. This species has become rare on its traditional bog habitats, in recent years favouring more intensively managed farmland and often associates with nearby water bodies. Its diet includes roots and tubers of grassy plants, historically Cotton Grass *Eriophorum* spp. on peatlands. They arrive typically in October, returning to breeding grounds in western Greenland in spring. They have a very localised distribution in Ireland with the main population found on the Wexford Slobs, Co. Wexford. Smaller populations are still found on peatlands scattered around the middle, west and north of the country. There has been a 2.4% annual decline in non-breeding population or a 30% decline over 15 years. This has been more pronounced outside Wexford where the annual decline is 4.9 % (EO).

Results from the International GWFG census which is carried out each year, indicate that the GWFG population in Ireland has slightly increased in size from 10657 in 2008/2009 to 2777 in 2010/2011. The GWFG population at Rahasane Turlough has generally been between 60 and 100 individuals over the past ten years. Peak counts are regularly recorded in the period of January to February each year so the peak count of 29 for 2011/2012 season may be premature. The all-Ireland population is currently estimated at 10, 977.

According to the Natura 2000 Standard Data Form for Rahasane Turlough SPA, this species is considered to be particularly vulnerable to habitat degradation as the flock has only one alternative feeding site at Cregganna.

[5] Colhoun, K., and Cummins S. (2013) Birds of Conservation Concern in Ireland 2014-2019. *Irish Birds* **9**: 523-544

6.2.3.3 Golden Plover (*Pluvialis apricaria*)

The Golden Plover (*Pluvialis apricaria*) is listed under Annex I of the EU Birds Directive and is Red-listed on the BoCCI. This species is listed as a qualifying feature for Rahasane Turlough SPA.

This species is often found inland during the non-breeding season on agricultural land often on or near wetlands but can also be seen along the coast especially near lagoons and estuaries. Its diet includes soil and surface dwelling invertebrates as well as plant material, seeds and grasses. Some of the small Irish breeding population probably remain in the winter; however, most are likely to migrate south. Irish birds are joined by Icelandic and Faeroese birds from October. They are widespread and found in a variety of inland and coastal sites. There has been a 0.1% annual decline in non-breeding population between 1994/95 and 2003/04(4). The all-Ireland population is 166,700.

6.2.4 Regularly occurring migratory birds not listed on Annex I of the Birds Directive

6.2.4.1 Wigeon (*Anas penelope*)

Wigeon (*Anas penelope*) is not included on Annex I of the EU Birds Directive, but is listed as a qualifying feature for Rahasane Turlough SPA. Due to continuing declines in wintering numbers of Wigeon, it is now Red-listed on the updated BoCCI listing (Colhoun and Cummins, 2013). Wigeon are common winter visitor to wetlands throughout Ireland from September to April. They graze on coastal seagrass and algae, particularly on *Zostera* spp. and *Enteromorpha* spp., and also feed regularly on grasslands and cereal crops, however many Wigeon winter on inland wetlands, lakes, rivers and turloughs as well as in coastal habitats. The Icelandic breeding component of this population winters mostly in Ireland and western Britain, though some continue on to parts of continental Europe.

The most recent estimate totals 82,370 which shows a decline in the mean peak between the 5 year periods of 1994/95 to 1998/99 and 1999/2000 to 2003/04 of 7.7%.

6.2.4.2 Teal (*Anas crecca*)

Teal (*Anas crecca*) is not included on Annex I of the EU Birds Directive, but is listed as a qualifying feature for Rahasane Turlough SPA. It is Amber-listed on the BoCCI. It is both resident and a winter migrant with most of the Icelandic population wintering in Ireland, and also some from Fennoscandia and northern Russia. The diet consists mostly of small seeds, but *Enteromorpha* sp. and molluscs are also frequently taken. They occasionally feed on chironomid larvae where available, though usually during the summer months. They feed by day where they are safe from shooting. They usually nest near small freshwater lakes or pools and small upland streams away from the coast, and also in thick cover. They are widespread on wetlands with good cover, such as reedbeds. They occur in a wide variety of habitats, both coastal and inland, and usually below an altitude of 200 metres, including coastal lagoons and estuaries and inland marshes, lakes, ponds and turloughs.

The most recent estimate totals 45,010 which shows a decline in the mean peak between the 5 year periods of 1994/95 to 1998/99 and 1999/2000 to 2003/04 of 1.3%.

6.2.4.3 Mallard (*Anas platyrhynchos*)

Mallard (*Anas platyrhynchos*) is not included on Annex I of the EU Birds Directive, but is listed as a qualifying feature for Rahasane Turlough SPA. Mallard is Green-listed on the latest BOCCI assessment (Colhoun and Cummins, 2013) Mallard are both resident and also winter migrants from Iceland, Fennoscandia, Russia, Poland, Denmark, Germany, The Netherlands, Belgium and France. Additional captive-bred birds are released each year for hunting. Their diet is highly variable, and plant material, particularly seeds predominate. A range of animal material is also taken, including molluscs and crustaceans. Other food taken includes grain and stubble, and they have been shown to feed on a variety of food items presented by humans. Mallard are the most widespread species, although not quite as numerous as Wigeon or Teal occurring in almost all available wetland habitats in Ireland.

The most recent estimate totals 38,250 which shows a decline in the mean peak between the 5 year periods of 1994/95 to 1998/99 and 1999/2000 to 2003/04 of 20.4%.

6.2.4.4 Northern Pintail (*Anas acuta)*

Northern Pintail (*Anas acuta*) is not included on Annex I of the EU Birds Directive, but is listed as a qualifying feature for Rahasane Turlough SPA. It is Red-listed on the BoCCI. Pintail is a local winter visitor to wetlands throughout Ireland from October to March. Their diet consists largely of plant seeds and underwater plants, while insects and crustaceans are also eaten. They also feed on farmland, particularly stubble. In winter, they form large flocks on brackish coastal lagoons, in estuaries and on large inland lakes.

The most recent estimate totals 1,235 which shows a decline in the mean peak between the 5 year periods of 1994/95 to 1998/99 and 1999/2000 to 2003/04 of 25.2%.

6.2.4.5 Northern Shoveller (*Anas clypeata)*

Northern Shoveller (*Anas clypeata*) is not included on Annex I of the EU Birds Directive, but is listed as a qualifying feature for Rahasane Turlough SPA. It is Red-listed on the BoCCI. Shoveller is a both a resident and winter migrant. Most occur between October and March. Wintering birds originate from breeding populations which range across France, northern Europe, the Baltic and western Russia. Ireland and northern Britain also support the small Icelandic breeding population during the winter. They feed predominantly on zooplankton which is found mostly on ephemeral wetlands, particularly turloughs and callows. They also feed on small molluscs, insects and larvae, seeds and plant material and are frequently seen dabbling around the edges of waterpools. Shoveler prefers shallow eutrophic waters rich in plankton, and occurs on a variety of habitats while wintering in Ireland, including coastal estuaries, lagoons and inland lakes and callows.

The most recent estimate totals 2,545 which shows a decline in the mean peak between the 5 year periods of 1994/95 to 1998/99 and 1999/2000 to 2003/04 of 15.4%.

6.2.4.6 Tufted Duck (*Aythya fuligula*)

Tufted Duck (*Aythya fuligula*), is not included on Annex I of the EU Birds Directive, but is listed as a qualifying feature for Rahasane Turlough SPA. Due to continuing declines of wintering numbers of Tufted Duck, it is now Red-listed on the updated BoCCI listing (Colhoun and Cummins, 2013). Tufted Duck is both a resident and a winter visitor. Birds breeding in southeast England have been seen to move to Ireland, possibly influenced by cold weather. They feed predominantly on mussels, and to a lesser extent on crustaceans, insect larvae (particularly caddis-fly) and bryozoans. This species shows a breeding preference for large open lakes in lowland areas, where nests are built in waterside vegetation. Many nest in close proximity to each other. They winter on lowland freshwater lakes and are often seen on town lakes, canals and slow-moving rivers.

The most recent estimate totals 36,610 which shows a decline in the mean peak between the 5 year periods of 1994/95 to 1998/99 and 1999/2000 to 2003/04 of 12%.

6.2.4.7 Lapwing (*Vanellus vanellus*)

Lapwing (*Vanellus vanellus*), is not included on Annex I of the EU Birds Directive, but is listed as a qualifying feature for Rahasane Turlough SPA. It is Red-listed on the BoCCI. Lapwing in Ireland are a mixture of residents, summer visitors from the Continent (France and Iberia) and winter visitors (from western and central Europe) with some overlap between all three groups. Greatest numbers occur in Ireland between September and April. Lapwing feed on a variety of soil and surface-living invertebrates, particularly small arthropods and earthworms. They also feed at night, possibly to avoid kleptoparasitic attacks by Black-headed Gulls, but also, some of the larger earthworm species are present near the soil surface at night, and thus are more easily accessible. They use traditional feeding areas, are opportunistic, and will readily exploit temporary food sources, such as ploughed fields and on the edge of floodwaters. They breed on open farmland, and appear to prefer nesting in fields that are relatively bare (particularly when cultivated in the spring) and adjacent to grass. The wintering distribution in Ireland is widespread with large flocks regularly recorded in a variety of habitats, including most of the major wetlands, pasture and rough land adjacent to bogs.

The most recent estimate totals 207,700 which shows a decline in the mean peak between the 5 year periods of 1994/95 to 1998/99 and 1999/2000 to 2003/04 of 19.5%.

6.2.4.8 Dunlin (*Calidris alpina*)

Dunlin (*Calidris alpina*), is not included on Annex I of the EU Birds Directive, but is listed as a qualifying feature for Rahasane Turlough SPA. Due to short and long-term declines in its wintering population and a recent breeding range contraction, Dunlin is now Red listed on the updated BoCCI listing (Colhoun and Cummins, 2013). It is Amber-listed on the BoCCI. Dunlin is a summer visitor from NW Africa/SW Europe, and a winter visitor from Scandinavia to Siberia, and a passage migrant from Greenland (heading south to winter in Africa). Most numbers occur during the mid-winter period. Their diet consists predominantly on small invertebrates of estuarine mudflats, particularly polychaete worms and small gastropods. They feed in flocks, in the muddier sections of the estuaries and close to the tide edge. Dunlin nest on the ground in sparse, low vegetation - in Ireland favouring machair habitats. They winter along all coastal areas - especially on tidal mudflats and estuaries however there are very few inland.

The most recent estimate totals 88,480 which shows a decline in the mean peak between the 5 year periods of 1994/95 to 1998/99 and 1999/2000 to 2003/04 of 25.7%.

6.2.4.9 Black-tailed Godwit (*Limosa limosa*)

Black-tailed Godwit (*Limosa limosa*), is not included on Annex I of the EU Birds Directive, but is listed as a qualifying feature for Rahasane Turlough SPA. It is Amber-listed on the BoCCI. This species is a winter visitor from Iceland with numbers remaining high throughout the winter, especially September. Black-tailed Godwits are visual and tactile feeders, feeding on a range of invertebrates, including bivalves, polychaete worms and shore crabs. They prefer to feed on muddier estuaries, but also feed in brackish pools and on nearby rough pasture. While on pasture, they feed on the larvae of crane fly (*Tipulidae*) and on the amphipod *Corophium volutator*. They have also been recorded feeding on grain in stubble fields on the Wexford Slobs. This species breed in lowland wet grassland and marshes. Nine breeding sites were identified in Ireland during the last breeding atlas. More recently, birds were present during the breeding season between 1996 and 1999 inclusive, though breeding was not proven. They winter in a variety of habitats, both inland (particularly grassland and river deltas) and coastal (particularly estuaries), though seldom seen along non-estuarine coast.

The most recent estimate totals 13,880 which shows a decline in the mean peak between the 5 year periods of 1994/95 to 1998/99 and 1999/2000 to 2003/04 of 1.6%.

6.2.4.10 Curlew (*Numenius arquata*)

Curlew (*Numenius arquata*), is not included on Annex I of the EU Birds Directive, but is listed as a qualifying feature for Rahasane Turlough SPA. It is Red-listed on the BoCCI. This species is a winter visitor to wetlands throughout Ireland, as well as breeding in small numbers in floodplains and boglands. They feed mostly on invertebrates, particularly ragworms, crabs and molluscs. They are usually well dispersed across the estuary while feeding, but roost communally, usually along salt marshes and sand banks. Curlew nest on the ground in rough pastures, meadows and heather and although not a common breeder is found in most parts of the country. They winter in a wide range of wetland habitats (coastal and inland) and other good feeding areas including damp fields. The Irish breeding population is supplemented by Scottish and Scandinavian breeders in winter. Numbers and range have declined substantially in recent decades and it is estimated by Birdwatch Ireland that around 80% of the Curlew breeding population has been lost since the 1970's with possibly only a few hundred pairs remaining. It is likely that increased afforestation and agricultural improvement are responsible for these declines.

The most recent estimate totals 54,650 which shows a decline in the mean peak between the 5 year periods of 1994/95 to 1998/99 and 1999/2000 to 2003/04 of 10.5%.

6.2.4.11 Redshank (*Tringa totanus*)

Redshank (*Tringa totanus*), is not included on Annex I of the EU Birds Directive, but is listed as a qualifying feature for Rahasane Turlough SPA. It is Red-listed on the BoCCI. Redshank is a resident, a winter visitor from Iceland and a passage migrant (birds on passage from Scandinavia/the Baltic breeding areas to West African wintering areas). Highest numbers occur during the early autumn, when there is overlap of the populations. They detect prey visually and feed mostly during the day along the upper shore of estuaries and along muddy river channels. They feed singly or in small groups, and their prey consists mostly of *Hydrobia* sp., *Corophium* sp. and nereid worms. Nesting usually occurs on the ground in grassy tussock, in wet, marshy areas and occasionally heather. Adults often keep guard standing on fence posts or high rocks. Redshank breeds mainly in the midlands (especially Shannon Callows) and the northern half of the country, but not commonly anywhere in Ireland. They winter all around the coasts of Ireland, Britain and many European countries and favour mudflats, large estuaries and inlets. Smaller numbers can be seen at inland lakes and large rivers.

The most recent estimate totals 31,090 which shows an increase in the mean peak between the 5 year periods of 1994/95 to 1998/99 and 1999/2000 to 2003/04 of 5.6%.

6.2.4.12 Black-headed gull (*Chroicocephalus ridibundus*)

Black-headed gull (*Chroicocephalus ridibundus*), is not included on Annex I of the EU Birds Directive, but is listed as a qualifying feature for Rahasane Turlough SPA. It is Red-listed on the BoCCI. Black-headed gulls are resident along all Irish coasts, with significant numbers arriving from the Continent in winter. They breed in small numbers on islands in larger lakes in western Ireland. They feed on insects' especially in arable fields and will also exploit domestic and fisheries waste. They breed both on the coast and inland where they will often nest in colonies. Usually, they nest on the ground in wetland areas, such as bogs and marshes and will also use manmade lakes. Numbers breeding inland have declined dramatically, probably due to predation by the American Mink, which is an able swimmer and is able to access previously inaccessible nesting areas. The largest colonies in Ireland are in Northern Ireland on Lough Neagh. Colonies in the republic are not widespread, the largest are found inland in Counties Galway, Monaghan and Mayo and at coastal sites in Counties Wexford and Donegal. Irish birds are augmented by wintering birds from northern and Eastern Europe and are widespread on both on the coast and inland. Gull distributions are generally too widespread for adequate monitoring by I-WeBS methods alone.

6.2.5 Assessing the Status of Bird Species at Rahasane Turlough

In order to assess the conservation status of the qualifying bird species at Rahasane Turlough SPA an assessment is carried out in **Table 6.7** which examines the relationship between a species' site trend and the current all-Ireland trend for the time period 1994/95 - 1998/99 to 1999/00 – 2003/04.

The colour coding used represents the following cases:-

- Green – species whose populations are stable or increasing at site level.
- Beige – species whose populations are declining at both site level and all-Ireland level. Therefore there is a potential for factors at a larger spatial scale to be influencing the observed trend at site level.
- Orange - species whose populations are exhibiting an intermediate (1 - 25%) decline at site level but are stable or increasing at all-Ireland level.
- Pink - species whose populations are exhibiting a moderate (25 – 49%) decline at site level but are stable or increasing at all-Ireland level.
- Red - species whose populations are exhibiting a high (>50%) decline at site level but are stable or increasing at all-Ireland level.

Table 6.7 Qualifying Interests of Rahasane Turlough SPA

Species name	BoCCI Category	Conservation condition[a]	Site Trend	All-Ireland trend
Wigeon	Amber to Red[b]	**Favourable**	2.04%	-7.7%
Teal	Amber	**Favourable**	171.66%	-1.3%
Mallard	Green	**Favourable**	138.72%	-20.4%
Northern Pintail	Red	**Favourable**	421.05%	-25.2%
Northern Shoveler	Red	**Favourable**	567.85%	-15.4%
Tufted Duck	Red	**Favourable**	100%	-12%
Black-tailed Godwit	Amber	**Favourable**	32.72%	1.6%
Lapwing	Red	**Intermediate Unfavourable**	-17.75%	-19.5%
Whooper Swan	Amber	**Intermediate Unfavourable**	-16.37%	29%
Golden Plover	Red	**Moderately Unfavourable**	-34.07%	2.1%
Curlew	Red	**Moderately Unfavourable**	-38.08%	-10.5%
Black-headed gull	Red	**Moderately Unfavourable**	-41.79%	-70%[d]
Dunlin	Red	**Highly Unfavourable**	-79.06%	-25.7%
Redshank	Red	**Highly Unfavourable**	-58.21%	5.6%[e]
Greenland White-fronted Goose	Amber	**Highly Unfavourable**	-60.51%	-20%

[a] Conservation condition of waterbird species is determined using the site trend data as described in Table 6.6. Conservation condition is assigned using the following criteria:
Favourable population = population is stable/increasing.
Intermediate (unfavourable) = Population decline in the range 1 - 24%.
Moderately Unfavourable population = populations that have declined between 25 – 49% from the baseline reference value.
Highly Unfavourable population = populations that have declined > 50% from the baseline reference value.
[b]A change in BoCCI status has occurred between the previous list (Lynas *et al*., 2007) and the current list (Colhoun and Cummins, 2013)[d]All-Ireland trend for Black-headed gull is 25-year trend taken from Colhoun and Cummins (2013).
[e]It should be noted that this species shows a national trend of -53% for the 11-14y period. Therefore the site trend might match national trend.

The only species of which it can be said shows a definite decline at the site level in contrast to its trend at national level is Whooper Swan. Although both Golden Plover and Redshank do appear to show a reduction in numbers at site level in comparison to national level, however on further investigation these species have shown long-term population declines and therefore it is considered that the site trend does not differ from the national trend. It is unclear at present what the reasons are for the site decline of Whooper Swan.

6.2.1 Qualifying Birds of Inner Galway Bay SPA

The conservation status of qualifying bird species of Inner Galway Bay SPA is laid out in the document 'Inner Galway Bay Special Protection Area (Site Code 4031) Conservation Objectives Supporting Document VERSION 1' (NPWS, 2013).With regards the 18 non-breeding waterbird species of Special Conservation Interest for Inner Galway Bay SPA, and based on the long-term (12-year) population trend for the site, it has been determined that:

1. One species is considered as **intermediate (unfavourable)** (Red-breasted Merganser); and

2. Seventeen species are currently considered as **favourable** (Light-bellied Brent Goose, Great Northern Diver, Cormorant, Grey Heron, Ringed Plover, Bar-tailed Godwit, Turnstone, Wigeon, Teal, Shoveler, Golden Plover, Lapwing, Dunlin, Curlew, Redshank, Black-headed Gull and Common Gull).

Site conservation condition and population trends were also reviewed in light of species' all-Ireland and international trends. The calculation of all-Ireland trends (island of Ireland) for the long-term (12-year) data period was facilitated by the provision of indices from the I-WeBS and the WeBS database11; International trends follow Wetlands International (2006).

7 IN-COMBINATION EFFECTS

As part of the Natura Impact Statement, other relevant projects and plans in the region must also be considered at this stage, together with the scheme. This step aims to identify any possible significant in-combination or cumulative effects/impacts of the proposed development with other such plans and projects on Rahasane Turlough SAC/SPA, Galway Bay Complex SAC and Inner Galway Bay SPA. Plans and Projects specific to Rahasane Turlough SAC/SPA are discussed. The potential 'In-Combination Effects' of other plans and projects are described in **Table 7.1.**

Table 7.1 Potential In-combination Effects of Other Plans and Projects

PLANS AND PROJECTS	KEY POLICIES/ISSUES/OBJECTIVES DIRECTLY RELATED TO RAHASANE TURLOUGH SAC/SPA, GALWAY BAY COMPLEX SAC AND INNER GALWAY BAY SPA	Impact on the qualifying features of Rahasane Turlough SAC/SPA, Galway Bay Complex SAC and Inner Galway Bay SPA
	LAND USE AND SPATIAL PLANS	
Galway County Development Plan 2009-2015	**Policy HL31:** It is the policy of the Council to implement Article 6(3) of the EU Habitats Directive, and to subject any plan (including County Development Plan, Local Area Plans) or project likely to impact Natura 2000 or European Sites (SACs, SPAs), whether directly (in situ), indirectly (ex-situ) or in combination with other plans or projects, to an Appropriate Assessment in order to inform decision making. A plan or project may only be authorised after the competent authority has made certain, based on scientific knowledge, that it will not adversely affect the integrity of the site; in the case of derogations, authorisation must be pursued under Article 6(4). **Policy HL32:** It shall be the policy of Galway County Council to ensure that development in Galway and the provision of services take into account the relevant Management Plans (if any) for SACs and SPAs in the county. **Policy HL33:** Have regard to any impacts developments may have on or near existing and proposed, Natural Heritage Areas, Special Protection Areas and Special Areas of Conservation, Nature Reserves, Ramsar Sites, Wildfowl Sanctuaries, Connemara National Park and any other designated sites including any future designations. **Policy HL34:** Consult the Department of the Environment, Heritage and Local Government in relation to proposed developments adjoining designated conservation sites. **Policy HL35:** Protect and conserve habitats and Species designated under the Habitats Directive, Birds Directive, Wildlife Act, Flora Protection Order, National Nature Reserves, Connemara National Park, Ramsar Sites and any other Directives, Acts or Policies which may be issued during the lifetime of this Plan.	Positive Impact
	Designated Sites, Habitats and Species Objectives **ObjectiveHL22:** Promote the conservation of biodiversity outside of designated areas, while allowing for appropriate development, access and recreational activity. **Objective HL23:** It is an objective of the Council to conduct a study to see if any areas would be suitable for designation as Local Nature Reserves. **Objective HL24:** It is an objective to provide protection to all natural heritage sites designated or proposed for designation in accordance with National and European legislation. This includes Special Areas of Conservation, Special Protection Areas, Natural Heritage Areas, Statutory Nature Reserves and Ramsar sites.	Positive Impact
	Natural Heritage and Biodiversity Policies **Policy HL36:** Promote education, knowledge and pride in the natural heritage of the County. **Policy HL37:** Facilitate the identification and protection of the main elements of the ecological network in the County and provide for its appropriate and sustainable use. **Policy HL38:** Seek to maintain and enhance, as far as it is practical and prudent, the natural heritage and amenity of the County by seeking to encourage the preservation and retention of woodlands, hedgerows, stonewalls and wetlands. Where their removal or interference with same cannot be avoided, appropriate measures to replace like with like should be considered, subject to considerations of safety and practicality.	Positive Impact

	Policy HL41: Support national agencies, local and community groups in protection, conservation and enhancement of the landscape and wildlife habitats **Policy HL43:** The Local Authority shall seek comply with the Habitats Directive and Natura 2000 recommendations, including the protection of fisheries habitats. **Policy HL44:** The local authority shall seek to protect fisheries habitats, in particular those listed in the Annexes of the Habitats Directive and specifically for the Freshwater Pearl Mussel and the White Clawed Crayfish. The avoidance of development in areas where flood risk has been identified shall be the primary response of the Planning Authority. Development proposals which include proposals for mitigation and management of flood risk will only be considered where avoidance is not possible and where development can be clearly justified with the Guidelines Justification Test. **Policy HL45:** No projects giving rise to significant adverse direct, indirect or secondary impacts on Natura 2000 sites arising from their size or scale, land take, proximity, resource requirements, emissions (disposal to land, water or air), transportation requirements, duration of construction, operation, decommissioning or from any other effects shall be permitted on the basis of this Plan (either individually or in combination with other plans or projects **Policy HL46:** All subsequent plan-making and adoption of plans under the control of Galway County Council arising from this plan will be screened for the need to undertake Appropriate Assessment under Article 6 of the Habitats Directive. **Policy HL47:** Galway County Council will set up procedures to ensure that any plan, project, etc. would take cognisance of the existing impacts on Natura 2000 sites and assess the cumulative and “in combination” effects that said plans and projects may have on any Natura 2000 site and to ensure compliance with the requirements of Article 6 of the Habitats Directive. **Policy HL48:** No ecological networks or parts thereof which provide significant connectivity between areas of local biodiversity are to be lost without remediation as a result of implementation of the County Development Plan. **Policy HL49:** Galway County Council shall protect wetlands, and associated surface and groundwater systems within the Plan area. **Policy HL50:** Galway County Council shall ensure that, in the supply of services and in zoning of lands and authorisation of development, the threatened habitats and species* which occur within and adjoining the Plan area are not placed under further risk of deterioration (habitats) or reduction in population size (species). *As identified in the National Parks and Wildlife “The Status of EU Protected Habitats and Species in Ireland”, (NPWS, Department of the Environment, Heritage and Local Government, 2008). Galway County Council shall ensure that plan formulation and development control shall take into account the relevant “Major Pressures reported in the assessment of Habitats and Species” and the “Main Objectives Over The Coming Five Years and Beyond” contained in the above publication. **Natural Heritage and Biodiversity Objectives** **Objective HL25:** Prepare an inventory of the geological geo-morphological heritage sites in County Galway and protect them from inappropriate development. **Objective HL26:** No ecological networks or parts thereof which provide significant connectivity between areas of local biodiversity are to be lost as a result of implementation of the County Development Plan without appropriate and reasonable remediation and/or compensatory measures. **Objective HL27:** The Council will avail of opportunities that may arise to create or promote new features of biodiversity in the context of new developments.	Positive Impact

PLANS AND PROJECTS	KEY POLICIES/ISSUES/OBJECTIVES DIRECTLY RELATED TO RAHASANE TURLOUGH SAC/SPA, GALWAY BAY COMPLEX SAC AND INNER GALWAY BAY SPA	Impact on the qualifying features of Rahasane Turlough SAC/SPA, Galway Bay Complex SAC and Inner Galway Bay SPA
	LAND USE AND SPATIAL PLANS	
	Coastal Zone and Inland Waterways Policies **Policy HL54:** Seek to have protected rivers, streams and other watercourses and, wherever possible, maintain them in an open state capable of providing suitable habitat for fauna and flora. **Policy HL55:** Seek to have protected and to enhance the natural heritage and landscape character of river and stream corridors (together with immediate floodplains and valleys of streams and smaller rivers) to maintain them free from inappropriate development, and to provide for public access where feasible and appropriate. **Policy HL56:** Seek to have protected and conserve their quality character and features by controlling developments close to navigable and non-navigable waterways. **Policy HL57:** Seek to have protected and seek to provide access to inland waterways. **Policy HL64:** Support the implementation of appropriate measures to manage surface water drainage and prevent/minimise flooding impacts on natural systems, human settlements and infrastructural elements.	Positive Impact
	Designated Sites, Habitats and Species Policies **Natural Water Systems Policies** **Policy HL71:** Implement water protection measures to prevent any deterioration of “good status” waters, and to restore substandard waters to “good status”. **Policy HL72:** Adopt and implement the provisions of the Western River Basin Management Plan and Shannon International River Basin Management Plan. Have regard to recommendations that may result from the applicable River Basin Management Plan. **Policy HL73:** Introduce a comprehensive and integrated approach to the management of our natural water resources. **Policy HL74:** Intensify public awareness of water quality issues and the measures required to protect natural water bodies. **Policy HL75:** Ensure that substandard public wastewater treatment plans are upgraded. In the interim prevent an increase in the nutrient load discharged from these plants and the urgent provision of modern sewerage treatment systems in those towns and villages that have insufficient capacity to meet current demands, do not meet modern standards or currently represent a pollution risk to local water courses. **Policy HL76:** Ensure that industrial facilities and commercial premises discharging wastewater are operating within the parameters of an IPPC licence or a wastewater discharge licence. **Policy HL77:** Ensure that all dwellings outside town sewerage systems have an appropriate wastewater treatment system, correctly installed and maintained. **Policy HL78:** Ensure that agricultural waste is returned to the land in accordance with the provisions of scientifically prepared nutrient management plans. **Policy HL79:** Ensure that all new treatment systems, including single house systems, comply with the relevant EPA wastewater manuals. **Policy HL80:** Protect and maintain the quality of bathing waters and bring back to good status any substandard bathing waters. **Policy HL81:** The Local Authority will investigate other “quality mark” schemes for beaches and work to achieve such awards	Positive Impact

	such as the Green Coast award which will increase the number of recognised beaches with a high standard of environmental quality and tourism potential. **Policy HL82:** Support the relevant agencies and statutory bodies in the control and elimination of invasive species in water bodies. **Policy HL83:** Ensure that all new development which is reliant on private waste water treatment and disposal systems is assessed with regard to the impact on ground waters, having regard to the relevant EPA wastewater treatment manuals. **Policy HL84:** Adopt the Galway Groundwater Protection Scheme and have regard to the need to protect water sources through the identification of source protection zones in the scheme. **Policy HL85:** Have regard to the programme of measures set out in the Western River Basin Management Plan and Shannon International River Basin Management Plan to bring water up to a good standard, as defined in the EU Water Framework Directive, by 2015. **Policy HL86:** Ensure that the ongoing development of Towns and their Environs are undertaken in such a way so as not to compromise the quality of surface water (and associated habitats and species) and groundwater within the zone of influence of the Development Plan or Local Area Plan area. **Policy HL87:** The Planning Authority shall consider the use of temporary proprietary effluent treatment units to service new developments as an interim measure until such time as the planned infrastructural investment as set out in the Water Services Investment programme is delivered and commissioned. **Policy HL88:** Galway County Council shall address the significant water management issues identified in the Water Matters Consultation publications for the relevant RBDs. **Policy HL89:** When published, the relevant policies and objectives of the Western and Shannon River Basin Management Plans and associated Programmes of Measures shall be integrated into the Plan through amendment or otherwise. **Policy HL90:** Galway County Council shall ensure that the ongoing development of Towns and their Environs are undertaken in such a way so as not to compromise the quality of surface water (and associated habitats and species) and groundwater within the zone of influence of the Development Plan area. **Policy HL91:** Land uses shall not give rise to the pollution of ground or surface waters during the construction or operation of developments. This shall be achieved through the adherence to best practice in the design, installation and management of systems for the interception, collection and appropriate disposal or treatment of all surface waters and effluents. **Invasive Species Policies** **Policy HL92:** The local authority will have regard to best practice with respect to minimising the spread of invasive species in the carrying out of its own development in the county and shall encourage private developers to have regard to same. **Policy HL93:** It is a policy of the Council to support measures for the prevention and eradication of invasive species. This will include the dissemination of information to raise public awareness, consultation with relevant stakeholders, the promotion of the use of native species in amenity planting and landscaping and the recording of invasive/native species as the need arises and resources permit.**Invasive Species Objectives** **Objective HL43:** Support initiatives that reduce the risks of invasions, by non-native species, help control and manage new and established invasive species, monitor impacts, raise public awareness, improve legislations and address international obligations.	Positive Impact

Craughwell Local Area Plan 2009 – 2015	**Policy EH4.1:** The Local Authority shall seek to comply with the Habitats Directive and Natura 2000 recommendations, including the protection of fisheries habitats. **Policy EH4.2:** No projects giving rise to significant adverse direct, indirect or secondary impacts on Natura 2000 sites arising from their size or scale, land take, proximity, resource requirements, emissions of construction, operation, decommissioning or from any other effects shall be permitted on the basis of this Plan (either individually or in combination with other plans or projects). **Policy EH4.3:** It shall be the policy of GCC to ensure that development within the Plan Area and the provision of services take into account the relevant Management Plans (if any) for SACs and SPAs in the area. **Policy EH4.4:** Consult the Department of the Environment, Heritage and Local Government in relation to proposed developments adjoining designated conservation sites.	Positive Impact
CONSERVATION AND MANAGEMENT PLANS		
NPWS Conservation Management Plan	A Conservation Management Plan for Rahasane Turlough SAC/SPA has not yet been published by the NPWS.The Conservation Objectives have been developed for Inner Galway Bay SPA and Galway Bay Complex SAC.	Positive Impact
Western River Basin Management Plan 2009-2015	The Western River Basin Management Plan, issued in July 2010, sets out a number of objectives and measures for all water bodies in the Western Region. The following applies to the Dunkellin River which forms part of Dunkellin Turlough SAC/SPA: **Objectives**: Ensure that the status of waters supporting protected areas is protected and (where necessary) improved by 2015. **Measures**: Implement 11 EU Directives. **The Clarin Kilcolgan Water Management Unit (WMU) Action Plan**, which was prepared as part of the Western River Basin District Management Plan, contains information on water body status, objectives and measures for the WMU. The Dunkellin River (WE_29_669) is currently classified as 'poor ecological status' and within the **Clarin Kilcolgan WMU Action Plan** the objective of good ecological status is to be achieved for this river by 2021.	Positive Impact
POLLUTION REDUCTION PLANS		
- IPPC Programme	There are five IPPC Licence holders discharging to the **Clarin Kilcolgan Water Management Unit.** None are within the Dunkellin River Catchment.	No Impact
- Craughwell Wastewater Treatment Plants	An Appropriate Assessment Screening Report carried out on behalf of GCC by Tobin Engineers concluded that the construction and operation of the proposed **Craughwell WWTP** would not have a significant negative impact on the Rahasane Turlough SAC/SPA, and that the plant would in fact have a moderate positive impact on the SAC during the operational phase as it will replace diffuse sources of pollution such as septic tanks with a modern water treatment plant with tertiary level treatment (Phosphorus removal).	Positive Impact

Local Authority Licenced Discharge	There are 21 Section 4 licenced facilities within the **Clarin Kilcolgan Water Management Unit**.	No Impact
FOREST MANAGEMENT PLANS		
Indicative Forestry Statement	Department of Agriculture, Fisheries and Food, Dec 2008 - Sets out Environmental Protection and Consultation Process when Proposing Afforestation Schemes.	Positive Impact
Coillte Draft Strategic Plan 2011-2015 East Galway/Roscommon (W2)	The long-term vision for the District is of forestry management at an intensity that is appropriate to the environmental sensitivity and productivity of its land resource. By adopting policies that ensure our efforts are concentrated on timber production in some areas and on habitat restoration in other areas we will maximise the benefits to the environment, local communities and the timber processing industry. This vision includes: 1. Forestry will be a vibrant industry in the area, integrated into the local economy, providing employment opportunities in the forest, the timber industry and in many downstream activities 2. Broadleaves will account for 25% of the gross area of the District 3. Natural and semi-natural habitats are protected and enhanced through appropriate management; 4. There is continuity of forest habitat for rare and threatened species; 5. Forest recreational sites will be a part of the tourism infrastructure and will be an important contributor to the tourism economy; 6. There will be a shared vision between the District and local communities on expectations from the forests and how they are managed.	Positive Impact
Forest Management Plan – Kilcornan (GY15) 2011-2015	Sets outs management objectives for the forestry located in the Clarinbridge, Kilcolgan and Craughwell areas in terms of nature conservation, species diversity, security, adjoining lands, thinning, clear felling, replanting and social and environmental impact assessment.	No Impact
FISHERIES PLANS		
The Western Regional Fisheries Board- Strategic Plan 2007-2011	**Water Quality Strategies** - Work with all relevant agencies and interest groups to identify sources of nutrients impacting on the main lakes, - Use the catchment management process to maximum effect to redress eutrophication and other water quality problems, - Disseminate information to the public in regard to impacts on water quality, - Seek to influence public opinion on the issue of water quality, - Monitor all proposals for development which may impinge on water quality, - Use the powers that are available to the Board to prosecute offenders where necessary, - Endeavour to influence Government and EU policies in regard to protection of water quality and activities which impact on it, and	Positive Impact

	- Monitor water quality trends on an on-going basis on selected rivers and streams.	
Inland Fisheries Ireland Corporate Plan 2011-2015	**Goals** To improve the protection and conservation of the resource. To develop and improve wild fish populations. To increase the number of anglers. To generate a better return for Ireland from the resource	Positive Impact
ROAD SCHEMES		
National Primary Route from Galway to Ennis M18	The proposed M18 route corridor crosses the Dunkellin River between the Rinn Bridge and the Dunkellin Bridge. As the works will be carried out downstream of Rahasane Turlough, no impacts in the form of water pollution are expected on the SAC/SPA. At a distance of approximately 1.2km, it is highly unlikely that these works will have a cumulative impact on Rahasane Turlough SAC in terms of visual impact or disturbance to birds. It is possible that the works will have a cumulative impact on the Galway Bay SAC and Inner Galway Bay SPA in the form of release of contaminants to the aquatic environment, however mitigation measures have been developed for this scheme and therefore this impact is not considered to be significant. The construction of the N18 embankment at this location will result in the infill of approximately 1.5ha of floodplain which will reduce the extent of Dunkellin Turlough. The M18 EIS identifies that the flooding at Dunkellin Turlough is also linked to the Rahasane SAC and SPA. Appendix 2.5 of the EIS states that: '*The flooding occurs when the flow rate of the river and of groundwater exceeds the capacity of the channel and the capacity of the underlying Weathered Limestone and Fractured Limestone aquifer to transmit the water. Groundwater and surface water in the system then backs-up until water levels are sufficient to inundate the flood plain of the Dunkellin River and the Rahasane Turlough*.' Dunkellin Turlough was identified in the EIS for M18 as being of low importance for birds and is unlikely to support significant numbers of the populations of birds which winter at Rahasane Turlough. However, there is potential for in-combination impacts to species which might migrate between Rahasane Turlough SPA and Inner Galway Bay SPA. If construction of these schemes were to occur concurrently or consecutively, disturbance impacts could apply to both the Rahasane Turlough and the Inner Galway SPAs if there is a flightline between the two sites which is likely to follow the Dunkellin River. The bird species that could potentially fly between the two include Wigeon, Golden Plover, Black-tailed Godwits and Lapwing. All construction works with the potential to cause disturbance impacts will be restricted to the Dunkellin River downstream of the Turlough and concentrated in the area upstream of Dunkellin Bridge where it is proposed that the M18 cross this river. It is stated in the EIS for this scheme that construction periods and techniques will be agreed with the IFI to ensure no damage to fish stocks occurs. It is also stated in relation to fisheries protection that a pollution-prevention plan should be drafted and a designated member of the construction team assigned to monitor the pollution prevention / control measures that are operational. This person should liaise with interested third parties (IFI, Angling Clubs etc.). It is likely that construction works will commence on the M18 prior to the Dunkellin FRS, therefore cumulative impacts on bird species migrating between Rahasane Turlough SAC and Inner Galway Bay SAC should be minimised. The implementation of a pollution prevention plan in agreement within Inland Fisheries Ireland is considered to be adequate in order to prevent suspended sediments and other pollutants entering the Dunkellin River as a result of the M18 scheme and therefore in-combination impacts on water quality, and consequently on Galway Bay SAC and Inner Galway SPA, as a result of the two projects are considered unlikely.	Potentially Negative Impact on Galway Bay Complex SAC /Inner Galway Bay SPA. No impact on Rahasane Turlough SAC. Without coordinated mitigation between the two schemes there are potential negative impacts on birds migrating between Rahasane Turlough SPA and Inner Galway Bay SPA.
M6 Galway to	The M6 (constructed in 2008/2009) between Galway and Ballinasloe crosses the Dooyertha River, a tributary of the Dunkellin	No Impact.

Ballinasloe Road Scheme	River, 8km upstream of Craughwell. Due to the distance of the new road from Rahasane Turlough (over 6km), it is not expected that this will have a cumulative impact on the SAC/SPA.	
FLOOD RELEIEF SCHEMES		
Draft Regional Flood Risk Appraisal for the Draft Regional Planning Guidelines for the West Region 2010 – 2022 (22 January 2010)	The Draft Regional Flood Risk Appraisal prepared for the Draft Regional Planning Guidelines for the West Region 2010-2022 outlines the Regional Flood Risk Appraisal for the West Region Authority's functional area. It examines the relationship between the Draft Regional Planning Guidelines, flood risk in the West Region and the management of flood risk. This document lists all the OPW Arterial Drainage and Flood Relief Schemes in the Western River Basin District. Apart from the Dunkellin River Flood Relief Scheme, there are no other flood relief schemes in the area which would affect the Rahasane Turlough.	Potentially Negative Impacts
Galway County Council Drainage Maintenance under the provisions of the Arterial Drainage Act, 1945.	In September 2014, Galway County Council completed stream maintenance measures along the upper stretches of the Aggard Stream north-east of Ardrahan between the townlands of Cregaclare and Monksfield, covering a length of ca. 4.03km. These works have been advanced due to a number of local residents in the Ballyboy townland being isolated following habitual winter flood events. These works were subject to Appropriate Assessment Screening. The standard best practice and OPW Standard Operating Procedures were adhered to. This ensuredthat there will be no impacts resulting from the proposed stream maintenance works on the qualifying habitats and species of the Natura 2000 sites. It was considered that any potential impacts were likely to be temporary and not significant and therefore impacts did not need to be investigated further. Therefore a Stage 2 'Appropriate Assessment' was not considered necessary. These works were carried out by Galway County Council under the provisions of the Arterial Drainage Act, 1945.	No Impact
LOCAL DEVELOPMENT		
Local Planning Applications	A search of the planning applications on Galway County Council's planning website was completed. The area considered included sites within or near lands within the extents of the November 2009 flood event. The planning applications that have been successful since 2010 and those that are currently under consideration were analysed. **Planning Applications in Craughwell (Ballymore Townland):** **Pl. Ref. 101039:** for retention of tyre centre and first floor to existing commercial building previously approved as builders store under pl. ref. no. 08/2971 (gross floor space 109sqm). **Conditional permission granted.** **Pl. Ref. 111652:** for the construction of 16 no. dwelling houses, consisting of 8 no. dwellings in 2 no terraces and 8 no semi-detached dwellings, including a proprietary effluent treatment plant and percolation area along with associated site development works to be accessed through previous approved planning application ref no. 05/2217, previous planning reference no.06/2172 (gross floor space 1808sqm) **Pending Decision: Extension of duration.** **Pl. Ref. 11364:** HR Property Developments Ltd have applied for extension of duration for the construction of 36 no. dwelling houses consisting of 12 no. dwellings in 3 no. terraces, 18 no. semi-detached and 6 no. detached dwellings including a proprietary effluent treatment plant and percolation area along with associated site development works (4233sqm)(previous pl.	Potentially negative, particularly with regard to the eminence of septic tanks.

	ref. 05/2217). This development is located approximately 300m from the extent of the November 2009 Dunkellin River flood event. **Extension of duration granted.** **Aggard More Townland:** **Pl. Ref. 110238:** to construct a dwelling house 266.3sqm, garage 59.9sqm, treatment unit and polishing filter. **Conditional Permission granted.** **Pl. Ref. 110239:** to construct a dwelling house 266.3sqm, garage 59.9sqm, treatment unit and polishing filter. **Conditional Permission granted.** **Pl. Ref. 11237:** For retention of modifications to elevations and layout of existing dwelling as constructed, granted under pl. ref. 08/3629. Permission to also include retention of garage as constructed and to include all associated site works and repositioning of dwelling along with the rectification of any discrepancy from previously granted dwelling (gross floor space house 302.62sqm garage 43.75sqm). Site located 500m south of the extents of the November 2009 flood event. **Conditional Permission granted.** **Fahymactibbot:** **Pl. Ref. 11379:** for the construction of two domestic extensions to an existing dwelling house (gross floor space 55sqm). **Conditional Permission granted** **Caheradine:** **Pl. Ref. 11304:** for the construction of a dwelling house, detached garage, septic tank and puraflo effluent treatment system and all associated works (previously granted under)outline permission no. 02/4580) (gross floor space 200sqm)(previous pl. ref. 06/47). **Extension of duration** g**ranted (unconditional).** **Pl. Ref. 11466:** for the construction of new extension to existing dwelling. Extension to consist of the construction of new extension to side of existing dwelling, incorporating new Living Areas to ground floor and bedroom to first floor. Also to include new entrance porch to front elevation with all associated site works (gross floor space 122.33sqm). **Conditional Permission granted** **South of Rahasane Turlough:** **Pl. Ref. 1191:** Application for Extension of Duration for the construction of a dwelling house, garage at rear, septic tank and associated services (previously granted under outline permission no. 02/1009) (gross floor space 218.8sqm) (previous pl. ref. 05/4623) in the townland of Rinn (approximately 200m from the extent of flooding area). **Granted (unconditional).** **Kileeneen More:** **Pl. Ref. 11250:** for a dwelling house, sewage treatment plant, percolation area and domestic garage (gross floor space house 244.96sqm garage 50.7sqm). **Conditional Permission granted** **Kilcolgan:** **Pl Ref. 101243:** Extension of duration for retention of garden centre and associated retail unit and permission sought for new car park (gross floor space 98sqm) (previous pl. ref. 04/4444) (ext of duration 10/15). Site located 200m south of November 2009 flooding extents. **Granted** (unconditional). **Stradbally East:** **Pl Ref. 11448:** Permission for development on site comprising of dwelling, stables and septic tank. Previous planning relating to dwelling was planning ref 32387. Directly adjacent to lands flooded during the November 2009 flood event. **Pending Decision.**	

	Killeely Beg: **Pl. Ref. 11461:** Extension of duration for change of house plans on site previously approved under planning ref. no. 05/4512 and permission to construct domestic garage and all associated services (gross floor space house 202.5sqm garage 72sqm)(previous pl. ref. 10/444) in the townland of Killeely Beg (200m from extent of November 2009 flooding). **Pending decision.** **Crinnage or Ballywulash:** **Pl. Ref. 10636:** Permission for reclamation of lands. Site located approximately 360m north of extent of November 2009 flooding. **Conditional permission granted.** **Pl. Ref. 10869:** for a children's community playground on behalf of Craughwell Community Dev. Assoc. Works will provide a level site, provision of an approved playground play surface, installation of playground equipment and boundary fencing. **Conditional permission granted.** **Pl. Ref. 101385:** Permission to construct a carbon neutral two storey dwelling house and sewage treatment plant system (gross floor space 260sqm) (230m from extent of November 2009 flooding). **Conditional permission granted.** **Pl. Ref. 11256:** for an extension to the rear of the existing school comprising of 2 no. Special Education Needs Rooms and 1 no. Classroom and all associated alterations to existing school and services to accommodate these works (gross floor space 181.8sqm). **Conditional permission granted.** **Pl. Ref. 1186:** Craughwell Athletic Club, to construct an Athletics Training Hall and Outdoor running track (gross floor space 1st phase 920sqm 2nd phase 1224sqm). **Conditional permission granted.** **Pl. Ref. 11881:** to construct a shed (gross floor space 62.16sqm**). Conditional permission granted.** **Pl. Ref. 111160:** for the alteration of a previously approved design for a dwelling, site entrance and associated site works, ref. 10/1385. Alterations relate to the redesign of the 2 storey dwelling house which will be located and scaled as previously, and the addition of a separate shed (gross floor space house 223sqm garage 31sqm). **Conditional permission granted.** **Pl. Ref. 111651:** for an extension to the rear of the existing school comprising of 2 no. special education needs rooms and 1 no. classroom and all associated alterations to existing school and services to accommodate these works (gross floor space 196.2sqm). **Pending decision.**	

7.1.1 Conclusion of In-Combination Effects

It is considered that as a result of the scale of the works and implementation of effective mitigations to avoid impacts affecting Rahasane Turlough SAC/SPA, there will be no potential for further cumulative impacts arising in combination with any other plans or proposals which would be of significance in respect of impacts affecting the conservation objectives or integrity of this Natura 2000 site.

8 IMPACT ASSESSMENT

8.1 CHARACTERISING IMPACTS

The methodology for the assessment of impacts is derived from the Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites (EC, 2002). When describing changes/activities and impacts on ecosystem structure and function, the types of impacts that are commonly presented include;

- direct and indirect effects,
- short- and long-term effects,
- construction, operational and decommissioning effects, and
- isolated, interactive and cumulative effects.

Impacts that could potentially occur through the implementation of the project can be categorised under a number of impact categories as outlined in the EC 2002 document as follows:

- Loss/Reduction of habitat area,
- Disturbance to key species,
- Habitat or species fragmentation,
- Reduction in species density, and
- Changes in key indicators of conservation value such as decrease in water quality and quantity.

8.1.1 Meaning of 'Adversely affect the integrity of the site'

The concept of the 'integrity of the site' is explained in the EU publication Managing Natura 2000 sites: The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, as follows;

'It is clear from the context and from the purpose of the directive that the 'integrity of the site' relates to the site's conservation objectives. For example, it is possible that a plan or project will adversely affect the integrity of a site only in a visual sense or only habitat types or species other than those listed in Annex I or Annex II. In such cases, the effects do not amount to an adverse effect for purposes of Article 6(3), provided that the coherence of the network is not affected. On the other hand, the expression 'integrity of the site' shows that focus is here on the specific site. Thus, it is not allowed to destroy a site or part of it on the basis that the conservation status of the habitat types and species it hosts will anyway remain favourable within the European territory of the Member State.

As regards the connotation or meaning of 'integrity', this can be considered as a quality or condition of being whole or complete. In a dynamic ecological context, it can also be considered as having the sense of resilience and ability to evolve in ways that are favourable to conservation. The 'integrity of the site' has been usefully defined as 'the coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is or will be classified' [6]

[6] PPG 9, UK Department of the Environment, October 1994.

A site can be described as having a high degree of integrity where the inherent potential for meeting site conservation objectives is realised, the capacity for self-repair and self-renewal under dynamic conditions is maintained, and a minimum of external management support is required. When looking at the 'integrity of the site', it is therefore important to take into account a range of factors, including the possibility of effects manifesting themselves in the short, medium and long-term.'

The integrity of the site involves its ecological functions. The decision as to whether it is adversely affected should focus on and be limited to the site's conservation objectives.

8.1.2 Precautionary Principle

The precautionary principle is a principle of EU Environmental Policy and is mentioned now in Article 191(2) of the Treaty on the Functioning of the European Union[7]. In addition the European Court of Justice in the Waddenzee Judgement (Case C- 127/02) ruled where there was scientific uncertainty about the effect on bird feeding and resting sites of a consent to mechanical cockle fishing in a Dutch SPA. The ECJ ruling stated[8]:

'It is therefore apparent that the plan or project in question may be granted authorisation only on the condition that the competent national authorities are convinced that it will not adversely affect the integrity of the site concerned [...] So, where a doubt remains as to the absence of adverse effects on the integrity of the site linked to the plan or project being considered, the competent authority will have to refuse authorisation.'

8.2 IMPACTS TO THE QUALIFYING INTERESTS OF NATURA 2000 SITES

The qualifying interests of the relevant Natura 2000 sites are the habitats and species for which the sites have been designated (as described in **Section 4.2**). When determining the impacts on the qualifying interests of Natura 2000 sites, the attributes as listed for those habitats and species and the conservation objectives of these habitats and species as detailed in **Section 3** are taken into account.

8.2.1 Potential Impacts during the Construction Phase

8.2.1.1 Impacts on Rahasane Turlough SAC

The current threats to the structure and function of the Turlough, which is a water-dependent habitat within the SAC/SPA (see Natura 200 data form for Rahasane Turlough SAC), include groundwater pollution, grazing, hunting, drainage, flooding and fertilisation.

As the proposed works will take place within and adjacent to the Dunkellin River, part of which is designated under Rahasane Turlough SAC/SPA, there are potential construction phase impacts to the instream habitats due to increased sedimentation and run-off of pollutants. Conservation of instream habitats are not however included in the conservation objectives of Rahasane Turlough SAC/SPA therefore effects on instream habitats are dealt with in full in the **Chapter 11 Aquatic Ecology** of the EIS. There may also be potential impacts to terrestrial turlough vegetation communities adjacent to the Dunkellin River if suspended sediment released during the construction stage is deposited within the turlough causing nutrient enrichment with knock-on effects to the plant diversity within the turlough vegetation community.

[7] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2010:083:0047:0200:en:PDF
[8] ECJ Case C-127/02

The primary potential impact on SAC habitats during the construction phase is likely to be increased suspended sediment supply thereby increasing nutrient supply and primary productivity within the turlough. The section of the Dunkellin River which runs through Rahasane Turlough is designated under Rahasane Turlough SAC/SPA and so any run-off or release of contaminants from works upstream will have the potential to have an indirect effect on this Natura 2000 site.

The '*Guidance on the Assessment of Pressures and Impacts on Groundwater Dependent Terrestrial Ecosystems – Risk Assessment Sheet GWDTERA2a – Turloughs*' (Working Group on Groundwater, Sub-committee on Turloughs, 2004) sets out guidance on assessment of risk to Turlough GWDTEs from phosphate. Within this document all turloughs are assigned a Current Trophic Sensitivity, based on the extent of selected plant communities as mapped and classified by Roger Goodwillie.

A significant relationship has been found between average Ellenberg-F scores (scores which indicate the tolerance of vascular plants to moisture (Hill, M. O. *et al*., 1999)) and Goodwillie's turlough vegetation communities (Tynan *et al*., 2002) which shows that ascending division numbers, observed with increasing relative depth in the turlough, are indicative of increasing moisture conditions, as reflected by the average Ellenberg index of the characteristic plant species (**Table 8.1**).

Table 8.1 Vegetation communities and Ellenberg scores

Vegetation types	Goodwillie community reference	Average Ellenberg (F) score	Definition of Ellenberg indicator values
Grass	2A-3C	6	Between 5 and 7 (5: Moist-site indicator, mainly on fresh soils of average dampness)
Sedge	4B-7B	7	Dampness indicator, mainly on constantly moist or damp, but not on wet soils
Aquatic	8A-12	10	Indicator of shallow water sites that may lack standing water for extensive periods

Ellenberg Fertility Scores were assigned to each turlough plant community by averaging the Ellenberg Fertility Scores for the frequently occurring species. Frequently occurring species were those which occurred in a community in >10% of turloughs surveyed. The turloughs were then ranked according to the proportional area of communities with low Ellenberg Scores (<4), i.e. the proportional area of low productivity, nutrient sensitive plant communities. A score of 4 or less indicates that a site is in the range of intermediate fertility to extreme infertility (Hill *et al*., 1999). Turloughs were then assigned a Receptor Sensitivity class depending on the proportion of communities in the turlough with Ellenberg N <=4, i.e.: >50% = Extreme Receptor Sensitivity class; <50% and >25% = High Receptor Sensitivity class and; <25% = Moderate Receptor Sensitivity class.

Rahasane Turlough had 0.09% of communities with Ellenberg scores <= 4 and therefore was classified in the Moderate Receptor Sensitivity class, i.e. the lowest class of sensitivity.

Potential construction effects relate specifically to water and include increased sediment within, and release of pollutants to, the Dunkellin River. These have the potential to impact on the attributes in **Table 8.2**. Where sediment will be deposited depends on what stage of flood the turlough is at. At full flood any sediment released to the Dunkellin River is likely to be deposited at the eastern end of the turlough where flow will dissipate from the channel while at the early stages of flood the flood waters will enter the turlough where there are breaks in the embankments.

Table 8.2 Potential Impacts of Suspended Sediment on Rahasane Turlough SAC Targets[9]

Attribute	Target	Potential for Impact During Construction Phase
Habitat area	Area stable at c. 203.3 ha or increasing, subject to natural processes.	The extent of turlough habitat through maintenance of flood duration will not be affected by any potential changes in water quality.
Habitat distribution	No decline, subject to natural processes.	The distribution of habitat will not be affected by any potential changes in water quality.
Hydrological regime	Appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat	Hydrological regime will not be affected during construction phase.
Soil type: area	Variety, area and extent of soil types necessary to support turlough vegetation and other biota	Soil type is unlikely to be affected during construction phase.
Soil nutrient status: nitrogen and phosphorous	Nutrient status appropriate to soil types	A significant release of sediment to the Dunkellin River during the construction phase could impact on the soil nutrient status at the eastern end of Rahasane Turlough if the Dunkellin River is over-topping its banks while significant construction works are underway upstream.
Physical structure: bare ground	Sufficient wet bare ground, as appropriate	Area of bare ground is unlikely to be affected by any potential changes in water quality during construction phase.
Chemical processes: calcium carbonate deposition and concentration	Appropriate $CaCO_3$ deposition rates and concentration in soil	The appropriate $CaCO_3$ deposition rate is unlikely to be affected by any potential changes in water quality during construction phase.
Water quality: nutrients; colour; phytoplankton; epiphyton	Appropriate water quality to support the natural structure and functioning of the habitat	**Water quality: nutrients** Maintain average annual TP concentration of ≤10µg l-1 TP, or ≤20µg l-1 TP, as appropriate. Rahasane Turlough has been classified as having a Medium Level of 'Natural Trophic Sensitivity' and a Medium Level of 'Current Trophic Sensitivity' which is the lowest level of sensitivity. **Water quality: colour** Maintain appropriate water colour. An impact on nutrient status or suspended sediment during construction phase has the potential to impact on colour. Increased water colour could also impact on the primary productivity of rooted plants, either the truly aquatic plants or those wetland species that can grow even when flooded. **Water quality: phytoplankton biomass** An impact on nutrient status or suspended sediment during construction phase has the potential to impact on 'chlorophyll a' concentration. **Water quality: epiphyton biomass** An impact on nutrient status or suspended sediment during construction phase has the potential to increase epiphyton as algal mats.
Active peat formation	Active peat formation, where appropriate	There is no peat formation at Rahasane Turlough and therefore no impacts.
Vegetation composition:	Maintain area of sensitive and high	If suspended sediment or pollutants are released into the Dunkellin River upstream of Rahasane

[9] Attributes and Targets extrapolated from NPWS (2013) *Galway Bay Complex SAC (000268) Conservation Objectives Supporting Document - Turlough Habitats*

Attribute	Target	Potential for Impact During Construction Phase
area of vegetation communities	conservation value vegetation communities/units at each turlough	Turlough during a time when the river is over-topping its banks within the turlough then sediment will likely settle out at the very eastern end of Rahasane Turlough. This area has been classified as 5B or GA1 and therefore is not one of the 6 high conservation value vegetation communities defined in **Table 3.8**
Vegetation composition: vegetation zonation	Maintain vegetation zonation/mosaic characteristic of each turlough	Any suspended sediment at high flood impact would be deposited at the eastern end of the turlough would be deposited on 5B vegetation community, a species poor and routinely grazed vegetation community. This community covers approximately 80ha of the turlough and is not considered to be highly sensitive to nutrient enrichment therefore impacts are considered unlikely (Goodwillie, pers comm.). Any nutrient enrichment would however have the potential to impact on 6A vegetation which occurs in the southern basin adjacent to the Dunkellin River. Enrichment would alter the current vegetation community favouring the more aggressive plant species thus reducing diversity.
Vegetation structure: sward height	Sward heights appropriate to the vegetation unit, and a variety of sward heights across each turlough	Aside from soil nutrient status, sward height is maintained by grazing which will not be impacted by any release of suspended sediments to the turlough.
Typical species: terrestrial, wetland and Aquatic plants, invertebrates and birds	Maintain typical species within Rahasane	Any release of suspended sediment is unlikely to cause direct impacts on typical species however a change in nutrient status of soil could result in changes to vegetation communities thereby resulting in species changes.
Fringing habitats:area	Maintain marginal fringing habitats that support turlough vegetation, invertebrate, mammal and/or bird populations	The marginal habitats at the potential depositional area (eastern end of the Turlough) are mostly improved grassland swards, pockets of hazel scrub and ash woodland none of which correspond to Turlough vegetation.
Vegetation structure:turlough woodland	Maintain appropriate turlough woodland diversity and structure	Actual area of flooded woodland is too small to map at Rahasane Turlough therefore impacts on turlough is considered unlikely as a result of release of suspended sediment.

8.2.1.2 Impacts on Rahasane Turlough SPA

The primary potential impacts on bird species during the construction phase are likely to be disturbance.

Indirect impacts affecting bird species may potentially arise as a result of increased suspended sediment thereby increasing nutrient supply and primary productivity within the turlough. This however is not considered likely to cause a significant impact on bird species within the SPA.

Potential run-off of other pollutants, such as hydrocarbons, may negatively impact bird species within the turlough.

Bird species that could potentially use the Dunkellin River as a migration route between Rahasane Turlough SPA and Inner Galway Bay SPA include Wigeon, Golden Plover, Black-tailed Godwits and Lapwing.

All construction works with the potential to cause disturbance impacts will be restricted to the Dunkellin River downstream of the Turlough. Any flightline between the two SPAs is likely to follow this river.

Disturbance impacts can be avoided if construction works in proximity to the turlough are carried out outside of the winter bird season, i.e. outside the September - March season entirely. If for practical reasons, the works at Rinn Bridge have to be undertaken at this time, then it should be determined whether the areas at the western end of the turlough are key areas for birds at this time of the year in order to determine if any disturbance impacts are likely to occur. Consultation with the local IWeBS recorder (Mr Pete Capsey) confirmed that bird distribution is completely dependent on the water levels at the site. However there are certain areas that groups of birds favour under 'normal' winter water levels.

Greenland White-fronted Geese tend to use an area of 'grass and mud' near the north-east corner of the turlough which is one of the higher areas in the Turlough and one of the last to flood. It is thought that Greenland White-fronted fly in to feed at Rahasane Turlough from another relatively nearby roosting site. Both Whooper Swans and Black-tailed Godwits are often near the western end of the turlough, where the water is deepest (Pete Capsey, pers comm.).

Whooper Swans feed within areas of deeper water while the Black-tailed Godwits feed on the spoil banks adjacent to the Dunkellin River. These spoil banks tend to stay above the high flood levels. Nonetheless, Black-tailed Godwits can disperse right across the entire turlough. Dabbling duck species such as Teal, Wigeon, Shoveler and Pintail are usually found near the eastern Craughwell end of the turlough. Over the 16 years that Pete Capsey has counted this site, he has seen increases in Shoveler and Pintail (dabbling ducks that use shallow water) and Little Egret (a species that is continually increasing its range and distributionthroughout the island) (Pete Capsey, pers. comm.).

8.2.1.3 Impacts on Galway Bay Complex SAC

As with Rahasane Turlough SAC it is considered that the potential impact to Galway Bay Complex SAC is increased sedimentation and run-off of pollutants which could arise during the construction phase of the project. The qualifying interests of Galway Bay Complex SAC considered to be within the potential zone of influence of the proposed works as listed in **Table 6.3**. An assessment of potential effects of suspended sediment on Galway Bay Complex SAC are discussed in **Table 8.3** in relation to the targets set for qualifying interests.

The majority of these qualifying objectives will not be impacted by potential increases in sediment discharge. Estuarine environments experience routine (diurnal) fluctuations in water levels (both tidal and riverine) and associated fluctuations in suspended solid levels.

Table 8.3 Potential Impacts of Suspended Sediment on Galway Bay Complex SAC Targets

Objective	Target	Potential for Impact During Construction Phase
To maintain the favourable conservation condition of Mudflats and sandflats not covered by seawater at low tide in Galway Bay Complex SAC, which is defined by the following list of attributes and targets.	**Target 1** The permanent habitat area is stable or increasing, subject to natural processes - •This target refers to activities or operations that propose to permanently remove habitat from a site, thereby reducing the permanent amount of habitat area. It does not refer to long or short term disturbance of the biology of a site.	There are no operations proposed to permanently remove this habitat from the site.
	Target 2 Conserve the following community types in a natural condition: • Intertidal sandy mud community complex – 513ha • Intertidal sand community complex – 232ha	Any release of suspended sediment is unlikely to significantly impact on the estimated area of intertidal community complexes. The construction phase will not involve significant continuous or on-going disturbance of communities. Without mitigation however there may be smothering, short term changes in sediment granulometry. No long term effects are considered likely.
The overall objective for 'Mediterranean salt meadows' in Galway Bay Complex SAC is to 'restore the favourable conservation condition' whilst the overall objective for 'Atlantic salt meadows' in Galway Bay Complex SAC is to 'restore the favourable conservation condition'. The assessment is divided into three main headings (a) Area (b) Range and (c) Structure and Functions.	(a) Area MSM Area - There is 8.184ha of MSM ASM Area - There is 9.832ha of ASM should be increasing, subject to natural processes ASM Range -	Area is not likely to be significantly impacted by any release of suspended sediment.
	(b) Range MSM Range - MSM range extends to the Kilcolgan River estuary in this area ASM range extends to the Kilcolgan River estuary in this area	Range is not likely to be significantly impacted by any release of suspended sediment.
	(c) Structure and Functions.	**Sediment supply:** If suspended sediment is released during high tide when the salt meadow habitat is submerged then the potential exists for increased sediment supply outside of natural levels. However this is considered likely to be short-term and not likely to have long term consequences. **Creeks and pans, Flooding regime, Vegetation zonation, Vegetation height, Vegetation cover,** **Typical species & sub-communities:** It is considered unlikely that any release of suspended sediment would result in a change to any of the above structures and functions. Any short-term changes would not be significant.

8.2.1.4 Impacts on Inner Galway Bay SPA

Aside from targets for specific species the two main objectives for Inner Galway Bay SPA are:

Objective 1: To maintain the favourable conservation condition of the waterbird Special Conservation Interest species listed for Inner Galway Bay SPA.

Objective 2: To maintain the favourable conservation condition of the wetland habitat at Inner Galway Bay SPA as a resource for the regularly-occurring migratory waterbirds that utilise it.

Any impacts caused during the construction phase of the project are likely to be limited to disturbance to species which are foraging, roosting or migrating within proximity to construction works and/or impacts on marine/estuarine habitats resulting from the release of pollutants to the Dunkellin River and subsequent transport to the Dunkellin River Estuary.

Table 8.3 outlines that during the construction stage, it is extremely unlikely to result in significant changes to the 'Intertidal sandy mud community complex community' and 'Intertidal sand community complex' which are the habitats most likely to influence the distribution of waterbirds at the site. Any release of pollutants such as hydrocarbons are unlikely to result in significant effects however mitigation measures at construction stage would ensure that any potential for impacts is minimised.

8.2.2 Potential Impacts during the Operational Phase, Longterm

8.2.2.1 Impacts on Rahasane Turlough SAC

Rahasane Turlough has the potential to be affected indirectly through alteration of the hydrological regime.

As discussed in Ní Bhrion (2008) flood duration is considered to be the dominant hydrological driver of turlough vegetation. Flood duration is also important to turlough invertebrates. Increased Water Volume can result in the following;

- Increase submergence time, selective for flood tolerant and late flowering plant species,
- Increased water depth favour aquatic plants,
- Reduction in light penetration, reduces plant photosynthesis, and
- Potential for temperature differentials to occur within water bodies, selective pressure on plants.

Decreased Water Volume can result in the following,

- Reduced flooding in winter, drier in summer, selective towards terrestrial plant species,
- In absence of a critical flooding level, tree growth will proliferate, and
- Reduced flooding time, increased area of land for agricultural use.

The current distribution of vegetation communities within this habitat may be particularly vulnerable to reduction in water table, or increased flooding and flood duration. In addition the Turlough could be supported by a number of water supply mechanisms.

An assessment of potential effects of any change in flooding regime on Rahasane Turlough SAC are discussed in **Table 8.4** in relation to the targets set for the qualifying interest.

Table 8.4 Potential Impacts of Change in Flooding Regime on Rahasane Turlough SAC Targets[10]

Attribute	Target	Potential for Impact During Operational Phase
Habitat area	Area stable at c. 203.3 ha or increasing, subject to natural processes.	The extent of turlough habitat through maintenance of flood duration will not be affected by the proposed scheme as it has been shown that the upper limit of turlough vegetation i.e.16.5mOD will be maintained.
Habitat distribution	No decline, subject to natural processes.	Turlough habitat will be maintained throughout the basins (See modelled post-works levels).
Hydrological regime	Appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat	**Groundwater contribution** Based on this design it is expected that baseflow (groundwater contribution) to the Dunkellin River will only be altered during higher flows when the main channel floods. Groundwater contribution during lower flows will continue in a similar pattern as there will be minimal influence at these times. **Flood duration** The appropriate hydrological regime necessary to maintain the upper limit of natural functioning of the turlough will be maintained. **Flood frequency** The natural annual temporal patterns in flood frequency will be maintained. **Flood area** The natural temporal pattern in flood area will be maintained. **Flood depth** The natural temporal and spatial patterns in flood depths will be maintained. **Permanently flooded/wet areas** Areas of permanent or semi-permanent flooding or water-logging will be maintained based on the the model predictions. The northern side of the main basin remains wet throughout the year which will be maintained based on the model (**Appendix A**)
Soil type: area	Variety, area and extent of soil types necessary to support turlough vegetation and other biota	Turlough soil type is largely determined by geology, morphology and hydrology (MacGowran, 1985; Coxon, 1986). Any changes in flood durations and hydrlogical regime in the long term may affect the area of soil types within the turlough.
Soil nutrient status: nitrogen and phosphorous	Nutrient status appropriate to soil types	Flooding affects plants mainly through the interruption of gaseous exchange. Additional impacts are the accumulation in soils of toxic substances that are caused by anaerobic metabolism of plants or bacteria and changes in soil structure. In general, in wetlands, phosphate is adsorbed onto soil particles from the water column, and a similar situation exists for nitrogen. This interaction may be most important in spring/early summer, during the last major flood recession before the growing season[11]. Any potential changes in flood durations and regime may affect soil nutrient status.
Physical structure: bare ground	Sufficient wet bare ground, as appropriate	Any potential change in flood duration has the potential to impact on bare ground extent. It is not anticipated that there will be changes in flood duration.
Chemical processes:	Appropriate $CaCO_3$ deposition rates and concentration in soil	The appropriate $CaCO_3$ deposition rate is unlikely to be affected by any potential changes in water quality during construction phase. Any potential change in flood duration has the potential

[10] Attributes and Targets extrapolated from NPWS (2013) *Galway Bay Complex SAC (000268) Conservation Objectives Supporting Document - Turlough Habitats*
[11] S. Tynan et al (2007)*Water Framework Directive: Development of a Methodology for the Characterisation of a Karstic Groundwater Body.*

Attribute	Target	Potential for Impact During Operational Phase
calcium carbonate deposition and concentration		impact on $CaCO_3$ deposition rate. It is not anticipated that there will be changes in flood duration.
Water quality: nutrients; colour; phytoplankton; epiphyton	Appropriate water quality to support the natural structure and functioning of the habitat	**Nutrients** Any potential changes in flood regime are unlikely to affect nutrient levels. **Colour** Any potential changes in flood regime are unlikely to affect colour. **Phytoplankton biomass** Any potential changes in flood regime are unlikely to affect phytoplankton biomass. **Epiphyton biomass** Any potential changes in flood regime are unlikely to affect the extent of epiphyton as algal mats.
Active peat formation	Active peat formation, where appropriate	There is no peat formation at Rahasane Turlough therefore no impacts are anticipated.
Vegetation composition: area of vegetation communities	Maintain area of sensitive and high conservation value vegetation communities/units at each turlough	Sensitive habitats at Rahasane include 2A, 2B, 3A, 3B, 6A and 6B and are distributed throughout the site. Other sensitive habitats which might be affected include those which retain standing water later in the season i.e. those habitats stated by Goodwillie as being sensitive 9A, 10A, 10B and 11B. There is no predicted change in flood levels and duration and therefore the current area of the sensitive communities are unlikely to be affected.
Vegetation composition: vegetation zonation	Maintain vegetation zonation/mosaic characteristic of each turlough	Any potential change in flood duration has the potential to impact on the current vegetation zonation/mosaic within the turlough. Increases in flood duration could increase the extent of wetland communities at the expense of drier habitats or a reduction in the depth could lead to a loss of wetland communities and increased representation of drier turlough vegetation communities.
Vegetation structure: sward height	Sward heights appropriate to the vegetation unit, and a variety of sward heights across each turlough	Sward height is maintained by grazing which could potentially be impacted by changes in flooding regime, i.e. reduced flood duration could mean extended grazing season. Any potential change in flood duration has the potential impact on sward height
Typical species: terrestrial, wetland and aquatic plants, invertebrates and birds	Maintain typical species within Rahasane	Any change in the area flooded has the potential to result in changes to typical species.
Fringing habitats: area	Maintain marginal fringing habitats that support turlough vegetation, invertebrate, mammal and/or bird populations	Fringing WN2 woodland ground layer communities could be influenced by routine or continued flooding influencing vascular and bryophyte plant species compostion, with knock-on effects to invertebrate community and in turn insectivorous / omnivorous large mammal communities Marginal 2A / GA1 communities could revert to 5B / GS4 through sustained inunudations or vise versa.
Vegetation structure: turlough woodland	Maintain appropriate turlough woodland diversity and structure	Actual area of flooded woodland is too small to map at Rahasane Turlough therefore impacts on turlough is considered unlikely as a result of any potential changes in flooding.

8.2.2.2 Impacts on Rahasane Turlough SPA

Operational impacts which may affect bird species within the SPA include changes in hydroperiod and alteration of turlough habitat which bird species depend on. Changes in water depths may alter usage by different species; e.g. diving duck numbers may decline if standing water is too shallow. These may be replaced by shallow feeding species such as dabbling ducks.

If there are no changes in hydroperiod or level of flooding at the lake then there will be no impacts on the bird species listed as qualifying interests of Rahasane Turlough SAC.

The main potential impact during operation is if there is a change in the hydrology which has a knock on effect on the change in the habitats within the turlough. The model report (**Appendix A**) states that there won't be any alteration to the hydrological regime, therefore there will be no subsequent change to habitats and their usage by bird species.

8.2.2.3 Impacts on Galway Bay Complex SAC

As with Rahasane Turlough SAC, it is considered that the potential impact to Galway Bay Complex SAC is the alteration of the Dunkellin River's hydrological regime which could lead to more rapid transport of pollutants such as nutrients, suspended sediment, microbiological contaminants and viruses and increased freshwater volume and/or flow to the receiving estuary and bay.

Tobin's model (Tobin, 2014) predicts that the scheme will increase the peak discharge rate into Galway Bay by 1% and the time to peak flow (Tp) was also estimated to be reduced from 95 hours to 93 hours. The proposed scheme conveys the freshwater discharge slightly more quickly but the total discharge is not increased over the course of the event.

The qualifying interests of Galway Bay Complex SAC considered to be within the potential zone of influence of the proposed works are listed in **Section 3**. An assessment of potential effects of any change in flow/volume of the Dunkellin River on Galway Bay Complex SAC is discussed in **Table 8.5** in relation to the targets set for the qualifying interest.

Table 8.5 Potential Impacts of Increased Flow/Volume of Dunkellin River on Galway Bay Complex SAC Targets

Objective	Target	Potential for Impact During Operation Phase
To maintain the favourable conservation condition of Mudflats and sandflats not covered by seawater at low tide in Galway Bay Complex SAC, which is defined by the following list of attributes and targets.	**Target 1** The permanent habitat area is stable or increasing, subject to natural processes - •This target refers to activities or operations that propose to permanently remove habitat from a site, thereby reducing the permanent amount of habitat area. It does not refer to long or short term disturbance of the biology of a site.	There are no operations proposed to permanently remove this habitat from the site.
	Target 2 Conserve the following community types in a natural condition: • Intertidal sandy mud community complex – 513ha • Intertidal sand community complex – 232ha	Any release of suspended sediment is unlikely to significantly impact on the estimated area of intertidal community. The construction phase will not involve significant continuous or on-going disturbance of communities. A slight increase in peak discharge rate of 1% is extremely unlikely to result in significant changes in the natural condition to the community types. No long term effects are considered likely.
The overall objective for 'Mediterranean salt meadows' in Galway Bay Complex SAC is to 'restore the favourable conservation condition' whilst the overall objective for 'Atlantic salt meadows' in Galway Bay Complex SAC is to 'restore the favourable conservation condition'. The assessment is divided into three main headings (a) Area (b) Range and (c) Structure and Functions.	(a) Area MSM Area - There is 8.184ha of MSM ASM Area - There is 9.832ha of ASM should be increasing,	Area is not likely to be significantly impacted by the 1% increase in peak discharge rate into Galway Bay and reduction in time to peak flow from 95 to 93 hours.
	(b) Range MSM range extends to the Kilcolgan River estuary in this area ASM range extends to the Kilcolgan River estuary in this area	Range is not likely to be significantly impacted by the 1% increase in peak discharge rate into Galway Bay and reduction in time to peak flow from 95 to 93 hours.
	(c) Structure and Functions.	**Sediment supply, Creeks and pans, Flooding regime, Vegetation zonation, Vegetation height, Vegetation cover, Typical species & sub-communities:** It is considered unlikely that 1% increase in peak discharge rate into Galway Bay and reduction in time to peak flow from 95 to 93 hours would result in a change to any of the above structures and functions.
To maintain the favourable conservation condition of Harbour Seal in Galway Bay Complex SAC, which is defined by the following list of attributes and targets	a) No artificial barriers Conserve the breeding sites b) Conserve the moult haul-out sites c) Conserve the resting haul-out sites d) Human disturbance	It is unlikely that there will be any significant effect on the seal population within the Galway Bay Complex SAC as a result of the proposed works.
To restore the favourable conservation condition of Otter in Galway Bay Complex SAC, which is defined by the following list of attributes and targets	e) No decline in distribution f) No significant decline in extent of terrestrial habitat. g) No significant decline in extent of marine habitat. No significant decline in extent of freshwater (river) habitat. h) No significant decline in extent of freshwater (lake/lagoon) habitat. i) No significant decline in couching sites and holts j) No significant decline in fish biomass available k) No increase in barriers to connectivity	Otter use the Dunkellin River both as a feeding source and a commuting corridor to the wider catchment. Once works are completed otter will continue to navigate the river corridor as before.

8.2.2.4 Impacts on Inner Galway Bay SPA

Aside from targets for specific species the two main objectives for Inner Galway Bay SPA are:

Objective 1: To maintain the favourable conservation condition of the waterbird Special Conservation Interest species listed for Inner Galway Bay SPA.

Objective 2: To maintain the favourable conservation condition of the wetland habitat at Inner Galway Bay SPA as a resource for the regularly-occurring migratory waterbirds that utilise it.

It is considered that there will be no direct impacts on the qualifying bird species of Inner Galway Bay SPA during the operational phase of the project. However any impact on the wetland habitats downstream of the N18 Bridge has the potential to impact on these species. Therefore impacts in relation to Objective 2 are considered below.

As with Galway Bay Complex SAC it is considered that the potential impact to Inner Galway Bay SPA is alteration of the hydrological regime of the Dunkellin River which could lead to more rapid transport of pollutants such as nutrients, suspended sediment, microbiological contaminants and viruses and increased freshwater volume and/or flow to the receiving estuary and bay.

Tobin's model predicts that the proposed scheme will increase the peak discharge rate into Galway Bay by 1% and the time to peak flow (Tp) was also estimated to be reduced from 95 hours to 93 hours. The proposed scheme conveys the freshwater discharge slightly more quickly but the total discharge is not increased over the course of the event.

Any slight increase in peak discharge by 1% and reduction in time to peak flow is not likely to cause the transport of significant additional quantities of suspended sediment and nutrients to the Dunkellin Estuary. **Table 8.5** outlines that this increase in peak discharge is extremely unlikely to result in significant changes to the 'Intertidal sandy mud community complex community' and 'Intertidal sand community complex' which are the habitats most likely to influence the distribution of waterbirds at the site.

9 MITIGATION MEASURES

9.1 GENERAL

Where a likely significant adverse effect has been identified during an Appropriate Assessment or cannot conclusively be ruled out, it may be possible to proceed with a proposal where mitigation measures can be implemented to address the adverse effect. These measures will allow any potential impacts affecting the conservation status of Rahasane Turlough SAC/SPA, Galway Bay Complex SAC and Inner Galway Bay SPA to be avoided.

9.2 CONSTRUCTION STAGE MITIGATION

Potential construction stage impacts are outlined in **Section 8.2**. It is considered that the main construction phase effects will involve the potential release of pollutants to the Dunkellin River which could impact qualifying habitats and species and disturbance which could lead impacts on qualifying bird species of Rahasane Turlough SAC/SPA, Galway Bay Complex SAC and Inner Galway Bay SPA.

9.2.1 Mitigation Measures for the control of Airborne Pollutants during Construction Activities

To protect sensitive receptors in the vicinity of the scheme the following measures are proposed. Measures to mitigate the emission of dust due to construction activities include:

(i) wind breaks and barriers,
(ii) control of vehicle access,
(iii) vehicle speed restrictions,
(iv) bed of gravel at site exit points to remove caked on dirt from tyres and tracks,
(v) washing of equipment at the end of each work day,
(vi) prevention of on-site burning,
(vii) hard surface roads should be wet swept to remove any deposited materials,
(viii) unsurfaced roads should be restricted to essential site traffic only, and
(ix) wheel-washing facilities should be located at all exits from the construction site.

9.2.2 Mitigation Measures for the control of Waterborne Pollutants during Construction Activities

The proposed project has been identified as potentially giving rise to adverse effects on water quality of the Dunkellin River with potential subsequent impacts on Rahasane Turlough SAC/SPA, Galway Bay Complex SAC and Inner Galway Bay SPA. Indirect impacts arising from sediment release from construction sites upstream of the turlough must be carefully managed and monitored for effectiveness at source. This is essential in terms of minimising turbidity and ensuring protection of Annex I habitat [3180] “Turloughs” for which Rahasane Turlough SAC is designated.

Water quality mitigation measures for avoidance, reduction and remediation of impacts are prescribed below.

Release of suspended solids to all surface waters will be controlled by interception and management of site run-off. Dewatering and surface water runoff discharges from the excavation and landspreading areas will be controlled, collected and routed via appropriate treatment measures. These measures will be in accordance with the CIRIA publication C648, ‘*Control of Water from Linear Construction Project*’ (CIRIA, 2006). Silty water shall be treated using ponds and temporary interceptors and silt traps will be installed. An interceptor drain will be located at the edge of the access track to intercept runoff.

These facilities will be maintained at least on a daily basis and the maintenance record will be maintained and available for inspection by the client and other statutory organisations.

Standard pollution control and mitigation measures, as outlined below, will be employed where relevant when working in and near the watercourse affected by the proposed works to prevent the release of deleterious substances to the Dunkellin River and its hydrologically connected Natura 2000 sites.

All two-stage channel works are proposed to be carried out outside of the existing channel thereby retaining the average annual flow within the existing channel. Excavation is to be undertaken along the bank with minimal interference with water quality.

General mitigation

A detailed design and method statement should be drawn up by the contractor indicating what standard measures will be taken to avoid (i) sediment or soil loss and (ii) cement and hydrocarbon release, associated with all aspects of the construction phase. The statement must include how these will be monitored for effectiveness. Given the scale of the works, the method statement must include details of the response strategy and chain of command in the event of flooding occurring during works. A mechanism for reporting of pollution incidents should be agreed in advance between the contractor(s) and Galway County Council. Given the scale of the works, it should be detailed as to how, in the event of flooding occurring during construction, water quality will be protected.

A Method Statement will be drawn up by Galway County Council listing in detail the methods which will be used for the proposed bank widening and associated spoil spreading. This needs to be sufficiently detailed to allow interested parties, to understand the extent and location of the works and the exact limits of what is being proposed and where. This will mean that non-scheduled or non-approved works will not take place and will allow more focused mitigation in areas which are considered more sensitive or more prone to risk than others.

A mechanism for reporting of pollution incidents should be agreed in advance between the contractor(s) and Galway County Council.

The work flow on site must be designed to minimise damage to the edge of the banks by heavy construction vehicles or cause rutting which would increase the risk of gully erosion or solids wash-out during intense rainfall.

Concrete and Cement

Wet concrete and cement are very alkaline and corrosive and can cause serious pollution to watercourses. The following precautions will be put in place with regard to Concrete and Cement;

- Disposal of raw or uncured waste concrete must be controlled to ensure that the watercourse or karst features will not be impacted.

- Best practice in bulk-liquid concrete management addressing pouring and handling, secure shuttering / form-work, adequate curing times.

- Where shuttering is used, measures should be put in place to prevent against shutter failure and control storage, handling and disposal of shutter oils.

- Wash water from cleaning ready mix concrete lorries and mixers may be contaminated with cement and is therefore highly alkaline. Due to the size of the site and the proximity of sensitive watercourses, it is recommended that lorries and mixers are washed out off site.

- Cement dust must be controlled as it is alkaline and harmful to the surrounding ecology. Activities which result in the creation of cement dust must be controlled by dampening down areas.

- The timing of the works must be specified and agreed with the IFI in relation to fish migration and spawning periods.

Fill Material

The rock type underlying much of the site is karstified limestone. Where rock fill is required, such as at Rinn Bridge, it should be recovered and reused from any excavations within the site. The importation of foreign material should be limited, however if it is required it should be the same rock type as found on site.

Hydrocarbons

Fuel and hydraulic fluids should not be stored on site, but if absolutely necessary, they must be stored in a locked and bunded container.

Refuelling should only take place in the site compounds.All stationary plant should be placed on drip trays to prevent leaking oils reaching the river or entering groundwater.

No washings or waste materials of any kind can be directed into watercourses; i.e. the Dunkellin River or any channels or ditches supporting connectivity with the Dunkellin River.

Machinery on site must have pollution control kits on hand in the event of an emergency.

Construction waste

All construction related waste, e.g., plastics, cable ties, geotextile etc. must be collected and disposed of correctly so that they don't enter the river channels. Given the size of the construction area overall, the amount of this kind of construction related foreign material may be considerable and care should be taken that they do not end up in the waterbodies.

Timing restrictions

Where out of river works are of a risky nature, such as large scale excavation works for the channel widening measure, restrictions also, generally, apply.

A construction works programme has been devised for the Dunkellin River and Aggard Stream Flood Relief Scheme and this is presented in **Figure 4.3.** The programme clearly respects the environmental sensitivities of the receiving environment and the recommendations of consultees. It should be noted that this is an outline programme of works only and may be subject to alterations subject to the timing of planning approvals, the final detailed design stage programme and following the appointment of a works contractor.

Stockpiling of spoil and Landspreading

Stockpiling of spoil should be minimised or avoided where possible. If it has to occur they should be placed on flat ground at least 10m back from the edge of the river bank preferably in a grassed area, so that any run-off can filter through the grass and prevent sediment run-off. They must also be placed on high ground so they cannot be inundated during floods. Silt fences should be used where there is a danger of soil wash-out from stockpiled soil or from earth works. Stone will be stockpiled since it will not be suitable for landspreading.

Until the spoil sites have stabilised, surface water runoff from the spoil heaps and landspreading sites will be collected via a shallow interceptor ditch with check dams to provide short term attenuation and serve as an additional silt-trap. The interceptor ditch will be excavated prior to works commencing for a distance of 100m even if the working area is confined to 20m. The number of check dams to be provided will have to be determined once the ditch is constructed and surveyed to determine the slope.

Spoil spread on adjacent lands should be kept at least 5m back from the edges of land drains and 10m from larger watercourses. All spoil should be re-seeded as soon as it has been spread in order to stabilise it and reduce the possibility of solids wash-out to surface waters. Silt fences should be used where there is a danger of soil wash-out from stockpiled soil or from earth works.

The work flow on each site in association with the scheme must be designed to minimise damage to the edge of river banks by heavy construction vehicles, with avoidance of rutting which would increase the risk of gully erosion or solids wash-out during intense rainfall.

Sediment and Pollution Control

Mitigation for the construction of the two stage channel will essentially be the same for each zone involved on all three of the lower Dunkellin River reaches between N18 and Rinn Bridge. As identified in **Section 8 Impact Assessment**, the principle risk will be from solids washout either directly from the edge of the bank or via drains traversing the new two-step channels. The contractor must specify specific sediment control measures in relation to the extensive excavations proposed for the two-stage channel. This may include, for example, specifying the approach to excavations such that works begin away from, and work towards the channel with a buffer zone left between the excavation area and the channel to prevent diffuse wash off. Flow paths to the river, in that case, can be more adequately protected with appropriate sediment control measures.

The stretch of bank to be lowered will be surveyed in detail to identify surface drains or recognisable karst features which might act as conduits or preferential flow routes for solids-contaminated run-off to the Dunkellin River, so that they can be managed in such a way that minimises the possibility of solids run-off during and after construction. Heavy traffic beside or over these drains should be avoided and excavations should be away from the edges as much as possible. The outlets from the drains should be blocked with temporary check dams or silt fencing, especially larger ones when they are being deepened, which is often likely to be necessary. Crossings of active drains should as much as possible be over existing culverts if available or else over crushed stones or other coarse rubble, excavated from earlier bank works.

In areas where soil overlays rock or rubble, then all the former should be removed in advance to reduce the risk of solids washout when the deeper rubble and rock layers are being removed.

Soil, shrubs and vegetation should not be stockpiled near the water's edge or beside active or potentially active drains on the new stepped channel.

When working the very edge of the new channel, care should be taken not to destabilise it or to leave it sloping toward the existing channel is a way that would increase the risk of erosion or solids run-off.

In areas where the base material is soil as opposed to rock, this should be re-seeded with a suitable species mix to allow rapid stabilisation of the surface. Where this would help to stabilise loose soil or other bed material, the new channel should also be rolled. This work should run in parallel to the widening works. Outside the growing season exposed soil should be covered with coir or geojute to minimise erosion and to encourage rapid establishment of vegetation.

If the water table rises to the level of the works area then all works should cease in the affected areas until it drops again. Theadvance warning of flood events is possible and the appointed contractor will be required to monitor both long and short term weather forecasts so that machinery and personnel can be prevented from entering the channel during periods of peak flow. Monitoring of the flow in the upstream catchment may be used as an aid to predict high flow events.

All heavy machinery traffic should be avoided along the outer edge of the new channel in order to minimise soil damage and ground damage.

After completion of the works, the site should be continually monitored, during wet weather in particular for evidence of preferential flows area where solids are entering the river. These should be blocked with checkdams, silt fences or a combination of both to help reduce solids wash-out.

It is recommended that before commencement and after completion of the works, the known salmon spawning areas would be monitored by the IFI to ensure that they have not been silted up. In the event that they have been these should be raked to remove deposited fines. This should be undertaken for at least two years after the works have been completed.

Any fringing stands of reeds or tall emergent vegetation (i.e. of *Sparganium* and *Phalaris*) should not be removed nor damaged during construction, unless specifically agreed in advance by the IFI. This is because these beds will act as partial protection against erosion of the edges of the new bank, and help to trap escaped solids from the earth works and provide bankside cover for fauna on the newly exposed left bank where overhanging riparian vegetation will be removed.

Details of Stormwater Pollution Prevention control measures are provided below.

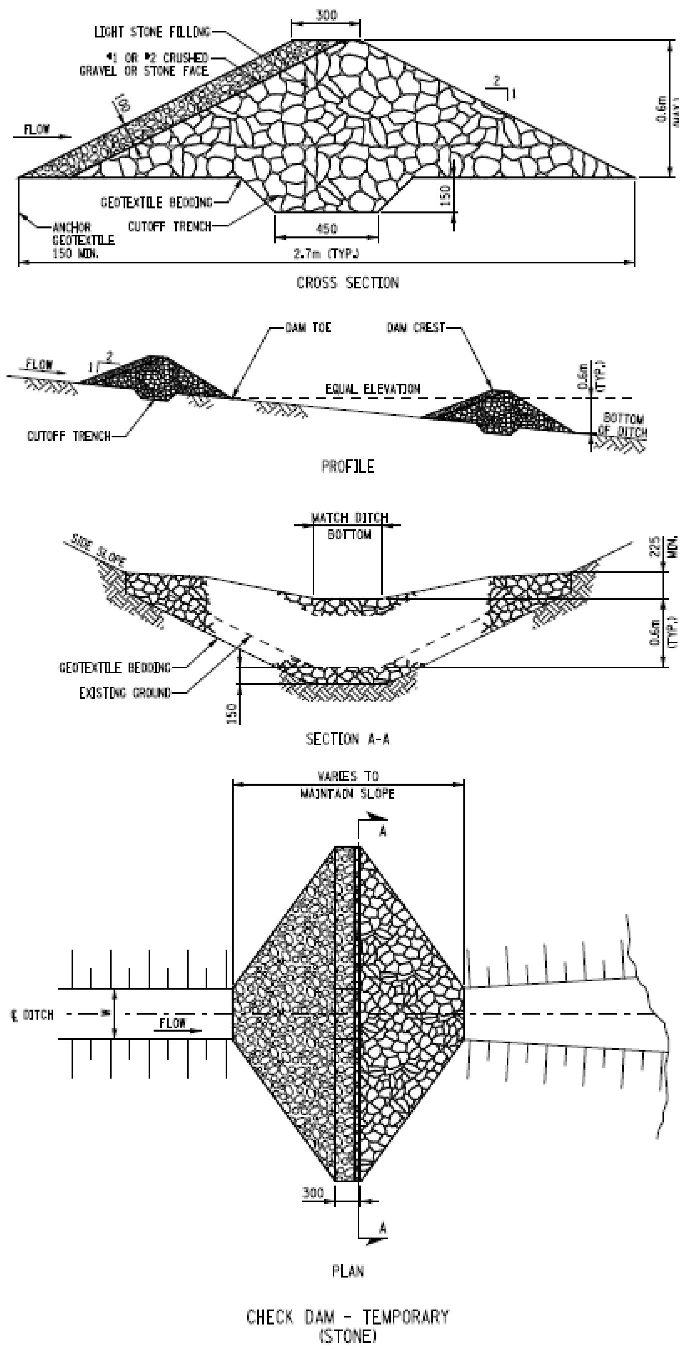
9.2.3 Swales and Settlement Ponds

Dewatering and surface water runoff discharged from the construction site, including any advance works, during and for the duration of the construction works will be controlled, collected and routed via appropriate treatment measures. Structural Measures for Erosion and Sediment Control such as Temporary Check Dams in Interceptor Ditches are shown in **Figure 9.1.**

9.2.3.1 Storm Runoff

Storm runoff from the working area and landspreading sites will be conveyed via a swale located on the down slope of the working area. Swales are wide, shallow, gently sloping depressions used to convey water. They increase stormwater infiltration and are a low maintenance option to remove sediments, nutrients and pollutants whilst adding a visually aesthetic component to a site. Swales are most effective on gentle slopes with the incorporation of attenuation features such as silt traps, see **Image 9.1** and **Image 9.2**, which attenuate flow and encourage the sedimentation of any potential silt. The flow will discharge to a proposed soakpit and a double silt curtain will be provided at the outfall prior to being discharged to the watercourse. The silt traps must be cleaned out regularly, to ensure the effectiveness of the system. These facilities will be inspected/ maintained at least on a daily basis and the maintenance record will be available for inspection by the Client and other statutory organisations as part of the method statement.


Image 9.1 and 9.2 Example of Silt Traps and Swale with Check Dams to control sediment



Notes

- Maximum drainage area contributing to temporary stone check dam shall be 0.8 ha.
- Measures shall be inspected every (7) calendar days or after each rainfall of 12mm or more within a 24 hour period. Measures shall be cleaned and repaired as required.
- Sediment shall be removed when accumulation reaches one-half of the measure height. Sediment shall be disposed of as unsuitable material
- Coarse aggregate facing material for the stone check dam shall meet the requirement of coarse aggregate filling, and
- Stone filling core material for the stone check dam shall meet the gradation requirements of light stone filling.

TEMPORARY CHECK DAM VOLUMES

DITCH SIDE SLOPE	VOLUME (m^3)
1:2	1.0 m^3 ±
1:3	1.5 m^3 ±
1:4	2.0 m^3 ±
1:6	3.0 m^3 ±

BASED ON V SHAPED DITCH SECTION
FOR TRAPEZOIDAL DITCH, ADD
1 CUBIC METER / METER OF DITCH WIDTH

*I =H/S
Where
I = Check Dam Spacing Interval
H= Check Dam Height
S= Channel Slope

Figure 9.1 Structural Measures for Erosion and Sediment Control - Temporary Check Dams in Interceptor Ditches

Table 9.1 Placement of Stone Checkdam within Interceptor Ditch

Ditch Slope	Temporary Check Dam Placement Interval (Based on 0.6m Height)
1%	60m
2%	30m
3%	20m
4%	15m
5%	12m
6%	10m
8%	7.5m
10%	6m

9.2.3.2 Culvert Installation

The pollution prevention controls to be adopted during the installation of the culvert for the access road are critical. If temporary or permanent diversion of the watercourse is required, this should be carried out prior to the removal of bankside vegetation.

Temporary stream diversions should be made on geotextile surfaces with a surface layer of coarse aggregate to hold it in place. Operation of machinery instream should be kept to an absolute minimum. All construction machinery operating instream should be mechanically sound to avoid leaks of oils, hydraulic fluid, etc. Machinery should be steam-cleaned and checked prior to commencement of instream works. Such works would preferentially be done during the dry period of the year when flows are low and the risk of suspended solids release is minimal; i.e. between May and September.

9.2.4 Dewatering

All dewatering flow should be passed through settlement ponds, as detailed above, to remove sediments. Where settlement ponds cannot be provided, temporary ponds can be formed by constructing bunds and placing an appropriate geotextile liner on top. Alternative methods of ensuring that the temporary settlement ponds are constructed in a manner that prevents sediment reaching the water environment may be adopted, providing this can be demonstrated to achieve the same or better level of treatment.

9.2.5 Silt Fences

The land spreading either side of any watercourse or land drain will be fenced with silt fencing comprising Terram or equivalent geo-textile fencing, secured to the ground to prevent the wash-out of suspended solids from the site to the watercourse as illustrated in **Figure 9.2**.

9.2.5.1 Silt Fence Installation Guidelines

- Silt fences are to be constructed on a level contour. Sufficient area should exist behind the fence for ponding to occur without flooding or overtopping the fence.
- The bottom of the fencing must be turned out towards the works area. This is to ensure sediment will not migrate under the fence. The silt fence should be exposed so that it can be easily maintained in the future.
- Construct silt fences with a setback of at least 900mm from the toe of a slope. Where a silt fence is determined not to be practicable due to specific site conditions, the silt fence may be constructed at the toe of the slope, but should be constructed as far from the toe of the slope as practicable. Silt fences close to the toe of the slope will be less effective and difficult to maintain.
- A trench should be excavated approximately 150mm wide and 150mm deep along the line the proposed silt fence.

- Bottom of the silt fence should be keyed-in a minimum of 300mm.
- Posts should be spaced a maximum of 3.5m apart and driven securely into the ground a minimum of 300mm below the bottom of the trench.
- When standard strength filter fabric is used, a plastic or wire mesh support fence should be fastened securely to the upslope side of posts using heavy–duty wire staples at least 25mm long. The mesh should extend into the trench. When extra-strength filter fabric and closer post spacing are used, the mesh support fence may be eliminated.
- Filter fabric should be purchased in a long roll, and then cut to the length of the barrier. When joints are necessary, filter cloth should be spliced together only at a support post, with a minimum 150mm overlap and both ends securely fastened to the post.
- The trench should be backfilled with compacted native material.

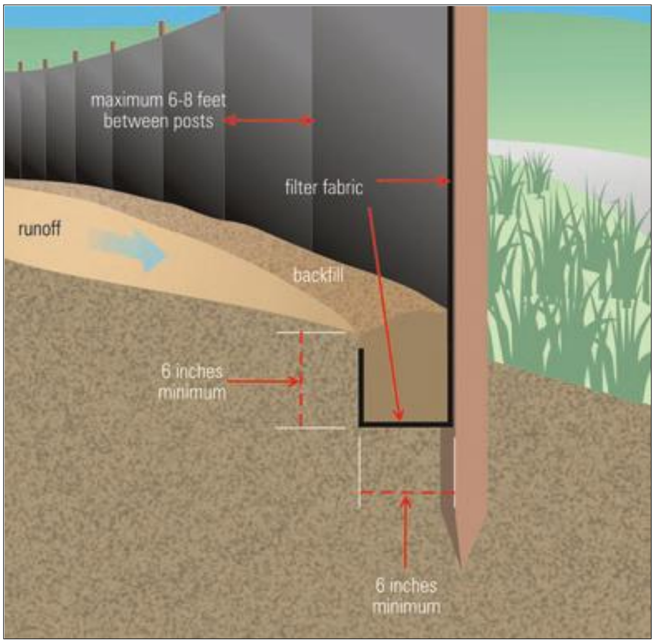


Figure 9.2 Illustration of proper techniques to be employed in installing silt fence installation.

9.2.1 Mitigation Measures for Each Flood Alleviation Area

Specific pollution control and mitigation measures are outlined in **Table 9.2** below for each of the scheme measures proposed. These will be employed where relevant when working in and near the watercourses affected by the proposed works to prevent the transport of deleterious substances to on-site watercourses and its associated water-dependent habitats and species.

Table 9.2 Summary of Mitigation Measures at Each Area

<table>
<tr><th>Works Item No.</th><th>Description of Works</th><th>Mitigation Measures</th></tr>
<tr><td>1</td><td>Main Channel (Craughwell Village)
i. A c.350m section of the Craughwell River will be temporarily dewatered by diverting the river into the newly deepened by-pass channel at Craughwell village. This stretch encompasses the R446 and masonry pedestrian bridges which will be excavated and underpinned in conjunction with the deepening measure. Craughwell River works will then occur in the dry.
ii. A c.600m stretch of the Craughwell River, downstream of (1), between the bypass channel outlet and upstream of the Aggard Stream confluence, will be regraded using short sections of cofferdam that isolate 50m sections of channel on alternate banks. Underpinning of the Railway Bridge will occur in conjunction with deepening of this reach. Flow will be temporarily confined to the opposing half of the channel whilst excavations will occur on one half of the channel. This will, we deduce, necessitate the stepwise isolation of at least 12 x 50 m sections of river on each bank.</td><td rowspan="2">Habitat and Fisheries
The construction phase for deepening of the Craughwell main channel is sequenced to occur over two subsequent summers, i.e., August/September 2015 and 2016. The proposed sequencing of the works in Figure 4.3 shows that item (i) occurs prior to (ii). This means that in the summer of 2016, for instance, the river can be diverted through the bypass channel for works to proceed in the Craughwell area in the dry, as well as works occurring downstream of the railway bridge. The design of the river enhancement works together with the associated construction works method statements will be the subject of detailed design between Galway County Council, the OPW and Inland Fisheries Ireland upon conclusion of the planning process (GCC, 2014). Initial details suggest that Dr Martin O'Grady, IFI Senior Research Officer, envisages that habitat reinstatement and fisheries enhancement can be adequately achieved in the Craughwell River reach as part of proposed deepening works.

Sediment Release
It is unknown what the residual substrates will be following regrading, but if these are erodible (e.g., gravelly silt) this could lead to suspended solids being temporarily transported downstream to Rahasane Turlough. To prevent this, it has been agreed that the surface 30-40 cm of coarse substrates (gravel, cobble, boulder and coarse sand) will be set aside and stored from each 50m stretch which is being excavated using the advancing coffer dam method, and then replaced when the bed has been excavated. It has been incorporated into the preliminary deepening design that it may be necessary to excavate to a slightly deeper level to accommodate the replacement material and additional EREP materials while retaining the desired, final bed levels. These measures are expected to protect the bed from erosion during floods while at the same time providing cover for parr and older fish. The use of heavy machinery along the banks e.g. for both excavation and insertion and removal of sheet-piling should be managed carefully along the river's edge in order to minimise bankside damage and erosion. In order to facilitate this, a temporary running track or geotextile and hard-core track along one bank will be used along with silt fences between construction sites and the river as a precautionary measure. This would help prevent heavy rutting of banks and solids washout to the river. Construction vehicles should not enter the channel unless within the confines of a coffer dam.

Substrate Removal & Stock Piling
In the area of riffle downstream of the masonry stone arched bridge in Craughwell the top 30cm layer of coarser substrate in the channel which will need to be removed prior to deepening. This will be removed</td></tr>
<tr><td>2</td><td>R446 Bridge
The channel will be deepened by approximately 0.6m at the R446 Road Bridge (underpinning of the bridge will be required).</td></tr>
</table>

Works Item No.	Description of Works	Mitigation Measures
3	**Masonry Arch Pedestrian Bridge** The channel will be deepened by approximately 0.6m at each arch (underpinning of the arches will be required).	and stockpiled safely on the banks. The substrate should be removed in two layers the top coarse layer which consists mainly of small cobbles and scattered small boulders followed by a lower gravel / coarse sand layer. These separated layers should be removed from each area in turn and also stored separately on geotextile on the bank. This substrate should be used in channel reinstatement following deepening. **Toxicity Associated with Use of Concrete at Bridge Underpinnings** The two bridges at Craughwell village can be underpinned in the dry and concrete works to be confined to shutter; thereforeso concrete spillage to the main channel is unlikely to occur, though best practice in concrete usage will be applied. Adequate curing times must be used before reopening the main channel to flow in the case of the R446 and Masonry Bridge.
4	**Bypass Channel (Craughwell Village)** The channel will be graded from an u/s level of 18.5mOD to a d/s level of 18mOD. (The bypass bridge will require underpinning to match proposed bed levels).	Rigorous implementation of measures and strategies to avoid concrete and hydrocarbon loss and avoid / limit sediment release. With good site management, best practice and careful engineering, the risks of significant impact with regard to these issues are likely to be low. See **Section 9.2** for standard mitigation measures. A detailed design and method statement should be drawn up by the contractor indicating what measures will be taken to avoid, (a) sediment or soil loss and; (b) hydrocarbon contamination, associated with all aspects of the construction phase, and how these will be monitored for effectiveness. Ensure the potential for contaminated washout from the bypass channel to Craughwell R. is avoided through good engineering and site management practice. Works are phased so that there is a suitable settling period following channel excavation/bridge underpinning prior to flow from the Craughwell River being diverted into the channel.
5	**Railway Bridge** The Channel will be deepened by up to 0.75m (underpinning/ scour protection of the railway bridge will be required).	
6	**Works at Rahasane Turlough** It is Not Proposed to Complete any Works within or adjacent to the main body of the Rahasane Turlough SAC.	Hydrological models predict virtually no changes to the hydrological regime of the Rahasane Turlough as a result of the scheme; hence the potential for significant impacts on the fully aquatic elements of turlough ecology is low. Even so, long-term monitoring of: (i) post-works water levels/ hydrology, and; (ii) vegetation zonation patterns as indicators of biological change, are essential to the mitigation. There needs to be a feasible remediation strategy in place to restore the hydrological function of Rahasane Turlough in the event that post-works hydrological changes are found to have occurred. If all mitigation is implemented at upstream construction sites as detailed in **Section 9.2**, then residual impacts on the Rahasane Turlough arising from sedimentation or turbidity are likely to be **imperceptible** and **short term** at worst. Given that the hydrological model predicts no significant changes to turlough hydrology, it is very likely that, so long as upstream in-channel works are appropriately mitigated and sequenced, the proposed scheme will not negatively affect the structure, function, range or area of Annex I Habitat 3180 “Turloughs” and hence will maintain “favourable conservation condition” of the SAC.
7	**Channel Works at Rinn** A two stage channel typically 20m wide will be	**Sediment and Pollution Control** The principle risk will be from solids washout either directly from the edge of the bank or via drains

Works Item No.	Description of Works	Mitigation Measures
	constructed from approximately 50m upstream of Rinn bridge to approximately 50m downstream of the bridge. Strictly out of channel maintenance works aimed at the removal of encroachment of terrestrial vegetation, removal of fallen/instream trees, with no dredging and no channelisation/arterial drainage works. Terrestrial vegetation along the river banks would be managed (i.e. trimming back of brambles and scrub) rather than being removed.	traversing the new two-step channels. The contractor must specify specific sediment control measures in relation to the extensive excavations proposed for the two stage channel. This may include, for example, specifying the approach to excavations such that works begin away from, and work towards the channel with a buffer zone left between the excavation area and the channel to prevent diffuse wash off. Flow paths to the river, in that case, can be more adequately protected with appropriate sediment control measures. The area of bank to be lowered will be surveyed to identify surface drains or recognisable karst features which might act as conduits or preferential flow routes for solids-contaminated run-off to the Dunkellin. In that case the main potential drains and flow routes will be known for each stretch. However, in advance of works on individual stretches a careful walk-over prior to commencement of each portion of the works should be undertaken so that smaller field drains and ditches are known in advance and these should be managed in such a way that minimises the possibility of solids run-off during and after construction. Heavy traffic beside or over these drains should be avoided and excavations should be away from the edges as much as possible. The outlets from the drains should be blocked with temporary check dams, especially larger ones when they are being deepened, which is often likely to be necessary. Crossings of active drains should as much as possible be over existing culverts if available or else over crushed stones or other coarse rubble, possibly accumulated from earlier bank works. In areas where soil overlays rock or rubble, then all the former should be removed in advance to reduce the risk of solids washout when the deeper rubble and rock layers are being removed. Soil, shrubs and vegetation should not be stockpiled near the water's edge or beside active or potentially active drains on the new stepped channel. When working the very edge of the new channel, care should be taken not to destabilise it or to leave it sloping toward the existing channel is a way that would increase the risk of erosion or solids run-off. In areas where the base material is soil, this should be stabilised with coir or geojute and re-seeded with a suitable species mix to allow rapid stabilisation of the surface. If the water table rises to the level of the works area then all works should cease in the affected areas until it drops again. The advance warning of flood events is possible and the appointed contractor will be required to monitor both long and short term weather forecasts so that machinery and personnel can be prevented from entering the channel during periods of peak flow. Monitoring of the flow in the upstream catchment may be used as an aid to predict high flow events. All heavy machinery traffic should be avoided along the outer edge of the new channel in order to minimise soil damage and ground damage. After completion of the works, the site should be continually monitored, during wet weather in particular for evidence of preferential flows area where solids are entering the river. These should be blocked with checkdams, silt fences or a combination of both to help reduce solids wash-out.

Works Item No.	Description of Works	Mitigation Measures
		Any fringing stands of reeds (i.e. of *Sparganium* and *Phalaris*) should not be removed nor damaged during construction unless specifically agreed in advance by the IFI. These beds will act as partial protection against erosion of the edges of the new bank, help to trap escaped solids from the earth works and provide bankside cover for fauna on the newly exposed left bank where overhanging riparian vegetation will be removed. See **Section 9.2** for standard mitigation measures.
8	**Works at Rinn Bridge** Three flood eyes will be provided each measuring 3.1m wide x 2.1m deep.	Mitigation as per works Item No. 1, 2 and 3 above. In addition, Rinn Bridge flood eye insertion works should be rescheduled to coincide with the channel widening measure in that reach in May – September 2016. All works on bridges that could result in solids wash-out to the river should be completed during the May-September period.
9	Maintenance works aimed at the removal of encroachment of terrestrial vegetation, removal of fallen/instream trees. Vegetation along the river banks would be managed (i.e. trimming back to 1.0m to 1.5m above high flood levels or top of bank) rather than being removed. Flood relief works will commence approximately 175m upstream of the Dunkellin bridge and consist of the construction of a two stage channel typically 20m wide.	Any fringing stands of reeds (i.e. of *Sparganium* and *Phalaris*) on the left bank should not be removed nor damaged during operation and maintenance phases, unless specifically agreed in advance by the IFI. These beds will provide bankside cover for fauna on the continually exposed left bank where overhanging riparian vegetation was removed. Additional broadleaved tree planting and, perhaps fencing, of the right bank riparian corridor is recommended to offset loss of riparian vegetation (and ecological function provided by riparian cover) on the left bank
10	**Works at Dunkellin Bridge** In conjunction with localised channel widening to facilitate the proposed bridge works (30m), the existing flood eyes shall be replaced with 2 new box culverts each measuring 13m wide x 2.3 m deep.	Mitigation as per works Item No. 1, 2 and 3 above.
11	**Channel Works from Dunkellin Bridge to Killeely Beg Bridge** Two stage channel works will continue from Dunkellin Bridge to Kileely Beg Bridge with a typical channel with of up to 20m.	Mitigation as per works Item No. 7 above.
12	**Works at Killeely Beg Bridge** In conjunction with localised channel widening to facilitate the proposed bridge works (14m), a new bridge will be provided with an 18m span and a soffit level of 7.80mOD.	Mitigation as per works Item No. 1, 2 and 3 above.
13	**Salmon Counter** The salmon counter will be relocated to a position upstream of Kileely Beg Bridge as part of the river enhancement works.	The exact details of weir construction are not known at this stage. However, it is proposed to use cofferdams to isolate the instream works, allow construction in the dry and to prevent solids and cement from entering the channel. These mitigations should be carefully monitored while underway to ensure that they are operating correctly. Particular care will be required when discharging bulk liquid concrete from the bank in order to avoid accidental spills. The operation should be monitored by IFI or an agent to ensure that all mitigation measures are being adhered to. All contaminated waters which enter the coffer

Works Item No.	Description of Works	Mitigation Measures
		dams will need to be pumped to settlement facilities before they are discharged. See standard mitigations (**Section 9.2**) in relation to sediment control and prevention of release of cement and hydrocarbons.
14	**Channel Works from Killeely Beg Bridge to the N18 Bridge** Two stage channel works will continue from Kileely Beg to the N18 Bridge with a typical channel width of up to 20m. From a distance of 400m upstream of the N18 Bridge the two stage channel will be tapered back to match existing channel widths.	Mitigation as per works Item No. 7 above.
15	**Works at Kilcolgan & N18 Bridges** No Works Proposed	N/A

9.2.2 Mitigation Measures during the Construction Stage for Wintering Bird Species

Disturbance impacts can be avoided if construction works in proximity to the turlough are carried out outside of the over-wintering bird season, i.e. outside the September - March season entirely. If for practical reasons, the works at Rinn Bridge have to be undertaken at this time, then it should be determined whether the areas at the western end of the turlough are key areas for birds at this time of the year in order to determine if any disturbance impacts are likely to occur.

9.2.3 Mitigation Measures during the Construction Stage for Otter

No otter holts were found within the study area. However, a pre-works survey should be completed and any new holts/couches identified should be monitored. Mitigation measures should be undertaken to avoid potential impacts.

The OPW EMPs and SOPs (see **Appendix F**) were produced to ensure that the environment was protected during maintenance activities. The SOPs were last revised in April 2011 and have been issued to all operational staff. The SOPs include a Guidance Note detailing ten steps to Environmentally Friendly Maintenance. Four of these steps significantly lessen the potential impacts of proposed works on otters.

These include:

1. Leave section untouched (if channel capacity is not effected, then leave intact and only maintain if environmental works are required) - This will ensure that unnecessary impacts are avoided, and overall potential impacts on otter will be minimised,

2. Management of trees (leave intact if no reduction in channel capacity is caused, remove overhanging branches to flood level and use a saw or secateurs for removal, not an excavator). This will ensure that suitable riparian habitat, for otters, will not be removed unnecessarily, and potential destructive impacts on otter sites from machinery will be avoided,

3. Replace boulders (reinstate boulders and gravels as removed by maintenance operations, reinstate boulders into channel from spoil heaps, and place boulders below low flow level and staggered) - This will ensure that features are available for otters to use as territorial sign posts, and substrate is available for fish (spawning/hiding places). Sustaining populations of fish will provide a valuable food source for otters, and

4. Steps to enhance fisheries (loosen bed gravels and if channel bed is composed of suitable material, excavate pools and create riffles). This will ensure that fisheries habitat, fish populations and food availability for otters are improved.

9.3 OPERATION STAGE MITIGATION MEASURES

9.3.1.1 Monitoring

Hydrological models predict no changes to the hydrological regime of Rahasane Turlough as a result of the scheme, although careful long-term monitoring of post works water levels must be carried out with the view to detecting any changes. Vegetation zonation patterns should be monitored by a turlough specialist for a number of years (monitoring programme devised by specialist) as this will provide the strongest biological indicator of any hydrological alterations that may be occurring and, in turn, affecting the fully aquatic elements of turlough ecology.

9.3.1.2 Remediation strategy

A comprehensive remediation strategy must be set out detailing how the hydrological regime of the turlough will be restored in the event that unforeseen post-works changes in turlough hydrology and/or biology are found to occur. The strategy needs to be a feasible engineering solution, e.g. the closure of the installed Rinn Bridge flood eye(s), or re-introducing channel constriction (infill of two-stage channel) in the Rinn Bridge reach.

9.3.2 Specific Mitigation Measures for Wintering Bird Species

A full monitoring programme is recommended to ensure that there are no changes in hydroperiod or level of flooding to show this. The monitoring programme would include not just continuation of the winter water bird counts but also a full vegetation/habitat monitoring as well as hydrological monitoring.

9.3.3 Ongoing Maintenance

Traditionally the artificial drainage channel flowing through Rahasane Turlough was subject to annual maintenance, a practice which has ceased in recent years. Cessation of these practices has led to a build-up of vegetation and silts within the main channel and its resultant contribution to annual flooding is unclear. However it is likely that the absence of localised channel maintenance works has exacerbated recent flood events at Rahasane Turlough and its surrounding areas.

However, as part of the Dunkellin Drainage District for which Galway County Council have a statutory maintenance responsibility, the Dunkellin River channel and Aggard Stream will require regular maintenance to prevent vegetation becoming overgrown thus increasing the risk of future flooding.

Proposals for targeted and defined maintenance of the artificial drainage channel should be considered as part of future management plans for Rahasane Turlough. Such maintenance and management operations will be subject to Appropriate Assessment.

10 CONCLUSIONS

10.1 INTEGRITY OF THE SITE

From the *Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC* (EC, 2002), the meaning of integrity is described as follows;

> '*The integrity of a site involves its ecological functions. The decision as to whether it is adversely affected should focus on and be limited to the site's conservation objectives' (MN2000, paragraph 4.6(3))*'.

10.2 INTEGRITY OF RAHASANE TURLOUGH SAC/SPA

Site specific conservation objectives have not yet been prepared for the Rahasane Turlough SAC and SPA.

The following conservation objectives have been provided by the NPWS for Rahasane Turlough SAC.

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected (see **Table 3.1**).

The following generic conservation objectives have been provided by the NPWS for Rahasane Turlough SPA.

Objective: To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA (**Table 3.2**).

The scheme model (**Appendix A**) has shown that the scheme will not materially alter flood regimes in Rahasane Turlough and will thus avoid impacts to the in-situ vegetation community which corresponds to the Annex I priority habitat and is the sole qualifying interest of Rahasane Turlough SAC. In addition, the maintenance of current flood regimes at Rahasane Turlough will not impact on the roosting, foraging and feeding avifaunal species of the turlough and thus will not impact Rahasane Turlough SPA.

Potential exists for construction phase impacts but these can be readily mitigated through the implementation of mitigation as outlined in **Section 9**.

From the information gathered and the predictions made about the changes that are likely to result from the construction and operation stages of the project, the integrity of site checklist is completed for Rahasane Turlough SAC and SPA in **Table 10.1** below.

Table 10.1 Integrity of Site Checklist for Rahasane Turlough SAC and SPA

Conservation objectives		
Does the project have the potential to:	**Yes or No**	**Comment**
Cause delays in progress towards achieving the conservation objectives of the site?	No	Annex I Habitats: The potential for loss and/or disturbance to habitats will be avoided and will not cause delays in achieving the conservation objectives of the site. Required mitigation measures are outlined in **Section 9**. SPA Bird species: The potential for loss and/or disturbance of key species will be avoided and will not cause delays in achieving the conservation objectives of the site. Required mitigation measures are outlined in **Section 9**.
Interrupt progress towards achieving the conservation objectives of the site?	No	Annex I Habitats: The potential for loss and/or disturbance to habitats will be avoided and will not cause delays in achieving the conservation objectives of the site. Required mitigation measures are outlined in **Section 9**. SPA Bird species: The potential for loss and/or disturbance of key species will be avoided and will not cause delays in achieving the conservation objectives of the site. Required mitigation measures are outlined in **Section 9**.
Disrupt those factors that help to maintain the favourable conditions of the site?	No	Potential impacts affecting ground water and surface water quality (a key indicator of conservation value) will be mitigated against. Required mitigation measures are outlined in **Section 9**.
Interfere with the balance, distribution and density of key species that are the indicators of the favourable condition of the site?	No	Potential impacts affecting ground water and surface water quality (a key indicator of conservation value) will be mitigated against. Required mitigation measures are outlined in **Section 9**.
Cause changes to the vital defining aspects (e.g. nutrient balance) that determine how the site functions as a habitat or ecosystem?	No	Potential impacts may occur through pollution of ground water and surface watercourses during the construction phase. However these impacts can be effectively mitigated. Required mitigation measures are outlined in **Section 9.2.2**.
Change the dynamics of the relationships (between, for example, soil and water or plants and animals) that define the structure and/or function of the site?	No	Potential impacts may occur through pollution of ground water and surface watercourses during the construction phase. This could impact on protected habitats and species downstream of the proposed development. Required mitigation measures are outlined in **Section 9.2.2**.
Interfere with predicted or expected natural changes to the site (such as water dynamics or chemical composition)?	No	Potential impacts may occur through pollution of ground water and surface watercourses during the construction phase. This could impact on protected habitats and species downstream of the proposed development. Required mitigation measures are outlined in **Section 9.2.2**.
Reduce the area of key habitats?	No	There will be no permanent loss of key habitats within the SAC Natura 2000 sites. However, potential impacts may occur through pollution of ground water and surface watercourses during the construction phase and changes in the regime during the operational phase. These could impact on protected habitats downstream of the proposed development. These impacts can be effectively mitigated with such measures outlined in **Section 9.2.2**.

Conservation objectives		
Does the project have the potential to:	**Yes or No**	**Comment**
Reduce the population of key species?	No	It is considered that there will be no direct impacts on the qualifying bird species of Rahasane Turlough SPA during the operational phase of the project. There is potential for disturbance during the construction stage. These impacts can be effectively mitigated and measures are outlined in **Section 9**.
Change the balance between key species?	No	It is not anticipated that there will be any changes in the balance between key species of Rahasane Turlough SAC and SPA.
Reduce diversity of the site?	No	Tobin's model has stated that the proposed flood relief scheme will not alter flood regimes on site which are critical in maintaining the intricate vegetation community mosaic and distribution throughout Rahasane Turlough. It is not anticipated that the diversity of Rahasane Turlough SAC and SPA will be reduced as a part of the proposed works.
Result in disturbance that could affect population size or density or the balance between key species?	No	There is potential for disturbance to wintering bird species during the construction stage of the project. The project programme has been developed to avoid works during the optimum season for these species as shown in **Figure 4.3.**
Result in fragmentation?	No	No impacts have been identified that would result in fragmentation of species or habitats for which the Rahasane Turlough SAC and SPA site has been designated.
Result in loss or reduction of key features (e.g. tree cover, tidal exposure, annual flooding, etc.)?	No	No key features of the Rahasane Turlough SAC and SPA sites will be lost as a result of construction or operation of the proposed development.

Source: *"Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC"*

10.3 INTEGRITY OF GALWAY BAY COMPLEX SAC

Site specific conservation objectives have been prepared for the Galway Bay Complex SAC (NPWS, 2013).

Objective: To maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the SAC has been selected (see **Table 3.4 and 3.5**).

The scheme model (**Appendix A**) predicts that therewill be an increase in the peak discharge rate into Galway Bay by 1% and the time to peak flow (Tp) was also estimated to be reduced from 95 hours to 93 hours. The scheme conveys the freshwater discharge slightly more quickly but the total discharge is not increased over the course of the event.

Any release of suspended sediment is unlikely to significantly impact on the estimated area of intertidal community. The construction phase will not involve significant continuous or on-going disturbance of communities. A slight increase in peak discharge rate of 1% is extremely unlikely to result in significant changes in the natural condition to the community types. No long term effects are considered likely.

Potential exists for construction phase impacts but these can be readily mitigated through the implementation of the measures as outlined in **Section 9**.

From the information gathered and the predictions made about the changes that are likely to result from the construction and operation stages of the project, the integrity of site checklist is completed for the Galway Bay Complex SAC in **Table 10.2** below.

Table 10.2 Integrity of Site Checklist for Galway Bay Complex SAC

Conservation objectives		
Does the project have the potential to:	**Yes or No**	**Comment**
Cause delays in progress towards achieving the conservation objectives of the site?	No	The potential for loss and/or disturbance to habitats and species will be avoided and will not cause delays in achieving the conservation objectives of the site. Required mitigation measures are outlined in **Section 9**.
Interrupt progress towards achieving the conservation objectives of the site?	No	The potential for loss and/or disturbance to habitats and species will be avoided and will not cause delays in achieving the conservation objectives of the site. Required mitigation measures are outlined in **Section 9**.
Disrupt those factors that help to maintain the favourable conditions of the site?	No	Potential impacts affecting ground water and surface water quality (a key indicator of conservation value) within the localised area of the proposed development will be mitigated against. Required mitigation measures are outlined in **Section 9**.
Interfere with the balance, distribution and density of key species that are the indicators of the favourable condition of the site?	No	Potential impacts affecting ground water and surface water quality (a key indicator of conservation value) within the localised area of the proposed development will be mitigated against. Required mitigation measures are outlined in **Section 9**.
Cause changes to the vital defining aspects (e.g. nutrient balance) that determine how the site functions as a habitat or ecosystem?	No	Potential impacts may occur through pollution of ground water and surface watercourses during the construction phase. Any release of suspended sediment is unlikely to significantly impact on the intertidal community complexes. The construction phase will not involve significant continuous or on-going disturbance of communities. These impacts can be effectively mitigated. Required mitigation measures are outlined in **Section 9.2.2**.
Change the dynamics of the relationships (between, for example, soil and water or plants and animals) that define the structure and/or function of the site?	No	Potential impacts may occur through pollution of ground water and surface watercourses during the construction phase. This could impact on protected habitats and species downstream of the proposed development. Required mitigation measures are outlined in **Section 9.2.2**.
Interfere with predicted or expected natural changes to the site (such as water dynamics or chemical composition)?	No	Potential impacts may occur through pollution of ground water and surface watercourses during the construction phase. This could impact on protected habitats and species downstream of the proposed development. Required mitigation measures are outlined in **Section 9**.
Reduce the area of key habitats?	No	There are no operations proposed to permanently remove habitat from the site and the area of key habitats is not likely to be significantly impacted by any release of suspended sediment.
Reduce the population of key species?	No	There are potential short term impacts to Annex II species such as Otter during the construction period only, from disturbance and potential run-off of pollutants. These impacts can be effectively mitigated and measures are outlined in **Section 9**.

Conservation objectives		
Does the project have the potential to:	**Yes or No**	**Comment**
Change the balance between key species?	No	There are potential short term impacts to Annex II species such as Otter during the construction period only, from disturbance and potential run-off of pollutants. These impacts can be effectively mitigated and measures are outlined in **Section 9**.
Reduce diversity of the site?	No	There are potential short term impacts to Annex II species such as Otter during the construction period only, from disturbance and potential run-off of pollutants. These impacts can be effectively mitigated and measures are outlined in **Section 9**.
Result in disturbance that could affect population size or density or the balance between key species?	No	There is potential for disturbance to Otter further downstream during the construction period only, from potential run-off of pollutants. Required mitigation measures are outlined in **Section 9**.
Result in fragmentation?	No	No impacts have been identified that would result in fragmentation of species or habitats for which the Galway Bay Complex SAC has been designated.
Result in loss or reduction of key features (e.g. tree cover, tidal exposure, annual flooding, etc.)?	No	No key features of the Galway Bay Complex SAC will be lost as a result of construction or operation of the proposed development.

Source: *"Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC"*

10.4 INTEGRITY OF INNER GALWAY BAY SPA

Conservation Objectives for Inner Galway Bay SPA, based on the principles of favourable conservation status, are described below.

Objective 1: To maintain the favourable conservation condition of the waterbird Special Conservation Interest species listed for Inner Galway Bay SPA (**Table 3.6**).

Objective 2: To maintain the favourable conservation condition of the wetland habitat at Inner Galway Bay SPA as a resource for the regularly-occurring migratory waterbirds that utilise it (**Table 3.7**).

The scheme model (**Appendix A**) predicts that there will be an increase in the peak discharge rate into Galway Bay by 1% and the time to peak flow (Tp) was also estimated to be reduced from 95 hours to 93 hours. The scheme conveys the freshwater discharge slightly more quickly but the total discharge is not increased over the course of the event.

Any slight increase in peak discharge by 1% and reduction in time to peak flow is not likely to cause the transport of significant additional quantities of suspended sediment and nutrients to the Dunkellin Estuary. This increase in peak discharge is extremely unlikely to result in significant changes to the 'Intertidal sandy mud community complex community' and 'Intertidal sand community complex' which are the habitats most likely to influence the distribution of waterbirds at the site.

From the information gathered and the predictions made about the changes that are likely to result from the construction and operation stages of the project, the integrity of site checklist is completed for the Inner Galway Bay SPA in **Table 10.3** below.

Table 10.3 Integrity of Site Checklist for the Inner Galway Bay SPA

Conservation objectives		
Does the project have the potential to:	**Yes or No**	**Comment**
Cause delays in progress towards achieving the conservation objectives of the site?	No	The potential for loss and/or disturbance of key species will be avoided and will not cause delays in achieving the conservation objectives of the site. Required mitigation measures are outlined in **Section 9**.
Interrupt progress towards achieving the conservation objectives of the site?	No	The potential for loss and/or disturbance of key species will be avoided and will not cause delays in achieving the conservation objectives of the site. Required mitigation measures are outlined in **Section 9**.
Disrupt those factors that help to maintain the favourable conditions of the site?	No	Potential impacts affecting ground water and surface water quality (a key indicator of conservation value) will be mitigated against. Any slight increase in peak discharge by 1% and reduction in time to peak flow is not likely to cause the transport of significant additional quantities of suspended sediment and nutrients to the Dunkellin Estuary and is extremely unlikely to result in significant changes to the 'Intertidal sandy mud community complex community' and 'Intertidal sand community complex' which are the habitats most likely to influence the distribution of waterbirds at the site. The potential for loss and/or disturbance of key species will be avoided and will not cause delays in achieving the conservation objectives of the site. Required mitigation measures are outlined in **Section 9**.
Interfere with the balance, distribution and density of key species that are the indicators of the favourable condition of the site?	No	Potential impacts affecting ground water surface water quality (a key indicator of conservation value) will be mitigated against. Required mitigation measures are outlined in **Section 9**.
Cause changes to the vital defining aspects (e.g. nutrient balance) that determine how the site functions as a habitat or ecosystem?	No	Potential impacts may occur through pollution of ground water and surface watercourses during the construction phase. However these impacts can be effectively mitigated. Required mitigation measures are outlined in **Section 9.2.2**.
Change the dynamics of the relationships (between, for example, soil and water or plants and animals) that define the structure and/or function of the site?	No	Potential impacts may occur through pollution of ground water and surface watercourses during the construction phase. This could impact on protected habitats and species downstream of the proposed development. Required mitigation measures are outlined in **Section 9.2.2**.
Interfere with predicted or expected natural changes to the site (such as water dynamics or chemical composition)?	No	Potential impacts may occur through pollution of ground water and surface watercourses during the construction phase. This could impact on protected habitats and species downstream of the proposed development. Required mitigation measures are outlined in **Section 9.2.2**.
Reduce the area of key habitats?	No	There will be no permanent loss of key habitats within the SPA Natura 2000 sites. However, potential impacts may occur through pollution of ground water and surface watercourses during the construction phase and changes in the regime during the operational phase. These could impact on protected habitats downstream of the proposed development. These

Conservation objectives		
Does the project have the potential to:	**Yes or No**	**Comment**
		impacts can be effectively mitigated and measures are outlined in **Section 9.2.2**.
Reduce the population of key species?	No	It is considered that there will be no direct impacts on the qualifying bird species of Inner Galway Bay SPA during the operational phase of the project.
Change the balance between key species?	No	It is considered that there will be no direct impacts on the qualifying bird species of Inner Galway Bay SPA during the operational phase of the project.
Reduce diversity of the site?	No	It is considered that there will be no direct impacts on the qualifying bird species of Inner Galway Bay SPA during the operational phase of the project.
Result in disturbance that could affect population size or density or the balance between key species?	No	Any impacts caused during the construction phase of the project are likely to be limited to disturbance to species which are foraging, roosting or migrating within proximity to construction works and/or impacts on marine/estuarine habitats resulting from the release of pollutants to the Dunkellin River and subsequent transport to the Dunkellin River Estuary. These impacts will be temporary and not significant. These impacts can be effectively mitigated and measures are outlined in **Section 9.2.2**.
Result in fragmentation?	No	No impacts have been identified that would result in fragmentation of species for which SPA site has been designated.
Result in loss or reduction of key features (e.g. tree cover, tidal exposure, annual flooding, etc.)?	No	Potential impacts affecting ground water and surface water quality (a key indicator of conservation value) will be mitigated against. Any slight increase in peak discharge by 1% and reduction in time to peak flow is not likely to cause the transport of significant additional quantities of suspended sediment and nutrients to the Dunkellin Estuary and is extremely unlikely to result in significant changes to the 'Intertidal sandy mud community complex community' and 'Intertidal sand community complex' which are the habitats most likely to influence the distribution of waterbirds at the site. The potential for loss and/or disturbance of key species will be avoided and will not cause delays in achieving the conservation objectives of the site. Required mitigation measures are outlined in **Section 9**.

Source: *"Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC"*

10.5 CONCLUSIONS

This Natura Impact Statement for the Dunkellin River and Aggard Stream Flood Relief Scheme has been carried out in accordance with Article 6 (3) of the ‘Habitats’ Directive 92/43/EEC. This Statement provides a professional scientific examination of the project and the relevant Natura 2000 sites, identifying and characterising any possible implications for the Natura 2000 site in view of the conservation objectives, taking account of in-combination effects.

Robust and effective mitigation measures have been proposed for the avoidance of any impacts affecting groundwater and surface water quality within all relevant Natura 2000 sites. Specific mitigation measures have been proposed for the prevention of impacts to all relevant Annex I and Annex II species.

The primary concerns are with regard to the sediment loss associated with individual flood relief scheme measures and changes to the hydrological regime. The timing and sequencing of upstream flood relief scheme measures coupled with mitigation applied with respect to each measure will reduce the potential for silt generation at source and stem the potential for losses. A construction works programme has been devised for the Dunkellin River and Aggard Stream Flood Relief Scheme and this is presented in **Figure 4.3**. The programme clearly respects the environmental sensitivities of the receiving environment and the recommendations of consultees.

Hydrological models predict that, both average wet weather flows and very high flood flows will give rise to similar water levels on the Rahasane Turlough as a result of the scheme.

As with Galway Bay Complex SAC it is considered that the potential impact to Inner Galway Bay SPA is alteration of the hydrological regime of the Dunkellin River which could lead to more rapid transport of pollutants such as nutrients, suspended sediment, microbiological and viruses and increased freshwater volume and/or flow to the receiving estuary and bay.

The scheme model (**Appendix A**) predicts that there will be an increase in the peak discharge rate into Galway Bay by 1% and the time to peak flow (Tp) was also estimated to be reduced from 95 hours to 93 hours. The scheme conveys the freshwater discharge slightly more quickly but the total discharge is not increased over the course of the event.

Any slight increase in peak discharge by 1% and reduction in time to peak flow is not likely to cause the transport of significant additional quantities of suspended sediment and nutrients to the Dunkellin Estuary.

The OPW EMPs and SOPs will form the backbone of the method statement, supplemented by mitigation measures provided in **Section 9**. The method statement will detail how these mitigation measures will be monitored for effectiveness by both Galway County Council themselves and independently through water quality monitoring proposed. A mechanism for reporting of pollution incidents will be agreed in advance between the contractor(s) and the IFI.

The conclusion of this Natura Impact Statement is that there will be no potential for cumulative impacts arising in combination with any other plans or proposals, with the implementation of best practice and the recommended mitigation measures, it is considered that the proposed Dunkellin River and Aggard Stream Flood Relief Scheme will not adversely affect the integrity of Rahasane Turlough SAC/SPA, Galway Bay Complex SAC and Inner Galway Bay SPA. No reasonable scientific doubt remains as to the absence of such effects.

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APPENDIX A

Dunkellin River and Aggard Stream Flood Relief Scheme, Description of the Proposed Works

Galway County Council

Dunkellin River & Aggard Stream Flood Relief Scheme

Description of the Proposed Works

TOBIN CONSULTING ENGINEERS

Galway County Council,
Aras An Chontae,
Prospect Hill,
Galway

Tobin Consulting Engineers,
Fairgreen House,
Fairgreen Road, Galway

Patrick J. Tobin & Co. Ltd.

REPORT

PROJECT: **Dunkellin River and Aggard Stream Flood Relief Scheme**

CLIENT: **Galway County Council,**
Aras An Chontae,
Prospect Hill,
Galway.

COMPANY: **TOBIN Consulting Engineers**
Fairgreen House,
Fairgreen Road,
Galway.

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Document Amendment Record

Client:	**Galway County Council**
Project:	**Dunkellin & Aggard Stream Flood Relief Scheme** **Technical Description for EIS**
Title:	**Technical Description for EIS**

PROJECT NUMBER: 6408				**DOCUMENT REF:** **6408-Works Description Section for EIS Revision K**			
K	Proposed Scheme	CK	Aug 14	MMcD	Sept 14	MMcD	Sept 14
Revision	**Description & Rationale**	**Originated**	**Date**	**Reviewed**	**Date**	**Authorised**	**Date**
TOBIN Consulting Engineers							

NON TECHNICAL DESCRIPTION

The extent of the overall study area for the proposed *Dunkellin River and Aggard Stream Flood Relief Scheme* has been divided into two distinct channels. These channels are:

1. the Dunkellin/Craughwell River from approximately 200m upstream of Craughwell Village to the sea at Kilcolgan just upstream of where the river enters Galway Bay.

2. the Aggard Stream and Monksfield River from the townland of Cregaclare (near Ardrahan), to its outfall at the confluence of the Dunkellin and Craughwell Rivers.

It is proposed to undertaken flood relief works along the Dunkellin in three reaches of the river:

a. in the vicinity of Craughwell Village,
b. locally at Rinn Bridge and
c. from a location just upstream of the Dunkellin Bridge to the N18 at Kilcolgan.

The works consist of channel deepening (not widening) in Craughwell village to the confluence of the Aggard Stream, local channel widening at Rinn Bridge, out of channel maintenance downstream of the Rahasane Turlough to Rinn Bridge (i.e., limited to trimming back of terrestrial bank vegetation such as trees and low hanging branches and removal of encroaching vegetation such as brambles and scrub) and channel widening from the Dunkellin Bridge to the N18.

It is not proposed to undertake any significant arterial drainage works along the Aggard Stream. The proposed works associated with the Aggard Stream will be limited to the replacement of field wall crossings which are blocked or have collapsed, together with maintenance works, including the non-invasive trimming of bank-side vegetation and the removal of areas of accumulated silt along the full length of the channel.

It is not proposed to undertake works within or adjacent to the Rahasane Turlough cSAC, NHA and SPA or within the Galway Bay Complex SAC.

The requirement for the proposed works are to relieve flooding generated from rainfall events similar to those that occurred in January 2005 and November 2009 which flooded properties in Craughwell Village and a number of townlands along the river including Rinn, Dunkellin and Killeely Beg. To place these works in context the following is a synopsis of the flooding that occurred in region in November 2009.

During the period 17th to 24th November 2009, daily rainfall amounts on Wednesday 19th were recorded as 26.7mm and 29.4mm at the Shannon and Claremorris Weather Stations, respectively. This peak rainfall was followed by peak flood levels :

a. upstream of Craughwell village along the R349 (Loughrea to Athenry Road) at approximately midday on Thursday 20th November,
b. at the Craughwell River/N6 road crossing during Thursday afternoon (road closed in afternoon resulting in significant traffic disruption), and
c. downstream of Craughwell at Rahasane Turlough during Friday 21st November.

The following photography, taken by the OPW & Central Fisheries Board, during the period Thursday 20th to Saturday 22nd November 2009, shows the extent of flooding which occurred in late November 2009.

Photograph A
November 2009 Event.
Looking Upstream from Craughwell

Note the relatively small area (approximately 1.2ha) and therefore volume of flooding in Craughwell village when compared with the extent of lands flooded at the Rahasane Turlough (>350ha) in Photographs B and C.

Photograph B
November 2009 Event.
Looking downstream from Craughwell

Note the relatively small area (approximately 1.2ha) of flooding in Craughwell in the foreground when compared with the extent of lands flooded at the Rahasane Turlough (>350ha) in background.

Photograph C
November 2009 Event.
Looking northwards across the Rahasane Turlough

The width of flooding shown is approximately 0.75 to 1.0km..

The proposed scheme aims to reduce the impact of similar extreme floods, on existing properties, while having minimal impacts, short term only impacts or no impact on local ecology or other sensitive designated areas such as the Rahasane Turlough and Galway Bay Complex.

The proposed scheme has used a series of computer models to establish the design of the excavations required and to also estimate the depth of flooding that may occur if events like January 2005 and November 2009 were to be repeated in the future.

The computer models have used recorded and locally gathered evidence of extreme flooding to establish the extent of the proposed flood relief works that are needed to protect, where possible, long established residential housing and commercial premises in the area.

Table A – Summary of the proposed Proposed Scheme

Location	Proposed Scheme
Main Channel (Craughwell Village)	The main channel shall in general be deepened by 0.6m with a localised maximum excavation of 1.0m.
Bridge Work in Craughwell	Both existing road bridges will require engineering works on each abutment to facilitate proposed channel deepening. Similarly the railway bridge will also require foundation works for the same purposes.
Bypass Channel (Craughwell Village)	The bypass channel is to be cleaned and excavated to alleviate flooding in Craughwell Village.
Rahasane Turlough	It is Not Proposed to Complete any Works within or adjacent to the main body of the Rahasane Turlough cSAC.
Channel Works between the Rahasane Turlough and Rinn Bridge and Works at Rinn	Out of channel maintenance downstream of the Rahasane Turlough to Rinn Bridge (i.e., limited to trimming back of terrestrial vegetation such as trees and low hanging branches and removal of encroaching vegetation such as brambles and scrub) with provision of new flood relief eyes to be constructed on one bank of the river in association with two stage channel widening 50m upstream and 50m downstream of the existing Rinn Bridge.

Channel Works beginning upstream of Dunkellin bridge	Works will commence approximately 175m upstream of the Dunkellin bridge and consist of the construction of a high level channel typically 20m in width along the left bank (as one looks downstream) of the river.
Channel Works from Dunkellin Bridge to Kilcolgan Bridge	Out of channel maintenance (limited to trimming back of bank side terrestrial vegetation to 1.0m to 1.5m above high flood levels) in association with the higher level “Two stage channel works” will continue from Dunkellin Bridge to Kilcolgan Bridge with a typical additional channel width of up to 20m.
Works at Dunkellin Bridge	In conjunction with localised channel widening the existing flood eyes shall be replaced with 2 new box culverts each measuring 13m wide x 2.3m deep. Existing stone from the bridge will be reused to match the retained main stone arch.
Works at Killeely Beg Bridge	In conjunction with channel widening a new bridge shall be provided with an 18m span.
Salmon Counter	The salmon counter will be relocated to a position upstream of Kileely Beg bridge as part of the river enhancement works

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DESCRIPTION OF THE PROPOSED SCHEME

1 GENERAL DESCRIPTION OF THE SCHEME

Following the invitations to tender from Galway County Council, in conjunction with the OPW, in January 2011, and the submission of Tender proposals by TOBIN Consulting Engineers and the RPS Group, both firms (the Design Team) were commissioned by the Council to undertake two service contracts, namely;

Service Contract 1: *"Dunkellin River and Aggard Stream Flood Relief Scheme - Engineering Consultancy Services",* a contract being undertaken by TOBIN Consulting Engineers,

and

Service Contract 2: "Dunkellin River and Aggard Stream Flood Relief Scheme - Environmental Consultancy Services", a contract being undertaken by the RPS Group.

The brief required TOBIN Consulting Engineers to review the proposed flood alleviation measures, contained in the report entitled *"Study to Identify Practical Measures to Address Flooding on the Dunkellin River including the Aggard Stream"* and dated June 2010, with a view to establishing a series of viable technical solutions, which address the environmental constraints which emerged as part of the planning stage and from the public consultation process undertaken in May 2011.

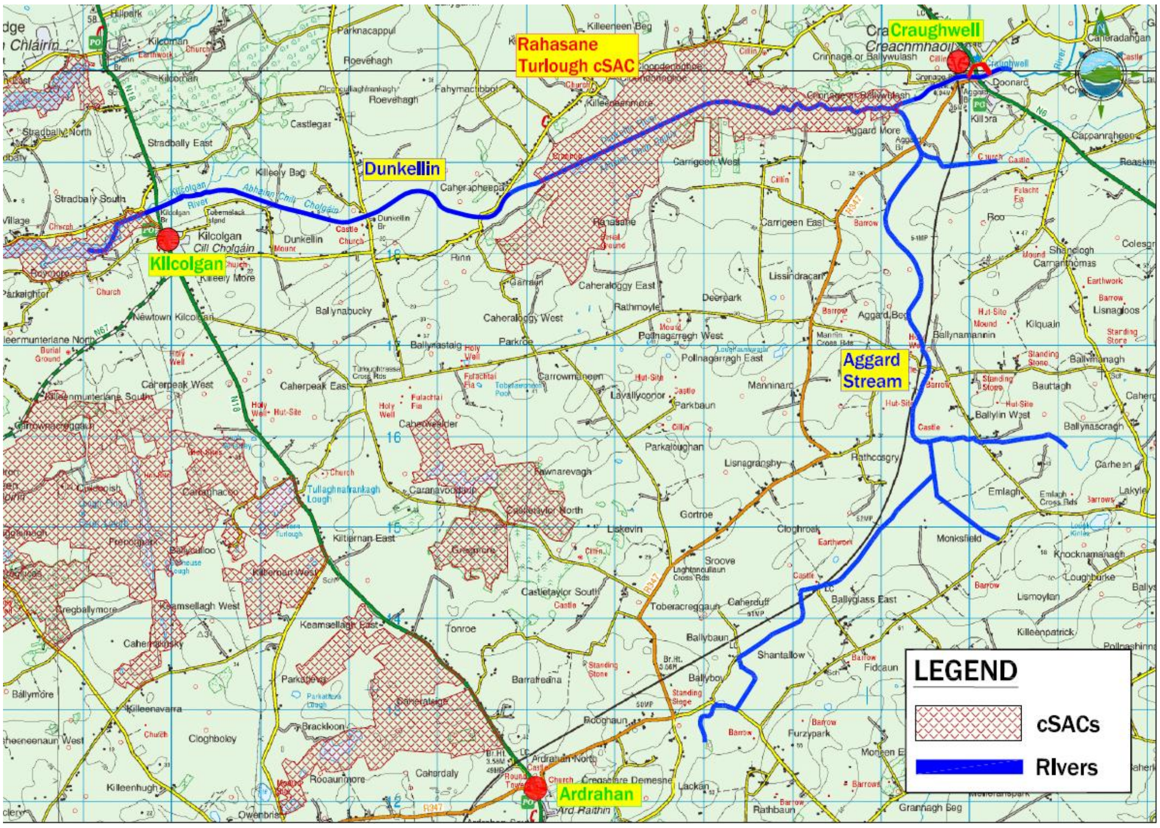


Figure 1-1 – Extent of the Study Area

The extent of the overall study area, as shown in Figure 1-1, has been divided into areas contributing to two distinct channels. These channels are:

3. the Dunkellin/Craughwell River from approximately 200m upstream of Craughwell Village, through the Rahasane Turlough cSAC, NHA and SPA, to the sea at Kilcolgan just upstream of where the river enters the Galway Bay Complex SAC.

4. the Aggard Stream and Monksfield River from the townland of Cregaclare (near Ardrahan), to its outfall at the confluence of the Dunkellin and Craughwell Rivers.

Whilst the Dunkellin River drains a significant area of lands to the east, northeast and south of Craughwell village (>200km^2), the particular reaches of river considered in this project are:

1. approximately 11km of the Dunkellin River which runs in a westerly direction from Craughwell Village to the sea at Kilcolgan.
2. approximately 7.5km of the Aggard Stream which flows in a northerly direction from Ardrahan to Craughwell.

It is not proposed to undertake any significant arterial drainage works along the Aggard Stream. The proposed works associated with the Aggard Stream will be limited to culvert replacement and the replacement of field wall crossings, together with maintenance works, including the non-invasive trimming of bank-side vegetation and the removal of areas of accumulated silt along the full length of the channel.

The Dunkellin River and its tributaries, rise at a number of locations to the east of Craughwell, and drain a number of population centres, including Woodlawn (Raford or Dooyertha River) and New Inn (Craughwell River), Cappataggle and Lough Rea (St Cleran's River) to name a few. Flows from each of the upper sub-catchment areas, combine to form the main channel reach at Craughwell Village, where the discharge is recorded at an OPW gauging station (Station No. 29007) on the main R446 (formerly N6) Road Bridge.

Figure 1-2, shows the extent of the Dunkellin River, from Craughwell Village to Kilcolgan, and the positions of the major hydraulic controls along this particular stretch of river.

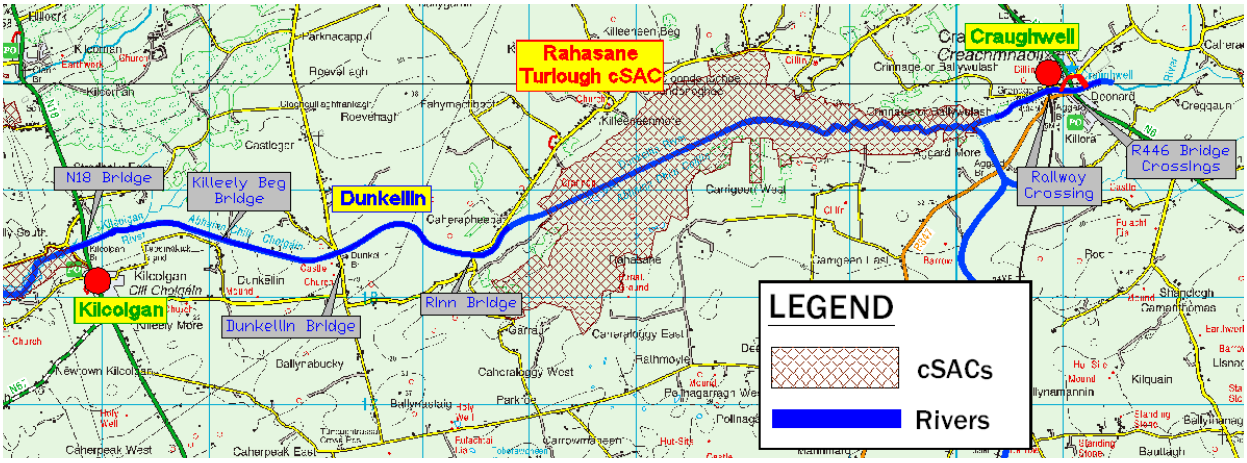
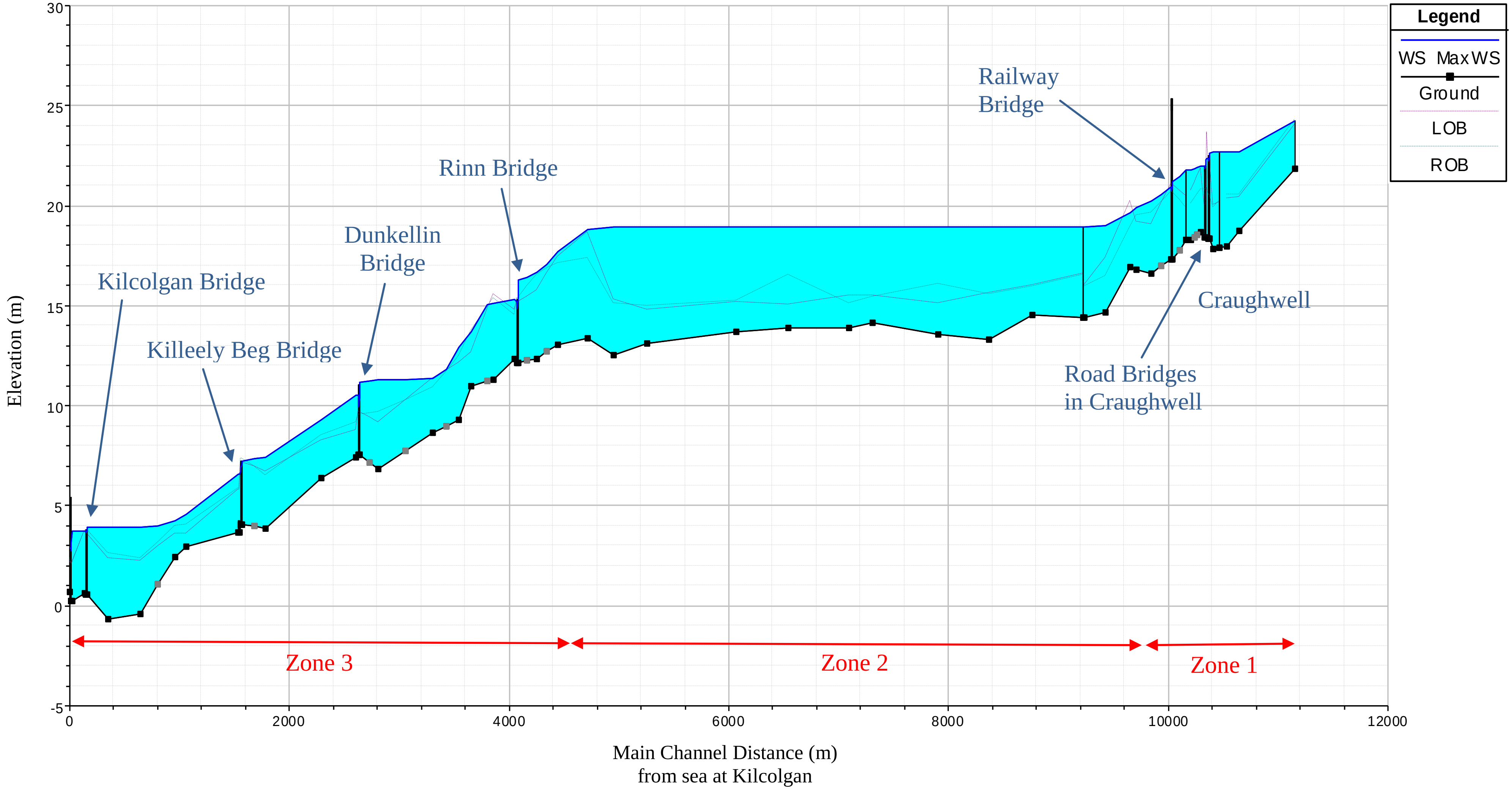


Figure 1-2 – Dunkellin Catchment from Craughwell to Kilcolgan

Figure 1-3, shows the longitudinal section of the Dunkellin River, from Craughwell Village to Kilcolgan, which was modelled using the hydraulic software package, HEC-Ras. It details the estimated surface water profile for the November 2009 event and compares this with the channel bed, left bank (LOB) and right bank (ROB).

Figure 1-3 – Longitudinal Section of the Dunkellin River from Craughwell to Kilcolgan



The depth of the main Dunkellin River channel varies quite considerably throughout its course. Natural embankments formed from excavated spoil, significant rock cuts and large flat flood plains, are predominant physical features of this channel.

The bed profile of the Dunkellin River, from Craughwell to Kilcolgan, as shown in Figure 1-3, ranges from a level of 22.29mOD (Malin Head) in Craughwell village, to 0.88mOD at Kilcolgan Bridge, and has three (3) zones along its length.

Zone 1 – Craughwell River, which has a relatively steep gradient in bed level at Craughwell Village.

Zone 2 – Rahasane Turlough cSAC, NHA and SPA, which has a gentle undulating bed level.

Zone 3 – Lower reach of the Dunkellin River, which has steep gradients in bed level from upstream of Rinn Bridge, to the sea at Kilcolgan.

These zones are described in more detail in the following sections and are used throughout this section to discuss the proposed flood relief measures.

1.1 ZONE 1 – CRAUGHWELL RIVER

This particular stretch of the Craughwell River in the village of Craughwell, consists of two distinct channels, namely,

a. the main channel and
b. the bypass or overflow channel.

During normal flow conditions, surface water flows are restricted to the main Craughwell River, coloured blue in Figure 1-4, and pass under two bridge crossings namely; the main R446 Bridge (formerly N6) and the old multi-arched stone bridge.

However, when flow conditions dictate excess surface water flow is directed around the main bridge crossing via an overflow channel and a further bridge crossing of the R446, highlighted in red on Figure 1-4. The effectiveness of this overflow channel (bypass channel) is limited, as it is not fully connected to the Craughwell River at its upstream location. High flows must follow a short section of overland flow before entering the overflow channel.

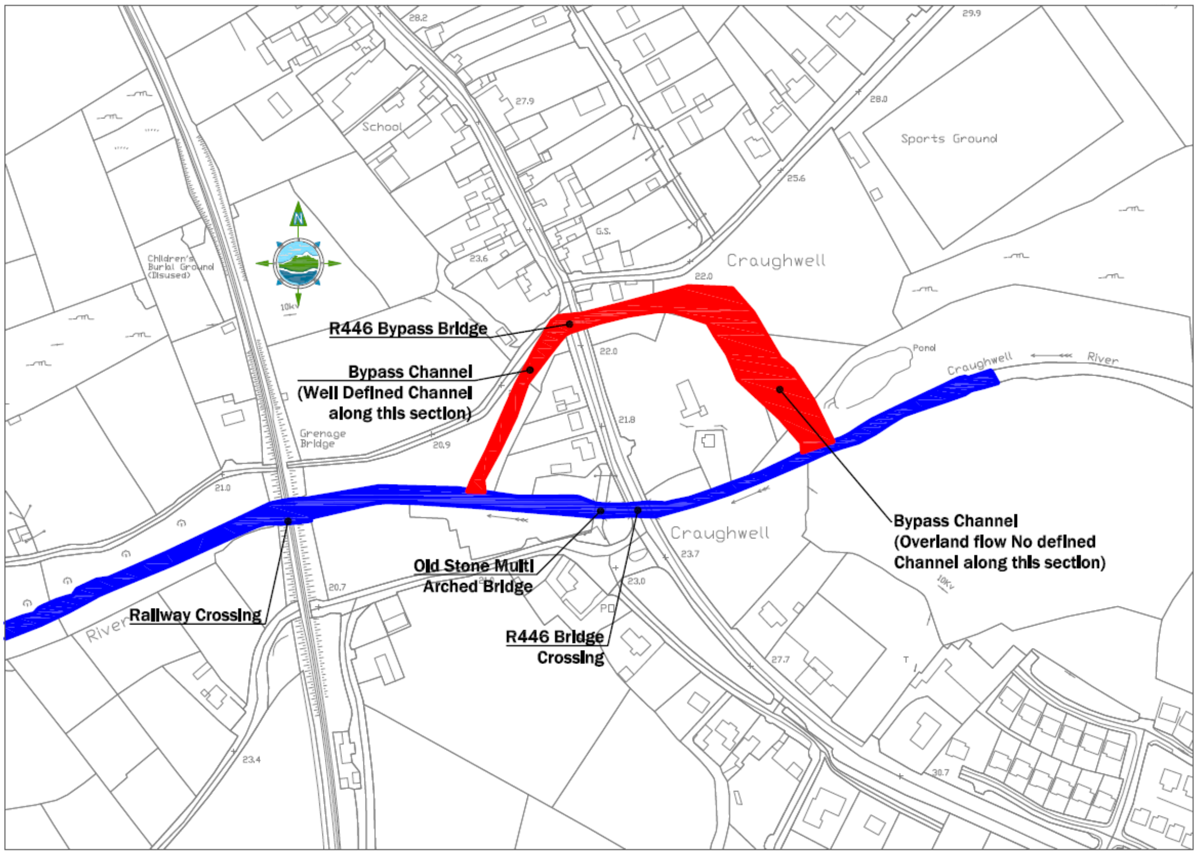


Figure 1-4 – Zone 1 Craughwell River at Craughwell Village

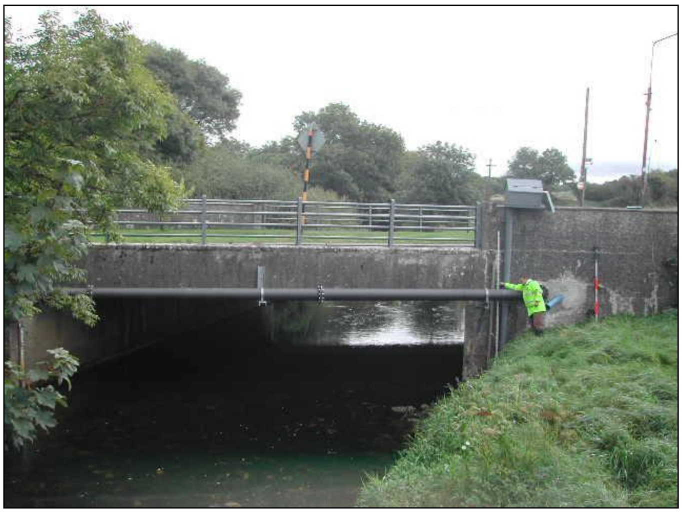
The channel along this stretch of the Dunkellin River, is of the order of 1.4m to 2.0m deep and the bed level gradient varies considerably, with a change in bed level occurring within Craughwell Village at the three bridge crossings.

There are a number of hydraulic controls along this stretch of the river. These controls are shown in the following photography and are :

a. The overflow or bypass channel within Craughwell Village (Photograph No. 1),
b. The two road bridges (Photograph No's. 2 and 3),
c. The old multi-arched stone bridge (Photograph No. 4) and
d. The railway bridge (Photograph No. 5).

Photograph No. 1

Overflow or Bypass Channel looking upstream from the R446 bridge crossing



Photograph No. 2

Main R446 Bridge Crossing along the main channel looking upstream from the multi-arched stone bridge crossing shown in Photograph No. 3

Note : Full span of bridge available for flow and the water main located on the downstream face does not impede flows.

Photograph No. 3
Bridge crossing of Bypass Channel looking upstream towards the channel shown in Photograph No. 1

Note : Unlike the Main R446 Bridge crossing, this structure has a central pier/support which reduces the overall effectiveness of the bridge.

The water main is located on the downstream face of the bridge and does not impede flows.

Photograph No. 4

Muli-arched Stone Bridge looking downstream from the main R446 bridge Crossing shown in Photograph No. 2

Note : Low Flows generally restricted to the main arches on the right of the photo. Only in times of high flows are the arches on the left utilised due to high bank levels.

Photo No. 5
Railway Bridge looking downstream through the stone arch.

Note : Water marks on the bridge abutments indicate that the full capacity (arch height) of this bridge is not hydraulically used.

1.2 ZONE 2 – RAHASANE TURLOUGH

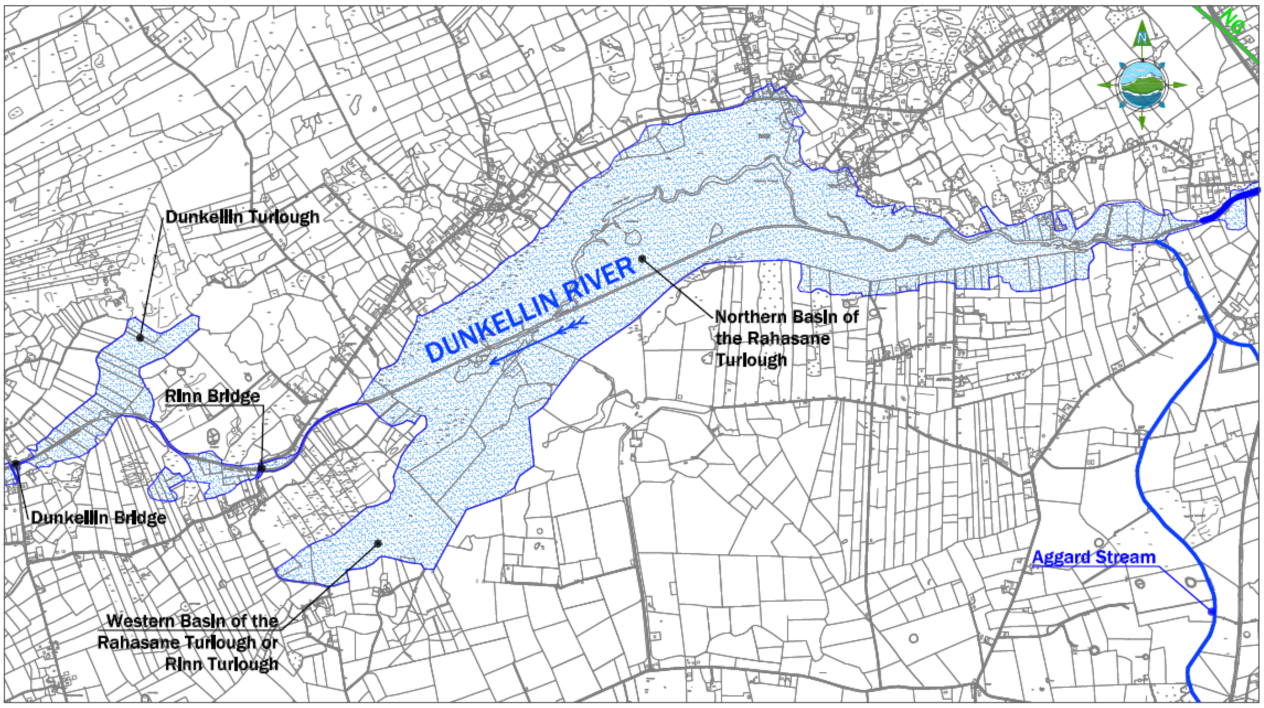
Water passing downstream of Craughwell Village, flows in a westerly direction for a distance of approximately 1km, where the Craughwell River and Aggard Stream combine to form the Dunkellin River.

During low flow conditions, surface water flows are restricted to the main Dunkellin River, which, following an Arterial Drainage Scheme in the 1850's, can be described as being "canalised" for a significant portion of its length. Along this particular stretch of the Dunkellin, the gradient of the channel bed is relatively flat, approximately 1 in 3,000.

During low flows, the channel varies in width from 10m to 30m. However, during periods of high flow, the Dunkellin River overflows its banks and floods the adjoining lands to form the Rahasane Turlough cSAC. The Rahasane Turlough cSAC is considered to be one of the largest turloughs in Europe and is of particular significance in an ecological context in that it is "one of only two large turloughs which still function naturally" (Site 000322 – Site Synopsis). The Rahasane Turlough cSAC is a rare habitat type of major conservation importance. This habitat type (turloughs) is listed in Annex 1 of the Habitats Directive.

The Rahasane Turlough (circa 4km in length) lies in gently undulating land and consists of two basins which are connected at times of flood but separated as the waters decline (Drew & Daly, 1996). These basins are detailed in Figure 1-5.

Figure 1-5 – Zone 2 Rahasane, Rinn & Dunkellin Turlough Complex



The larger of these, the northern basin, is described as the Rahasane Turlough proper. The Rahasane Turlough was formerly the natural sink of the Dunkellin River, but now an artificial channel takes some of the water further downstream. Water escapes the artificial channel to flood the northern basin where it flows into an active swallow hole system (NPWS, Site : 000322 - Site Synopsis).

The second of these basins, the western basin, known as the Rinn Turlough, is orientated north-south and is connected to the main Rahasane Turlough by a raised channel (circa 0.5m above the floor of the Rahasane Turlough). This Rinn Turlough is an overspill basin to the main turlough (Drew, 1986).

During flood conditions the width of the “Dunkellin River”, or the flood plain, increases quite significantly, as can be seen in Photograph No. 6.

In a number of locations along Rahasane Turlough cSAC, the flood plain can be greater than 1km wide and, at its highest levels, can extend to cover an area of over 300ha.

Photograph No. 6
Rahasane Turlough

Taken in November 2009 looking northwards

The Rinn Turlough (Western Basin) is in the foreground.

The Rahasane Turlough (Northern Basin) is shown in the upper portions of the image.

Typical bed levels of the channel within the Rahasane Turlough cSAC are of the order of 13.0mOD Malin Head (TOBIN Topographical Survey 2010) with other localised depressions, or sinkholes, having levels of 11.0m OD Malin Head (Drew 1986).

Downstream of the Rahasane Turlough cSAC, flow is westerly toward Rinn Bridge, through a well defined canalised channel, measuring up to 3.3m in depth, and 15 to 20m in width. The section of channel downstream of the turlough is shown in Photograph No. 7. This section of the channel is formed in a rock cut, for a significant portion of its length, and the gradient of the channel bed is typically 1 in 200.

Photograph No. 7
Dunkellin River looking upstream from Rinn Bridge

1.3 ZONE 3 – RINN BRIDGE TO KILCOLGAN

The main channel exiting the Rahasane Turlough (Photograph No. 7) and the Rinn Bridge (Photograph No. 8), which is located approximately 800m downstream of the turlough, are the main downstream features impacting on the hydraulic control of the river.

Downstream of the Rinn Bridge, and during low flow conditions, surface water flows are restricted to the main Dunkellin River, which again, following the Arterial Drainage Scheme completed in the 1850's, can be described as being "canalised" for a significant portion of its length. During these low flows, this particular stretch of the river varies in width from 10m to 15m and, the gradient of the channel bed is approximately 1 in 300.

Photograph No. 8
Rinn Bridge taken from the upstream left bank

Note the central pier dividing the two spans

The bed level at this structure and the upstream channel control the normal flood levels in the Rahasane Turlough.

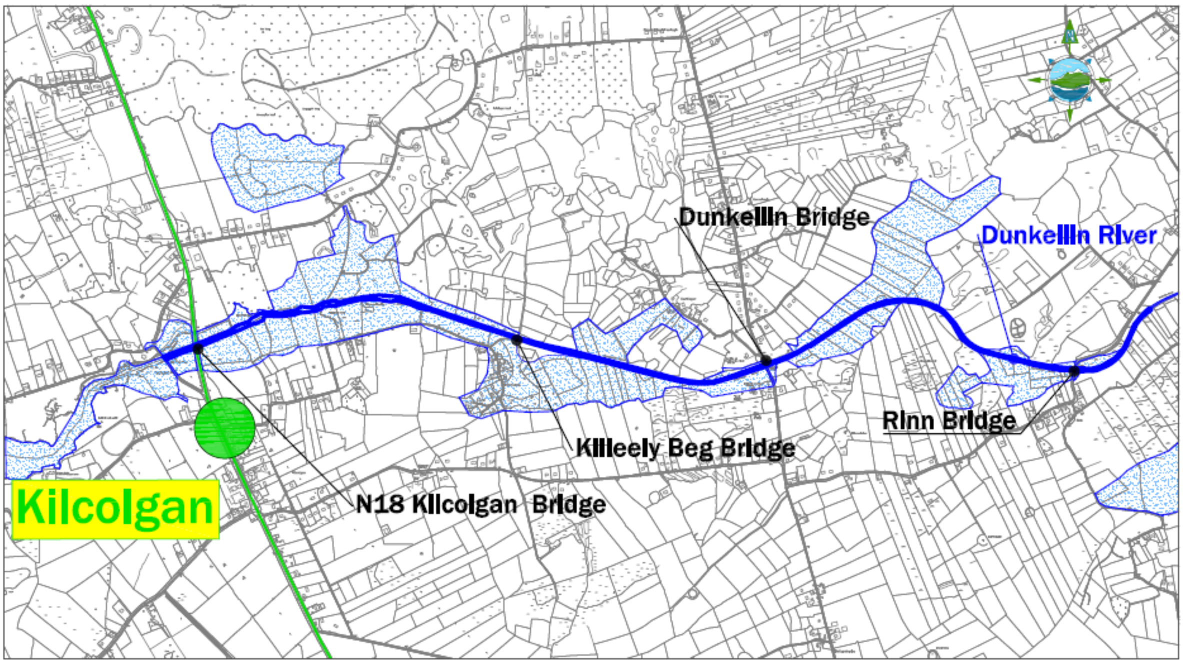


Figure 1-6 – Zone 3 Rinn Bridge to Kilcolgan

During high flows, the Dunkellin River also overtops its banks approximately 750m downstream of the Rinn Bridge and flood waters enter the Dunkellin Turlough as shown in Photograph No. 9.

Photograph No. 9
Dunkellin Turlough

Facing upstream with the Dunkellin Bridge in the centre of the image with a cluster of houses on each of the right and left banks

Photograph No. 10
Upstream face of the Dunkellin Bridge showing the main arch and flood eyes on the left bank

Low Flows at this location are restricted to the main channel and stone arch visible on the right of the photograph.

High flows overtop the channel and pass under the roadway via the three visible (smaller) arches.
However, restrictions, such as the trailer and piles of stone reduce the effectiveness of these flood eyes.

Downstream of the Dunkellin Bridge, the Dunkellin River continues for a further 2.5km to the sea via the Killeely Beg Bridge, the Kilcolgan Road (N18) Bridge and a local road bridge (stone arch). The lands and main channel within the vicinity of the Kilcolgan Road Bridge are tidal. Downstream of Dunkellin Bridge, the Dunkellin River continues to follow a well defined canalised channel, with gradients of between 1 in 300, and widths ranging from 10 to 30m, until it reaches the sea at Kilcolgan.

1.4 AGGARD STREAM

The Aggard Stream, as shown in Figure 1-7, discharges into the main Dunkellin channel at the confluence of the Craughwell and Dunkellin rivers approximately 1km downstream of Craughwell Village. The stream rises in the townland of Cregaclare, where water entering the channel, via surface contributions and ground water springs, flows in a northerly direction for a distance of approximately 4km in the townland of Monksfield. At this location, the channel discharges into the Monksfield River which, after a further 3.5km, enters the Aggard Stream. The channel flows almost parallel to the western railway corridor and crosses this railway at three locations.

Unlike the Dunkellin River, there are no designated sites (cSAC's, NHA's or SPA's) along the route of the Aggard Stream and Monksfield River.

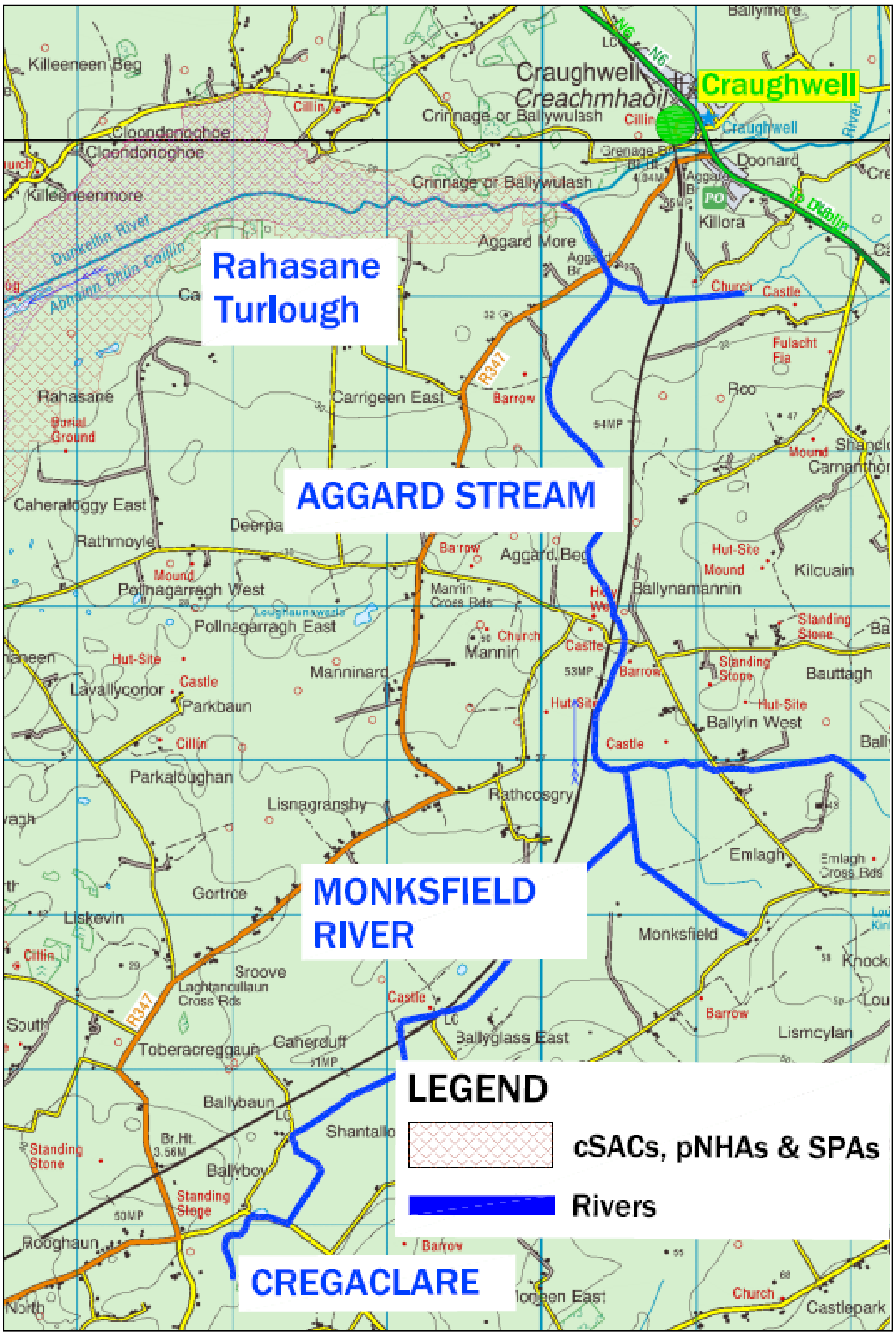


Figure 1-7 – Aggard Stream & Monksfield River

The bed profile and right/left bank levels along the Aggard Stream and Monksfield River from the townland of Cregaclare to the Dunkellin River are shown in Figure 1-8.

Along this channel, the bed profile ranges from a level of 32.5mOD (Malin Head) in its upper reaches, in the townland of Cregaclare, to 16.6mOD at the confluence with the Dunkellin River approximately 1km downstream of Craughwell.

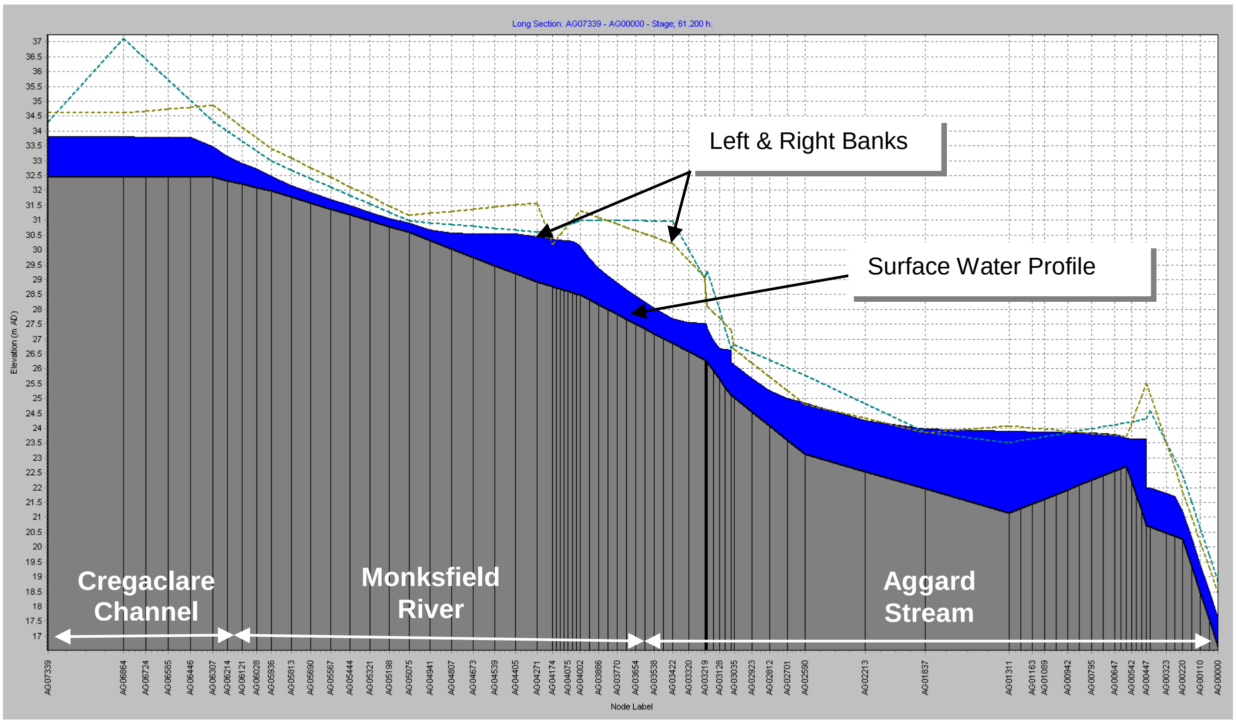


Figure 1-8 – Long Section of the Aggard Stream

The base width and side slopes of the Monksfield River and Aggard Stream are quite variable throughout its length.

In its upper reaches, along the Cregaclare Channel, the width of the stream is relatively narrow with some sections being 2.0 to 2.5m wide where the water depth is also quite shallow and stagnant as a result of the very flat gradient in bed level.

Along this stretch of the channel, field boundaries and local access crossings, as shown in Photographs 11 and 12, also impede the flow in the channel.

Photograph No. 11
Typical Boundary Crossing along the Aggard Stream in Cregaclare

Note : boundary wall traverses the channel without any pipework crossing to improve conveyance

Photograph No. 12
Typical Field Crossing along the Aggard Stream in Cregaclare

Dense weedy growth is also a significant feature of the upper reaches of this channel

Downstream of the Cregaclare Channel, in the townland of Ballyglass and Monksfield, the channel width becomes more pronounced and is typically 3.0 to 5.0m. The bed profile also steepens to a gradient of approximately 1 in 500. Along this stretch of the Monksfield River, the hydraulic control features are also more defined with concrete culverts and stone arch bridges used to traverse the railway line.

2 OVERALL DESIGN PHILOSOPHY

2.1 NEED FOR THE PROPOSED SCHEME

One of the most recent, and prior to November 2009, the highest recorded flooding event on the Dunkellin River, recorded by the gauging station in Craughwell (Station No. 29007), took place on the 10th of January 2005.

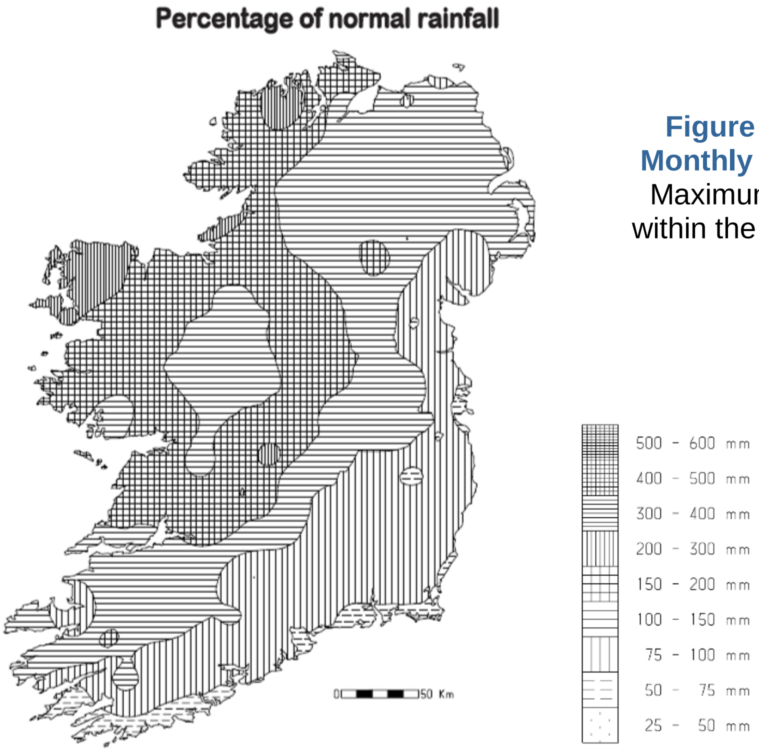


Figure 2-1 Extract from Met Eireann Monthly Weather Bulletin January 2005
Maximum Recorded Percentage Rainfall within the Dunkellin catchment ranged from 100% to 150%

The maximum level recorded on 10th January 2005 corresponded to a staff gauge reading of 2.83m, or a water level of 21.53mOD Malin Head.

Digital records, along with aerial photography for this flooding event, were documented by the OPW and the following photographs highlight some of the flooded lands, to the west of Craughwell, a number of days after the event has passed.

Photograph No. 13 January 2005 Event looking downstream to the west of Craughwell towards the Rahasane Turlough on 12th Jan 2005

Photograph No. 14
January 2005 Event looking upstream towards Craughwell from the Rahasane Turlough on 12th Jan 2005

The width of the flood at this location was approximately 375m

A number of weather events occurred across Ireland, during the first three weeks of November 2009, which resulted in record rainfall and high water levels being recorded in many parts of Galway. The flooding which occurred at Craughwell, and downstream at Rinn Bridge, Dunkellin Bridge and Killeely Beg Bridge, was as a result of several days of persistent rain over the country which, when combined with high winter water tables, resulted in water levels which exceeded those normally encountered in many rivers during the same period.

During November 2009, the weather station at NUI Galway recorded a monthly total of 329.4mm of rain, which represents 286% of the average November rainfall for the period 1961 to 1990. Leading up to this flooding, a peak daily rainfall of 60.8mm was recorded at NUI Galway on the 17th November 2009.

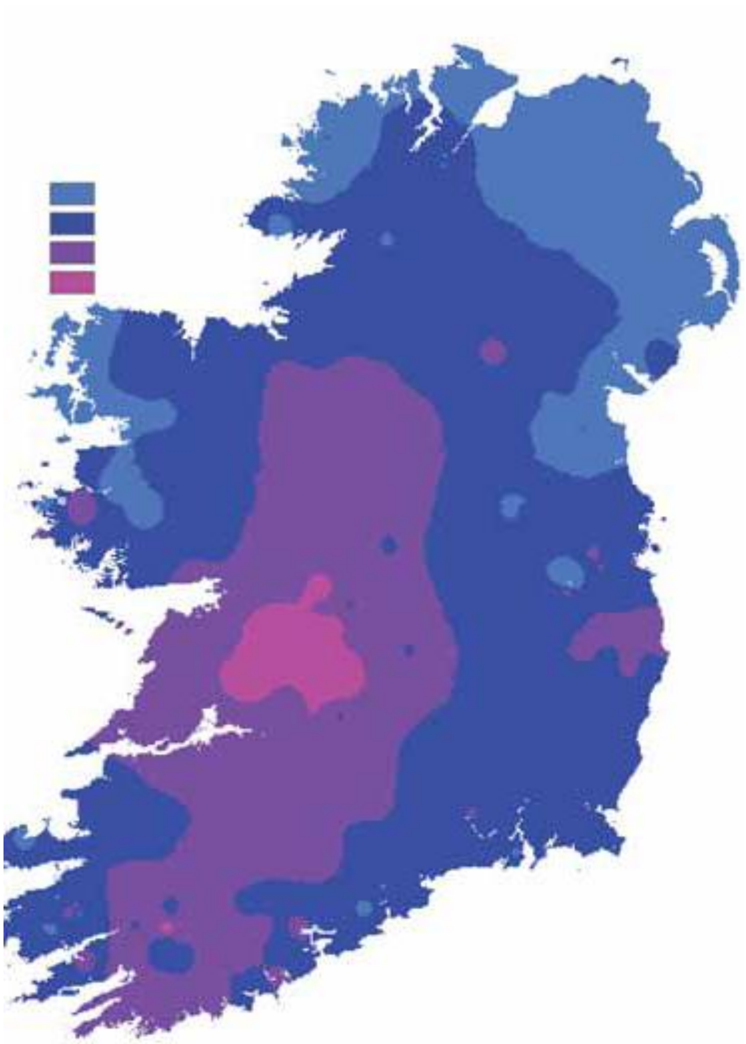


Figure 2-2 Extract from Met Eireann Monthly Weather Bulletin November 2009

During the period 17th to 24th November 2009, daily rainfall amounts on Wednesday 19th were recorded as 26.7mm and 29.4mm at the Shannon and Claremorris Weather Stations, respectively, but based on the rainfall data recorded at NUI Galway, it is clear that localised heavier rainfalls occurred in the Galway Area. This peak rainfall was followed by peak flood levels :

d. upstream of Craughwell village along the R349 (Loughrea to Athenry Road) at approximately midday on Thursday 20th November,
e. at the Craughwell River/R446 road crossing during Thursday afternoon (road closed in afternoon resulting in significant traffic disruption), and
f. downstream of Craughwell at Rahasane Turlough during Friday 21st November.

The following photography, taken by the OPW & Central Fisheries Board, during the period Thursday 20th to Saturday 22nd November 2009, shows the extent of flooding which occurred in late November 2009.

Photograph No. 15 Flooding in Craughwell at the Main R446 crossing on 20th Nov 2009

The extent of dwellings flooded, or at risk from flooding, in the village is evident .

Turbulent flow crossing the R446 is also evident in the lower left foreground where both the bypass (lower left) and main N6 bridge crossing (centre) were overtopped.

The R446 (formerly N6) Road was closed for 4 days during this event.

Photograph No. 16 Rahasane Turlough downstream of Craughwell on 23rd Nov 2009

The Kilcolgan Road with ribbon development is visible in the upper portions of the photograph. This road was closed for 10 days during this event and properties were flooded along this stretch of the Dunkellin River

Photograph No. 18
Flooding at Dunkellin Bridge on 23rd Nov 2009

View facing upstream with the Dunkellin Bridge in the centre of the image with a cluster of houses on each of the right and left banks

The Dunkellin Turlough is also visible in the background

Photograph No. 17
Flooding in townland of Killeely Beg on 23rd Nov 2009

The "canalised" Dunkellin River is a straight section of channel in this location. The channel breaks its banks and follows the natural contours of the adjacent lands and ultimately bypasses the Killeely Beg Bridge in the centre of the photo (surrounded by trees).

Note : extent of dwellings flooded, or at risk from flooding, in this location

Following a review of aerial photography of the November 2009 event and by establishing an account of local anecdotal evidence, the estimated flood plain during the November 2009 event can be established. This flood plain is shown in Figure 2-3.

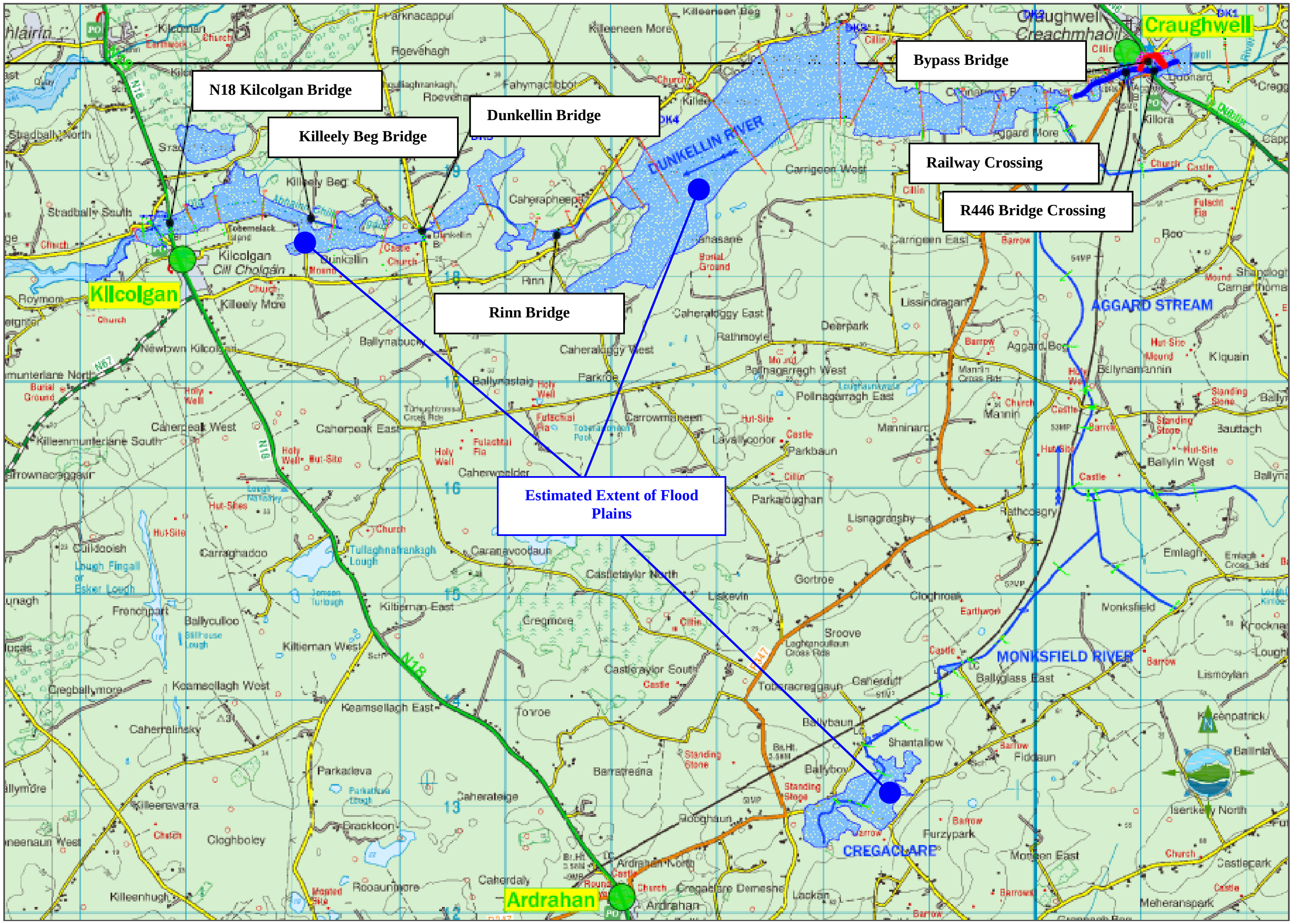


Figure 2-3 – Estimated Flood Plains along the Dunkellin and Aggard Stream based on Photography of the Nov 09 Event and local anecdotal evidence

From the recorded hydrographs of the event, aerial photography, measured wrack levels, direct observation from local residents and the estimated flood plain contained in Figure 2-3 it can be observed that:

1. Flooding upstream of Craughwell along the R349, (Athenry to Loughrea Road) north of Craughwell, occurred in advance of the flooding on the R446 within the village.

2. The R446 road bridges (2 No. flat deck concrete structures and 1 No. old stone arched bridge) are significant hydraulic restrictions, as both the main bridge and the additional "bypass/overflow" were overtopped.

3. The railway bridge, with a smaller effective cross sectional area, is also a significant restriction and an influencing factor on the upstream flooding within Craughwell.

4. The main channel downstream of the railway bridge and upstream of the Aggard/Dunkellin confluence, despite its steep bed gradient is also causing a restriction on flow.

5. The channel exiting the Rahasane Turlough cSAC and the Rinn Bridge have insufficient capacity to cater for this event.

6. The Dunkellin Bridge and Killeely Beg Bridge, and the channel upstream and downstream of these structures, also have insufficient capacity to cater for this event.

These observations, further analysis of the recorded river flow data, possible flood alleviation measures, and the mathematical modelling of these measures are discussed later in this section.

The following aerial photography details a number of locations where dwellings and commercial properties were flooded during the November 2009 event.

Photograph No. 19 Craughwell Village

Three dwellings were flooded in Craughwell, located in the centre of the photo and to the left of the R446 roadway. The R446 was also closed for 4 days during this event.

Two commercial properties were also flooded including the underground car park of the new development in the top left hand portion of the image.

Whilst the dwelling on the right of the photo was not flooded the surrounding gardens were inundated with flood waters.

Photograph No. 20 Rahasane Turlough

A number of properties were flooded at a number of locations along the northern shores of the Rahasane Turlough.

Whilst this image was taken after the flood had subsided, the threat to the Kilcolgan road is evident in this image.

Photograph No. 21 Killeely Beg Townland

A total of five dwellings were threatened by flood waters in the townland of Killeely Beg when the Dunkellin River broke its left bank and travelled along what appears to be the natural contour of an old channel.

2.2 FLOOD RELIEF DESIGN STANDARDS

It is generally accepted by the Office of Public Works (OPW) and Local Authorities that, where possible, a flood relief scheme should accommodate the 100-year design flood.

A significant amount of Hydrometric Data was received from the OPW for several hydrometric gauges within the study area. Figure 2-4 shows the location of the OPW hydrometric stations used in this study. The data consists of:

- Annual maximum series of recorded water levels and estimated flows for the Data Logger Stations, on the Dunkellin Catchment listed above, for the period of records dating from the commissioning of the hydrometric station to January 2010.

- Instantaneous 15 minute water level and flow data for the flood period 01/11/2009 to 15/01/2010 for each hydrometric station listed above, with the exception of Rahasane Turlough Station where the data logger was inundated during the November 2009 flooding event resulting in no data being available beyond 07:30hrs on the 19/11/09.

- Station rating equations and rating periods

The Environmental Protection Agency, Hydrometric Office, Castlebar has also provided data of measured flow for the November 2009 flooding event at Craughwell Station 29007, where measurements were carried out on the 21/11/2009 one day after the peak of that flood event.

The OPW have also undertaken a review of measurement records of the Hydrometric Station at Craughwell (Station No. 29007) and in doing so have considered the quality assurance and accuracy of data presented for this gauge. The mathematical review of the recorded data using both the EV Type I and EV Type II extreme value distributions have shown that due to:

a) partial blockages of the old Craughwell bridge
b) debris blockages
c) reduced conveyance (caused by gravel movements, weed growth, over hanging woody vegetation
d) bridge skew, and
e) bypassing flow (bypass channel)

careful consideration of the return period estimates is required.

In completing the review of the hydrometric data the OPW have estimated that the November 2009 event, at a flow of 84.8 m^3/sec has a return period of 122 years.

The estimated return period floods have also been established by the OPW. These are presented in Table 2-1.

Table 2-1 – Summary

Flow (m3/s)	Return Period (years)	EV1	EV2
28.6	1	-	-
34.0	2	0.37	-
42.0	5	1.50	1.72
49.3	10	2.25	2.77
60.5	25	3.20	4.32
70.3	50	3.90	5.66
81.4	100	4.60	7.16
94.0	200	5.30	8.86
98.4	250	5.52	9.45
113.2	500	6.21	11.45
130.0	1,000	6.91	13.71

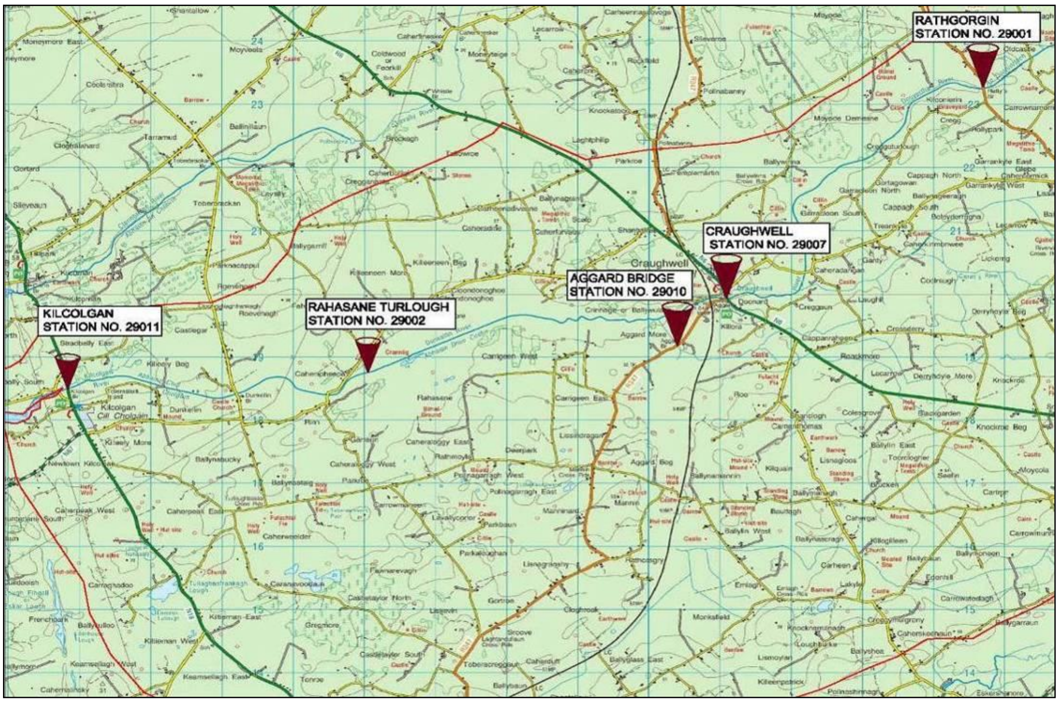


Figure 2-4 – Location of Hydrometric Stations in Dunkellin Catchment

2.3 CLIMATE CHANGE & FUTURE FLOW SCENARIOS

Two broad approaches are considered when implementing a proposed flood relief scheme.

These are:

(1) Design based on historic records

This approach considers historic flood and water level data and while climate change impacts are investigated, no allowance is made for climate change in relevant design parameters.

(2) Design for Climate Change

Designing for climate change is an approach where the level of proposed defences or the size of the proposed channel works are such that future climate change predictions are considered.

Whilst the design of the proposed works along this stretch of the Dunkellin River takes into account a series of environmental river enhancement works, the proposed approach to implementing the Dunkellin & Aggard Flood Relief Scheme is to design for climate change.

The document entitled *"Assessment of Potential Future Scenarios for Flood Risk Management"* and published by the OPW in August 2009 has been reviewed as part of this planning stage design.

This document states that :

"To provide an adequate understanding of the potential implications of the predicted impacts of climate change and other future changes, with due consideration of the significant uncertainty associated with such predictions, the OPW recommends that a minimum of two potential future scenarios are considered."

The two minimum scenarios are referred to as the :

"Mid-Range Future Scenario (MRFS) which it is intended to represent a 'likely' future scenario, based on the wide range of predictions available and with the allowances for increased flow, sea level rise, etc. within the bounds of widely accepted projections."

And

"High-End Future Scenario (HEFS), is intended to represent a more extreme potential future scenario, but one that is nonetheless not significantly outside the range of accepted predictions available, and with the allowances for increased flow, sea level rise, etc. at the upper the bounds of widely accepted projections."

The allowances, in terms of numerical values, for future changes which should typically be used for each of these scenarios, are set out in Table 2-2.

Table 2-2 – Allowances for Future Scenarios (100 year time horizon)

	Mid-Range Future Scenario MRFS	High-End Future Scenario HEFS
Extreme Rainfall Depths	+ 20%	+ 30%
Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 500 mm	+ 1000 mm

In developing the mathematical model for the study area, the Mid Range Future Scenario (MRFS) has been adopted to establish the possible impact that the increases may have on the recommended flood alleviation measures.

The estimated 100 year return flow at each gauging station, the allowance for future scenarios and the November 2009 event are summarised in Table 2-3.

Table 2-3 – Estimated Design Flows used in the development of the Proposed Flood Relief Works

	Craughwell 29007	Aggard Stream 29010
Estimated 100yr Return Flow	81.4 m³/s	18.00m³/s
Allowance for Mid-Range Future Scenario	16.28 m³/s	3.6 m³/s
Estimated Future Scenario	**97.68 m³/s**	**21.6m³/s**
Estimated Peak Flow November 2009 Event	84.8 m³/s	21.46 m³/s

2.4 HYDRAULIC MODELLING AND TESTING OF THE PROPOSED FLOOD RELIEF SCHEME

2.4.1 Hydraulic Modelling

The modelling software used for the purposes of this study is HEC-Ras, a 1 dimensional (1D) hydraulic model. The model is based on cross-sections of the water course, surveyed as part of this study and supplemented, where required on a limited basis, with additional cross sectional information from the original OPW Arterial Design which was completed in the mid 1950s. All of the topographical information, particularly level information, is based on the Malin Head datum. The extent of the survey cross sections used in the hydraulic model were determined by analysing the November 2009 flood event and selecting critical locations where flood level information was available from automatic gauging stations and anecdotal evidence from local representatives.

The modelled reach of the Dunkellin River is approximately 10.8km long, and starts approximately 780m upstream of the Main N6 bridge Crossing in Craughwell.

The modelled reach starts with an elevation of approximately 24 m.OD Malin, in Craughwell and ends with an elevation of 0.8 m.OD Malin, in Kilcolgan.

The downstream extent of the model is approximately 125m downstream from the N18 Bridge Crossing at Kilcolgan and this downstream boundary is in a tidal reach. The downstream boundary used in the hydraulic model is a high tide of 2.9mOD.

A number of assumptions have been made with regard to the model build for this study. These are summarised as follows:

- Surface features such as walls, buildings, isolated trees, fences and hedges have not been included in the model. These features may affect flows along the floodplain that are not accounted for in the model.
- Default weir, culvert and bridge loss coefficients have been used.
- All structures included in the model have been assumed to be in good condition and will withstand a flood event without damage.
- The model used in this study is a one-dimensional mathematical model, which has some limitations.
- Roughness co-efficients were based on Manning's 'n' values as derived from Chow (Open-Channel Hydraulics, McGraw-Hill, 1959).
- The hydraulic model was calibrated using the November 2009 event and the depth of water encountered along the river and through the Rahasane Turlough. This event was recorded at the Craughwell & Aggard gauging stations and has also been estimated to be greater than a 1% AEP (i.e., 1 in 100 year return period) event.
- The base model used the flow recorded at the Craughwell gauge as a Q-T (flow-time) input, and compared the model's calculated flow with the recorded flood depths along the channel reaches. The flow recorded at Aggard Bridge was also included in the model build and calibration.

3 DETAILED DESCRIPTION OF THE PROPOSED SCHEME

3.1 INTRODUCTION

Initially, three broad modelling designs or Strategic Schemes were examined in the development of the preferred flood relief scheme and following consultation with key environmental stakeholders a fourth and final "Preferred Scheme" was developed.

The first scheme examined a package of coherent, effective works, which concentrated on channel improvements and reconstruction of those structures whose removal would be essential in an effective scheme of works. This first scheme known as "Strategic Scheme No 1" examined the impact of works associated with :

1. deepening particular lengths of the channel between bridge structures,
2. the use of flood eyes or bypass/over culverts at the Dunkellin Bridge and Rinn Bridge,
3. removal of the old multi-arched stone bridge crossing (pedestrian bridge) in Craughwell, and
4. deepening of the bed level at the Railway Crossing and R446 (formerly N6) bridge in Craughwell Village.

The second scheme known as "Strategic Scheme No. 2" examined the incremental benefit of more extensive bridge replacement, including :

1. the impact of channel widening, in lieu of deepening as examined under Strategic Scheme No.1,
2. the complete replacement of the Killeely Beg and Dunkellin Bridges,
3. the use of bypass culverts at the Railway Bridge in Craughwell,
4. removal of the old multi-arched stone bridge crossing (pedestrian bridge) in Craughwell, and
5. the complete replacement of the bridges on the R446 in Craughwell with larger span structures.

The third scheme known as "Strategic Scheme No. 3" examined the benefit of more extensive main channel deepening (Dunkellin River) in Craughwell and the deepening of the bypass channel in Craughwell, including :

1. the impact of channel widening in the lower reaches of the Dunkellin River at Kilcolgan,
2. the complete replacement of the Killeely Beg Bridge,
3. the provision of flood embankments between Killeely Beg and Dunkellin Bridge
4. the provision of two large bypass culverts at the Dunkellin Bridge,
5. the use of three bypass culverts at Rinn Bridge downstream of the Rahasane Turlough cSAC,
6. channel works downstream of the Rahasane Turlough and upstream of Rinn Bridge,
7. deepening of the main channel at the Railway Bridge in Craughwell, the deepening of the main channel in Craughwell including underpinning of the railway bridge in Craughwell,
8. the deepening of the main channel in Craughwell to facilitate retention, by underpinning, of the old multi-arched stone bridge crossing (pedestrian bridge) in Craughwell, and
9. the deepening of the main channel in Craughwell to facilitate retention, by underpinning, of the bridge crossing on the R446 in Craughwell, and
10. the deepening of the bypass channel in Craughwell to facilitate retention, by underpinning, of the bridge crossing on the R446 in Craughwell.

The fourth scheme known as “Strategic Scheme No. 4” or ultimately the proposed “Preferred Scheme” examined the benefit of the main channel deepening in Craughwell, as detailed in Strategic Scheme No. 3, but reduced the extent of the proposed excavations between the Rahasane Turlough and Rinn Bridge limiting works to out of channel maintenance downstream of the Rahasane Turlough to Rinn Bridge (i.e., trimming back of terrestrial vegetation such as trees and low hanging branches and removal of encroaching vegetation such as brambles and scrub) and bypassing of the Rinn Bridge. The proposed works downstream of the turlough (at Rinn Bridge) have been designed so as to limit the predicted impact on water levels within the Rahasane Turlough.

The hydraulic models of the Strategic Schemes, combined with early public and stakeholder consultation, consultation with Galway County Council and the OPW, indicated that the particular selection of flood alleviation measures, included in “Strategic Scheme No. 4” would produce the “Preferred Scheme”.

The proposed works strike a delicate balance at Rahasane Turlough cSAC. Extreme floods would be passed through the Turlough where possible, by limited excavations downstream of the turlough and adaptations at Rinn Bridge, which would deliberately minimise the predicted changes in water levels within the turlough so to maintain the ecologically critical water level range.

The impact of this change in hydraulic control, downstream of the turlough, and the predicted change on normal water depth levels, means that the full benefits of flood relief, expected under “*Strategic Scheme No. 3”* cannot be achieved. The model predicts that the November 2009 flood level of 18.9mOD, within the Rahasane Turlough, will not be reduced and further alternative and localised flood protection measures (subject to consultation with local residents) may be required along the northern shore of the turlough.

The proposed engineering measures, working from the downstream location at the Kilcolgan Bridge on the N18, included in Strategic Scheme No. 4 or the ***“Preferred Scheme”*** and as detailed in Table 3-1, can be summarised across three zones as follows:

Zone 3 – Rinn Bridge to Kilcolgan:

Works to be undertaken downstream of the Rahasane Turlough from the townland of Rinn to the N18 at Kilcolgan.

Zone 2 – Rahasane Turlough:

No works to be undertaken along/within the Rahasane Turlough.

Zone 1 – Craughwell Village:

Works to be undertaken from Craughwell Village to the confluence of the Aggard Stream.

In addition to the engineering measures detailed above, additional works will be undertaken within the river channel to aid the passage of fish up the river. This will involve the construction of river enhancement works. These works will be developed further at detailed design stage through consultation between the Design Team, the Inland Fisheries Ireland, Galway County Council, the OPW and other relevant authorities.

Table 3-1 – Summary of the proposed *"Preferred Scheme" in Zones 1, 2 &3*

Zone	Works item No.	Description of Location	Proposed Scheme
1	1	Main Channel (Craughwell Village)	The main channel shall be deepened from 17.85mOD (35m u/s of the road bridge in Craughwell) to 14.66 mOD (610m d/s of the railway bridge)
	2	R446 Bridge	The channel shall be deepened by approximately 0.6m at the R446 Road Bridge (underpinning of the bridge will be required)
	3	Masonry Arch Pedestrian Bridge	The channel shall be deepened by approximately 0.6m at each arch (underpinning of all arches will be required).
	4	Bypass Channel (Craughwell Village)	The channel shall be graded from an u/s level of 18.5 to a d/s level of 18.0 mOD. (The bypass bridge will require underpinning to match proposed bed levels)
	5	Railway Bridge	The channel shall be deepened by up to 0.75m. (underpinning/scour protection of the railway bridge will be required)
2	6	Works at Rahasane Turlough	It is Not Proposed to Complete any Works within or adjacent to the main body of the Rahasane Turlough cSAC.
3	7	Channel Works at Rinn	A two stage channel typically 20m wide will be constructed from approximately 50m upstream of Rinn bridge to approximately 50m downstream of the bridge. Strictly out of channel maintenance works aimed at the removal of encroachment of terrestrial vegetation, removal of fallen/instream trees, with no dredging and no channelization/arterial drainage works. Terrestrial vegetation along the river banks would be managed (i.e. trimming back of brambles and scrub) rather than being removed.
	8	Works at Rinn Bridge	Three flood eyes will be provided each measuring 3.1m wide x 2.1m deep
	9	Channel Works beginning upstream of Dunkellin bridge to Kilcolgan Bridge	Maintenance works aimed at the removal of encroachment of terrestrial vegetation, removal of fallen/instream trees. Vegetation along the river banks would be managed (i.e. trimming back to 1.0m to 1.5m above high flood levels or top of bank) rather than being removed. Flood relief works will commence approximately 175m upstream of the Dunkellin bridge and consist of the construction of a two stage channel typically 20m wide.
	10	Works at Dunkellin Bridge	In conjunction with localised channel widening to facilitate the proposed bridge works (30m), the flood eyes shall be replaced with 2 new box culverts each measuring 13m wide x 2.3m deep
	11	Channel Works from Dunkellin Bridge to Killeely Beg Bridge	Two stage channel works continue from Dunkellin Bridge to Killeely Beg Bridge with a typical channel width of up to 20m.
	12	Works at Killeely Beg Bridge	In conjunction with localised channel widening to facilitate the proposed bridge works (14m), a new bridge shall be provided with an 18m span and a soffit level of 7.80 mOD.
	13	Salmon Counter	The salmon counter will be relocated to a position upstream of Kileely Beg bridge as part of the river enhancement works
	14	Channel Works from Killeely Beg Bridge to the N18 Bridge	Two stage channel works will continue from Killeely Beg to the N18 Bridge with a typical channel width of up to 20m. From a distance of 400m upstream of the N18 Bridge the two stage channel will be tapered back to match existing channel widths.
	15	Works at Kilcolgan & N18 Bridges	No Works Proposed

3.2 PROPOSED WORKS DOWNSTREAM OF THE RAHASANE TURLOUGH CSAC (ZONE 3)

3.2.1 Works Item No. 15 – Works At Kilcolgan Bridge

It is not proposed to undertaken any engineering measures at the Kilcolgan Bridge on the N18.

3.2.2 Works Item No. 14 – Channel Works from Killeely Beg Bridge to the N18 Bridge

The proposed works from upstream of the Kilcolgan Bridge at the N18 (Chainage 956m) to Killeely Beg Bridge (Chainage 1,529m) will consist of two-stage channel works whereby the top width of the channel will be increased from an average of 14m to a proposed average width of 34m. A 500m long embankment shall also be constructed on the left bank, from Killeely Beg Bridge with a maximum height of 3.0m above existing ground level. The proposed works will not involve excavation within the existing channel (in river works) and it is not proposed to alter the existing bed levels. This method of construction means that average annual flow can be contained within the existing channel and excavation can be undertaken along the bank with minimal interference to the water quality.

Maintenance works aimed at the removal of encroachment of terrestrial vegetation, removal of fallen trees and other obstacles will be undertaken along the river bank where flood relief works are not undertaken. Terrestrial vegetation along the river banks would be managed (i.e. trimming back to 1.0m to 1.5m above high flood levels) rather than being removed.

However, while it is proposed to undertake excavations along the left bank of the Dunkellin River, and that these works can be undertaken in dry bank conditions, such excavations have the potential to impact on the water quality of the river whereby silt may enter the river. This risk can be reduced or eliminated by operating in the dry conditions along the river bank.

Figure 3-1 provides an illustration of a typical cross section of the works to be undertaken along this section of the Dunkellin River.

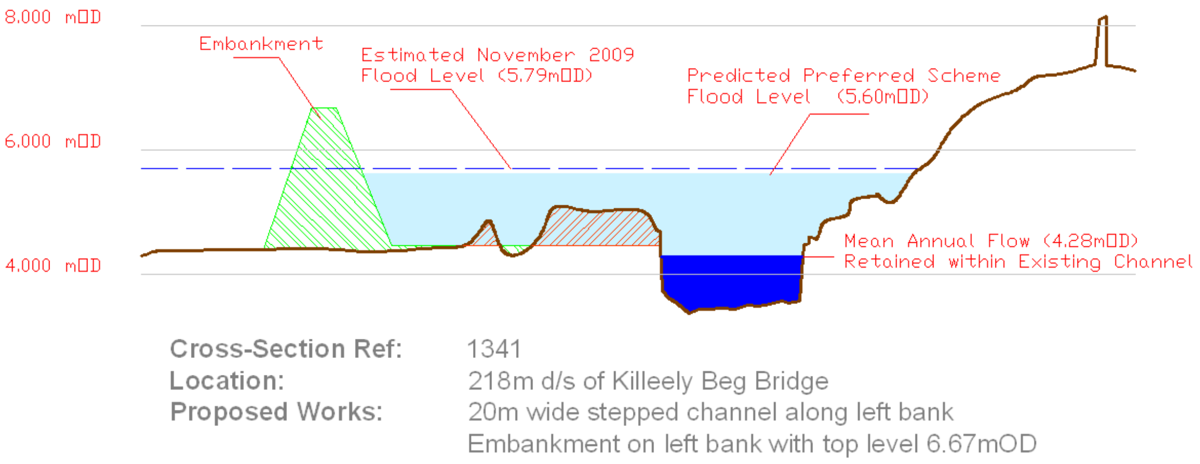
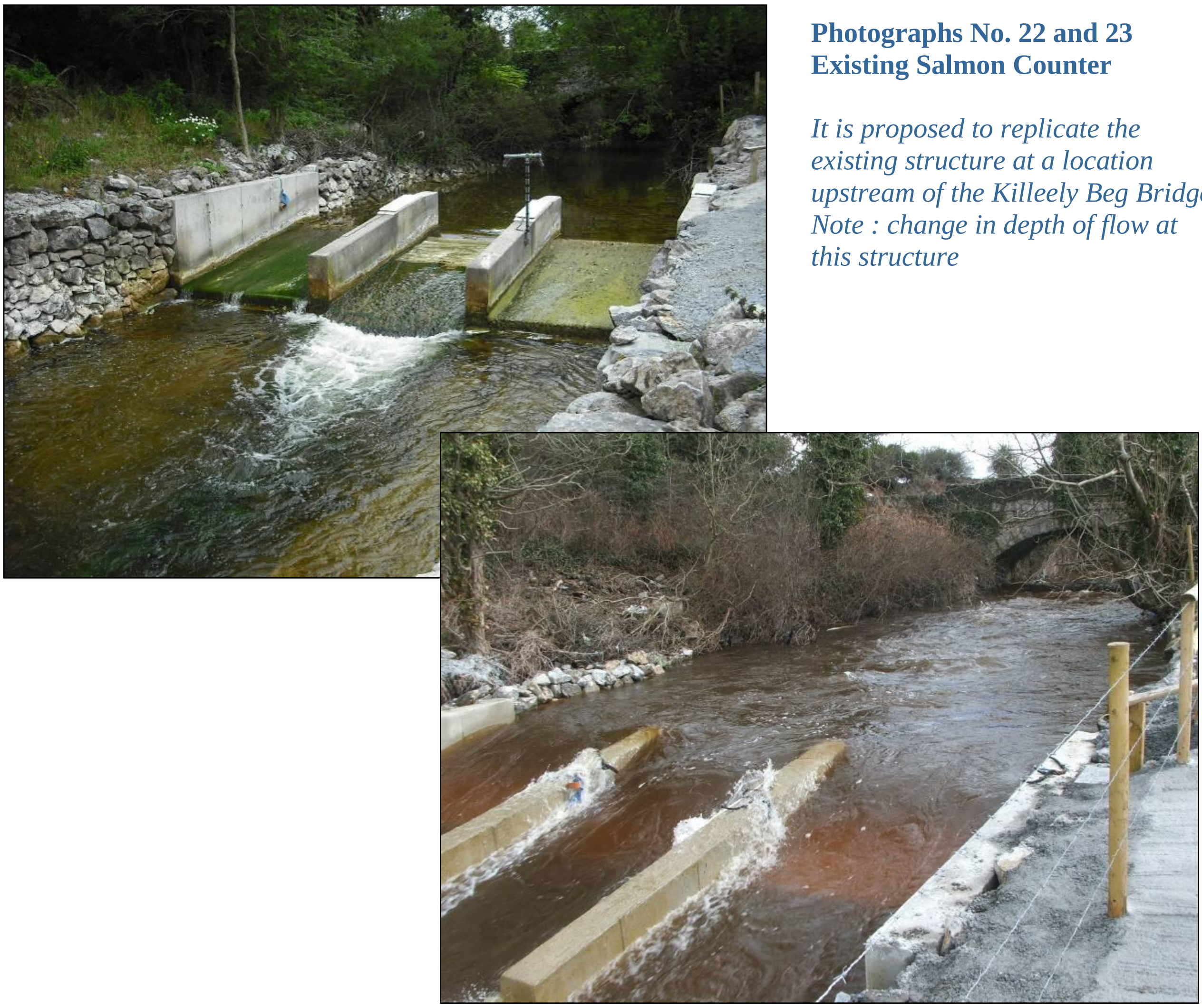


Figure 3-1 – Typical Cross Sectional Detail downstream of Killeely Beg Bridge

3.2.3 Works Item No. 13 – Relocation of the existing Salmon Counter

The existing salmon counter, shown in Photographs No. 22 and 23, is impacting on the high level water surface profile in the vicinity of Killeely Beg Bridge and is resulting in high water levels upstream of the bridge. Following consultation with the Inland Fisheries Ireland and other local parties, it is proposed to relocate this structure to a location upstream of the Killeely Beg Bridge. The proposed structure will be similar in all aspects to the existing concrete structure.



Photographs No. 22 and 23
Existing Salmon Counter

It is proposed to replicate the existing structure at a location upstream of the Killeely Beg Bridge. Note : change in depth of flow at this structure

The proposed salmon counter will be constructed in cast-insitu concrete and this will be undertaken in two halves, utilising cofferdam type construction whereby flow can be restricted to one half of the channel width allowing the civil engineering works to be undertaken in the dry conditions of the other half. This method of construction reduces the risk of wet concrete and other construction debris entering the river.

3.2.4 Works Item No. 12 – Works at Killeely Beg Bridge

Engineering works in the townland of Killeely Beg will include the complete replacement of the existing stone arched bridge. The existing bridge is approximately 8.2m wide and is a hydraulic constraint causing flooding upstream of the existing bridge.

It is proposed to replace this existing structure with a new bridge with a clear span of up to 18m and the proposed indicative bridge works are illustrated on Figure 3-2.

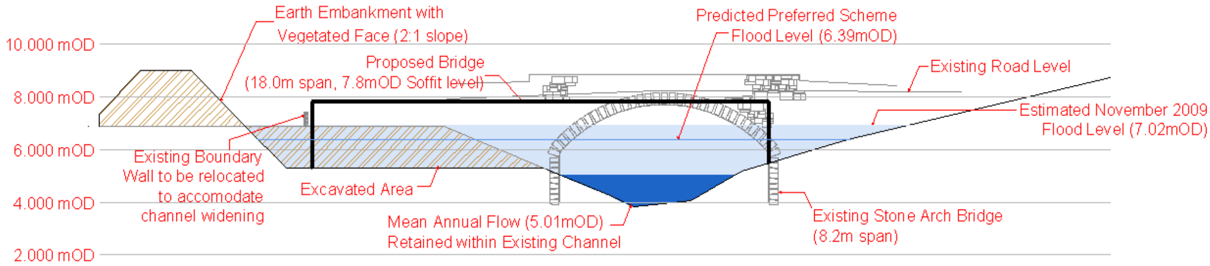


Figure 3-2 – Proposed Works at Killeely Beg Bridge

It is expected that the new bridge will be constructed from precast bridge beams resting on new concrete abutments on each river bank. It is also proposed to retain stone from the existing facades to construct the parapets of the proposed precast bridge.

The works will require the closure of the existing access road which is utilised for land access only and traffic disruption will be minimal. The proposed channel widening and bridge works will also require the realignment of the existing access road where suitable excavated material from the channel works can be utilised as fill material.

3.2.5 Works Item No. 11– Channel Works from Dunkellin Bridge to Killeely Beg Bridge

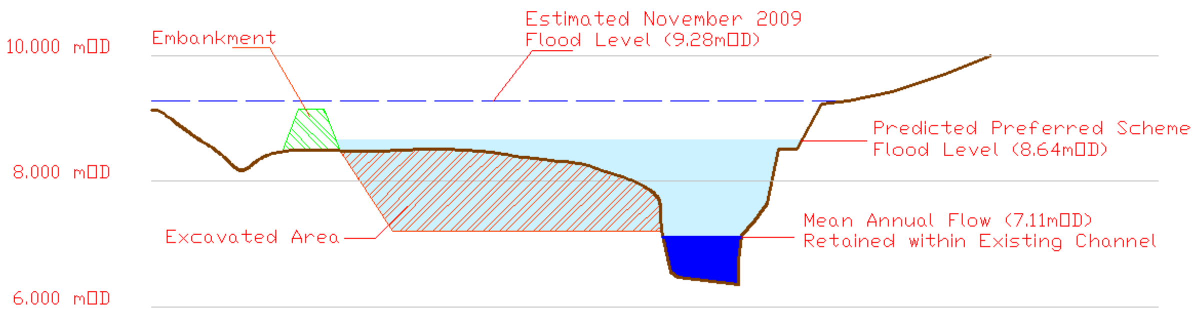
The proposed works from the Killeely Beg Bridge (Chainage 1,566m) to Dunkellin Bridge (Chainage 2,628m) will again consist of two-stage channel works whereby the top width of the channel will be increased from an average of 13m to a proposed width of 35m. The proposed works will not involve excavation within the existing channel (in river works) and it is not proposed to alter the existing bed levels. This method of construction again means that average annual flow can be contained within the existing channel and excavation can be undertaken along the bank with minimal interference to the water quality.

It is also proposed to construct an embankment on the left bank to a height above the predicted flood level. This flood embankment and two stage channel works will control and contain the extent of floodwater which had previously bypassed Killeely Beg Bridge (November 2009) and flooded numerous properties in Killeely Beg. It is proposed to use excavated material to form the embankment where possible.

However, while it is proposed to undertake excavations along the left bank of the Dunkellin River, and that these works can be undertaken in dry bank conditions, such excavations have the potential to impact on the water quality of the river whereby silt may enter the river. This risk can be reduced or eliminated by operating in the dry conditions along the river bank.

Maintenance works aimed at the removal of encroachment of terrestrial vegetation, removal of fallen trees and other obstacles will be undertaken along the river bank where flood relief works are not undertaken. Terrestrial vegetation along the river banks would be managed (i.e. trimming back to 1.0m to 1.5m above high flood levels) rather than being removed.

Figure 3-3 provides an illustration of a typical cross section of the works to be undertaken along this section of the Dunkellin River.



Cross-Section Ref: 2286 (Adjacent to DK31)
Location: 334m d/s of Dunkellin Bridge
Proposed Works: 20m wide stepped channel along left bank
Embankment on left bank with top level 9.14mOD

Figure 3-3 – Proposed Works Channel Works from Killeely Beg Bridge to Dunkellin Bridge

3.2.6 Works Item No. 12 – Works at the Dunkellin Bridge

Engineering works in the townland of Dunkellin will include the provision of bypass culverts to one side of the existing main stone arch. The existing structures at this location consist of a stone arched bridge spanning the main channel with five flood eyes located along the left bank of the channel. The existing flood eyes are insufficiently sized to cater for predicted flood flows and as such it is proposed to provide two new bridge structures each with a clear span of 13m and both located on the left bank. The construction of the proposed structures will require demolition of the existing flood eyes on the left bank and it is proposed to retain stone from the existing facades to construct the parapets of the proposed precast bridges.

The proposed indicative bridge works are illustrated on Figure 3-4.

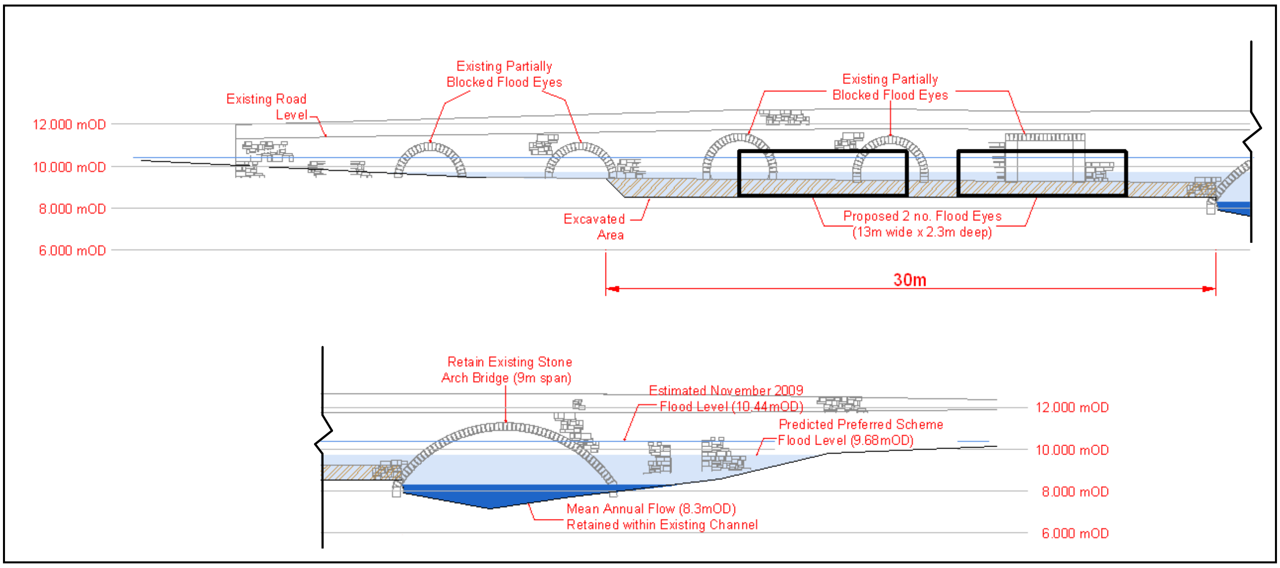


Figure 3-4 – Proposed Works at the Dunkellin Bridge

It is expected that the new bridge structures will be constructed from precast bridge beams resting on new concrete abutments.

The works will require the closure of the existing public road and therefore traffic disruption will be encountered. However road diversions can be put in place on the northern approaches at Roveagh and along the southern approaches at Madden's Forge with local access, to the northern and southern sides of the river, being maintained throughout the works.

3.2.7 Works Item No. 9 – Channel Works from the Dunkellin Bridge to Rinn Bridge

The proposed works from the Dunkellin Bridge (Chainage 2,634m) to Cross Section 3053 (419 metres upstream) will again consist of two-stage channel works whereby the top width of the channel will be increased from an average of 15m to a proposed width of 37m. The proposed works will again not involve excavation within the existing channel (in river works) and it is not proposed to alter the existing bed levels.

This method of construction again means that average annual flow can be contained within the existing channel and excavation can be undertaken along the bank with minimal interference to the water quality.

However, while it is proposed to undertake excavations along the left bank of the Dunkellin River, and that these works can be undertaken in dry bank conditions, such excavations have the potential to impact on the water quality of the river whereby silt may enter the river. This risk can be reduced or eliminated by operating in the dry conditions along the river bank.

Figure 3-5 provides an illustration of a typical cross section of the works to be undertaken along this section of the Dunkellin River.

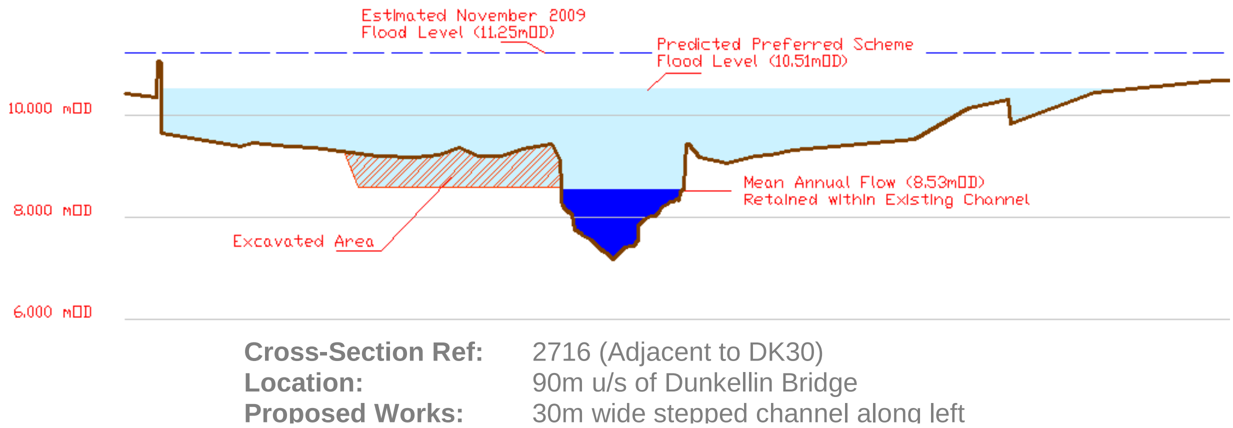


Figure 3-5– Proposed Works Channel Works from Dunkellin Bridge to Rinn Bridge

3.2.8 Works Item No. 8 – Works at Rinn Bridge

Engineering works in the townland of Rinn will include the provision of three bypass culverts on the left bank of the existing main concrete bridge. The existing structure at this location consists of a concrete flat deck bridge spanning the main channel with a single support located in the centre of the existing channel. It is not proposed to undertake any works on the existing bridge as the bed level of this bridge is considered to be a significant factor in controlling the water levels in the Rahasane Turlough cSAC. It is however proposed to provide three precast by pass culverts on the left bank of the existing channel. The culverts will consist of three precast concrete units measuring 3.1m wide by 2.1m high.

The proposed indicative bridge works are illustrated on Figure 3-6.

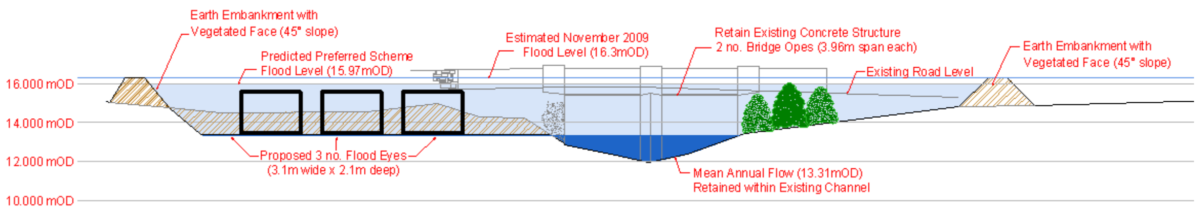


Figure 3-6 – Proposed Works at the Rinn Bridge

The construction of the proposed structures will require excavation of the existing road and will therefore require the closure of the existing public road and traffic disruption will be encountered.

However road diversions can be put in place on the northern approaches at Craughwell and along the southern approaches at Rinn and Madden's Forge with local access, to the northern and southern sides of the river, being maintained throughout the works.

3.2.9 Works Item No. 7 – Channel Works at Rinn Bridge

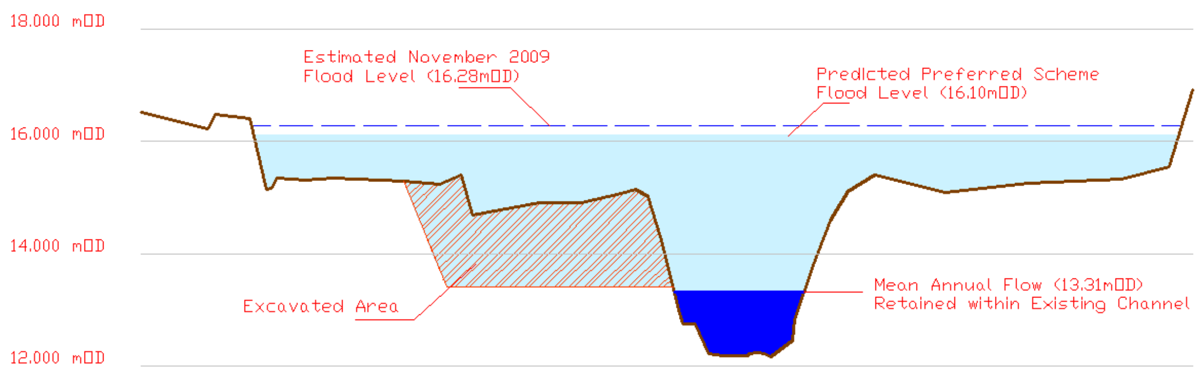
The proposed works at Rinn Bridge also include for the construction of two stage channel works for a distance of approximately 50m upstream and downstream of the bridge whereby the top width of the channel will be increased from an average of 21m to a proposed width of 41m. The proposed works will again not involve excavation within the existing channel (in river works) and it is not proposed to alter the existing bed levels. It is proposed to limit the extent of excavation in this section of channel to a maximum of 50m upstream of the bridge but also avoid excavation within the existing channel, so as to provide a natural hydraulic control for water levels in the turlough.

Strictly out of channel maintenance works aimed at the removal of encroachment of terrestrial vegetation, removal of fallen trees will be undertaken along the river bank where flood relief works are not undertaken. Terrestrial vegetation along the river banks would be managed (i.e. trimming back to 1.0m to 1.5m above high flood levels) rather than being removed.

However, while it is proposed to undertake excavations along the left bank of the Dunkellin River, and that these works can be undertaken in dry bank conditions, such excavations have the potential to impact on the water quality of the river whereby silt and other construction debris may enter the river. This risk can be reduced or eliminated by operating in the dry conditions along the river bank.

These proposed works will not enter the Rahasane Turlough cSAC.

Figure 3-7 provides an illustration of a typical cross section of the works to be undertaken at Rinn Bridge.



Cross-Section Ref: 4069 (Adjacent to DK26)
Location: 2m u/s of Rinn Bridge
Proposed Works: 20m wide stepped channel along left bank

Figure 3-7 – Proposed Works Channel Works from Rinn Bridge to the Rahasane Turlough

3.3 THE RAHASANE TURLOUGH CSAC (ZONE 2)

3.3.1 Item No. 6

Following development of Strategic Scheme No. 3, where channel deepening within the environs of Craughwell and channel & bridge widening downstream of the Rahasane Turlough were considered, it was found that proposed works would have an impact on the normal depth ranges of water within the turlough. This impact was thought to be environmentally significant and have the potential to impact on the normal hydrological and thus ecological regimes within the turlough. A fourth scheme, “Strategic Scheme No. 4” was therefore considered.

This fourth scheme considered the use of flood embankments or walls along the shore of the turlough without the need to change the depth of flooding within the turlough.

While offering flood protection on a theoretical basis, this proposal may not:

1. provide the necessary flood protection (from the Rahasane Turlough) due to the variable karstic nature of the bedrock in the region and the unpredictable potential movement of water beneath the flood protection wall or embankment (bringing a risk of “burst up” due to differential pressure of approximately 2.2m head across the wall), and

2. allow the drainage of surface/ground water, from lands along the northern boundary of the water body, behind the proposed wall, into the Rahasane Turlough, to occur naturally. This movement of water may be due to surface water flow or ground water movement in rock fissures or other unknown karstic features. Attempts to detail flexible pinch valves/flap valves to permit unidirectional drainage from behind the wall are unsound from a flood protection viewpoint, because such valves inevitably become blocked by debris in a partly open position.

Considering these risks the construction of flood embankments or walls in this karstic region were not considered viable and are therefore not proposed. However, the Craughwell to Kilcolgan Road and properties along the northern shore of the turlough will continue to be at risk of flooding during the extreme design flood events.

3.4 PROPOSED WORKS UPSTREAM OF THE RAHASANE TURLOUGH (ZONE 1)

3.4.1 Works Item No. 1 – Channel Deepening from the Aggard Stream to Craughwell Village

The proposed works, from a location approximately 600 metres downstream of the Railway Bridge in Craughwell (Chainage 9,426m) to a point 35m upstream of the R446 Road Bridge in Craughwell (Chainage 10,373m), will consist of channel regrading whereby the existing bed level will be lowered by 1.0 to 1.5 m over an approximate length of 950m. A summary of these works is given in Table 3-2. The proposed works will involve excavation within the existing channel (in-river works) and as such have the potential to impact on water quality in the area.

Table 3-2 – Craughwell channel works

Chainage	Location	Proposed Works
9426	Approximately 600 m downstream of Railway Bridge	Deepen Channel to 14.66 m.O.D. using side slope of 1:2
9426-10037	Downstream of Railway Bridge	Grade Channel from 14.66 m.O.D. to 16.83 m.O.D.
10037	Railway Bridge	Deepen Channel to 16.83 m.O.D. using side slope of 1:2
10037-10123	From Railway bridge approximately 127 m upstream	Grade Channel from 16.83 m.O.D. to 17.51 m.O.D.
10123-10373	Craughwell Village	Grade Channel from 17.51 m.O.D. to 17.85 m.O.D.
10373	Approximately 35 m upstream of Craughwell R446 Road Bridge	Deepen Channel to 17.85 m.O.D. using side slope of 1:2

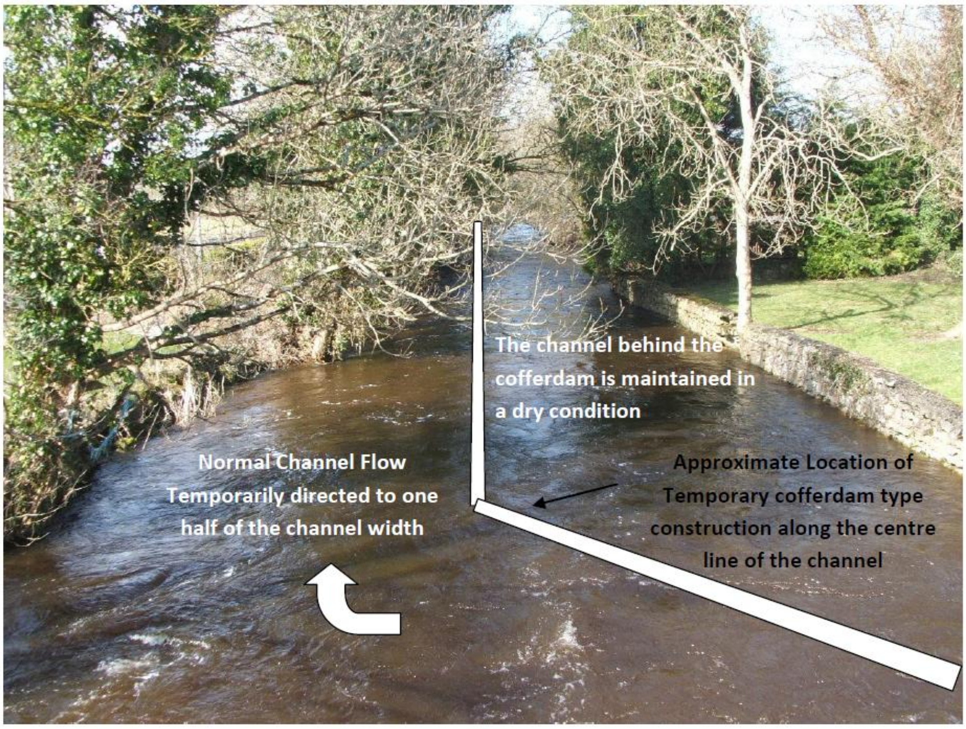
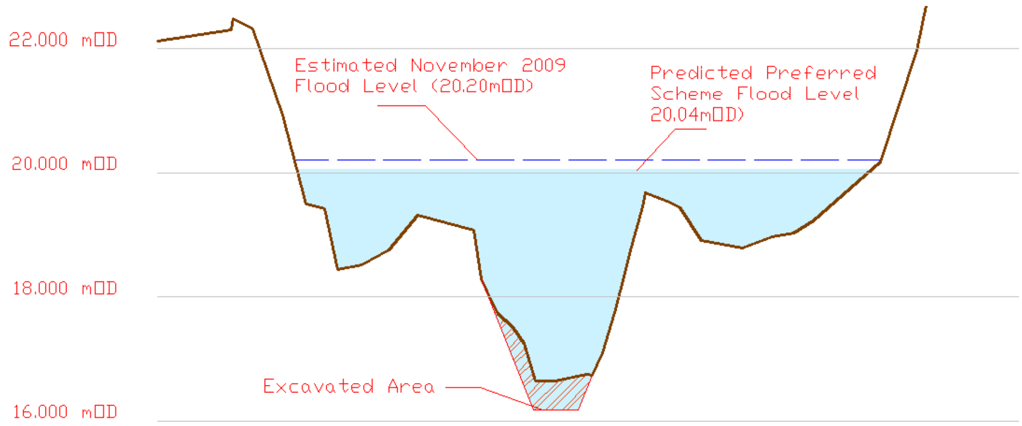


Figure 3-8 provides an illustration of a typical cross section of the works to be undertaken along this section of the river in the vicinity of Craughwell Village.



Cross-Section Ref: 9848 (Adjacent to DK10)
Location: 183m d/s of Railway Bridge
Proposed Works: Deepen Channel by approx. 0.6m

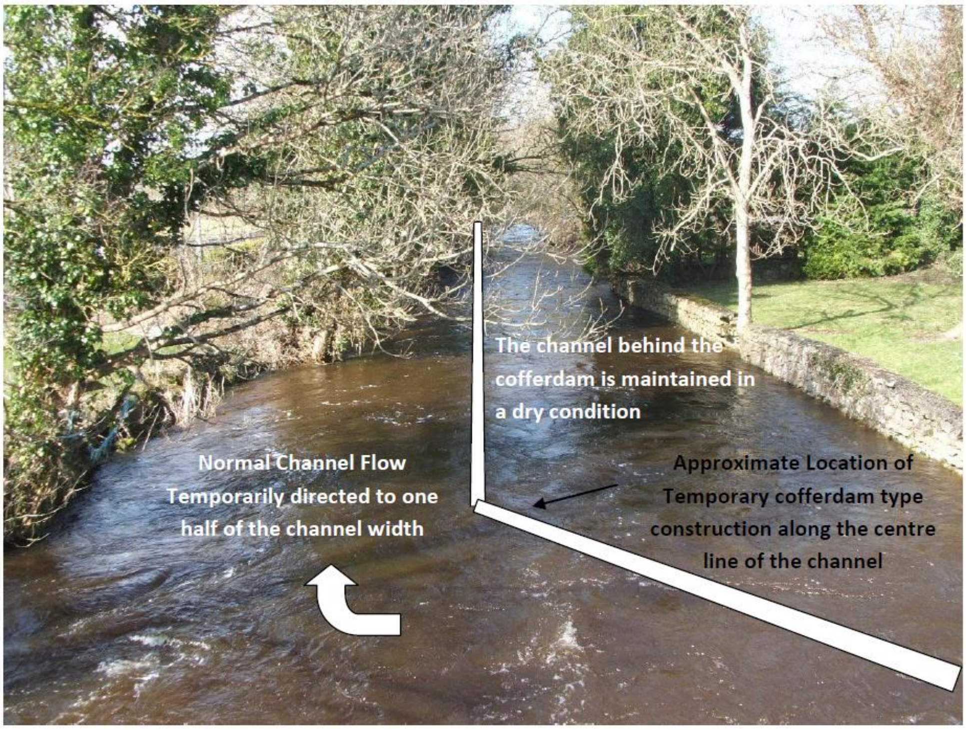


Figure 3-8 – Proposed Works Channel Works in the vicinity of Craughwell Village and sketch of cofferdam location

It is envisaged that excavation of the channel in this location will be dependent on the phasing of works along the bypass channel, low flow conditions in the river and the extent to which flow in the river can be diverted or restricted to one half of the existing channel. In addition it is also proposed to retain existing bankside trees (if healthy and suitable for retention) provided that their retention does not pose a concern with regard to the safe construction of the works, safe recreational use of the channel and safe maintenance of the channel. It is expected that a qualified arborist will be retained at the detailed design stage to examine and determine the most appropriate trees that can be retained or if necessary make recommendations with regard to the replacement of trees that require removal.

Works associated with channel deepening in the vicinity of the old stone bridge and the bridge crossings of the R446 can be undertaken in dry conditions whereby the bypass channel can be utilised a diversion route once the proposed channel works and underpinning on the bypass channel are complete.

The remaining channel works downstream of the proposed confluence of the bypass channel and the Dunkellin River will be undertaken along the length of the channel in segmented sections using cofferdam type temporary works construction.

It is envisaged that temporary cofferdam type construction or temporary sheet pile walls (with a length of 50 to 100m depending on the depth of water and ground conditions) will be used in the location described in Figure 3-8. This process allows river water to be directed to one half of the channel width allowing the civil engineering works to be undertaken, in relatively dry conditions, on the other side of the channel. Once this half of the proposed channel works is excavated, within the confines of the cofferdam, it is expected that river water will be directed to the new section allowing the adjacent excavations to be completed. This sequence of construction is expected to commence at the lower downstream point of the works and continue upstream in this "*leap-frog*" type construction method. This method of construction reduces the risk of construction debris and silt entering the river.

It is also proposed to store excavated material, such as the natural gravels, boulders and cobbles found on the existing river bed, so that such material can be reused in the development of the river enhancement works. The design of the river enhancement works together with the associated construction works method statements will be the subject of detailed design between Galway County Council, the OPW and Inland Fisheries Ireland upon conclusion of the planning process.

Such river enhancement works along this stretch of the river will aim to restore the natural morphological form (C type) of this channel at the new river bed level and develop a series of riffle, glide and pool structures. This process involves the reintroduction of some excavated material to create weirs or paired deflectors, excavation of pools and the introduction of salmonid spawning beds.

It is also proposed that the river enhancement works will be undertaken in tandem with the main excavations works within each cofferdam enclosure so that the short term impact on ecology is minimised.

3.4.2 Works Item No. 5, 3, and 2 – Works at the Railway Bridge, old multi-arched stone pedestrian bridge and main R446 Bridge in Craughwell

As noted in Section 3.3.1 it is proposed to regrade the main channel in Craughwell from a location downstream of the railway bridge to a location just upstream of the village. The regrading works will include a reduction in bed level in the range of 1.0 to 1.5m over an approximate length of 947m.

This regrading also requires the deepening of the bed level at the three main bridges in Craughwell, namely; the Railway Bridge, the old stone multi-arched pedestrian bridge and the bridge crossing on the R446. This proposed work is shown in Figure 3-9 to Figure 3-11 inclusive. The required depth of underpinning will be as follows:

1) Up to 0.50m of underpinning or scour protection required at the Railway Bridge
2) Up to 0.70m of underpinning at the old stone multi-arched pedestrian bridge and
3) Up to 0.60m of underpinning at the bridge crossing on the R446.

Underpinning or scour protection involves one of two main techniques whereby :

a) material is excavated from beneath the foundations of the existing bridge and replaced with mass concrete. The sequence of work is such that that the stability of the existing structure is not compromised. The work tends to be labour intensive and is normally undertaken in partial but sequential excavations under the bridge abutment.
b) a secant or contiguous piled wall is constructed along the foundation of the existing bridge to allow the deepening or regrading to take place.

It is envisaged that the foundations of the existing R446 road bridge and the stone arched pedestrian bridge will be supported through the use of direct underpinning i.e., item (a) above, where all of the work can be undertaken in the dry when the existing bypass channel is deepened and temporarily used as the main river channel for the duration of the underpinning and channel deepening. The underpinning of these structures will be labour intensive as the works will be undertaken by hand because headroom beneath each bridge soffit is minimal and access for heavy plant is limited.

It is envisaged that the foundations of the existing railway bridge will require scour protection through the use of a secant or contiguous piled wall along each side of the bridge piers or abutments i.e., item (b) above. However, this work will require the use of either a floating barge or construction of a temporary cofferdam to facilitate access to the bridge piers. The use of temporary cofferdams allows the works to be undertaken in two phases, whereby flow can be restricted to one half of the channel width allowing the civil engineering works to be undertaken in the dry conditions which exist within the other half of the channel.

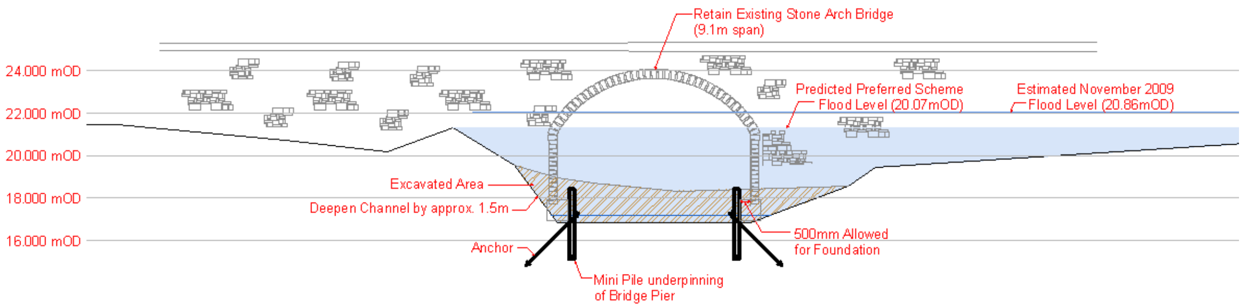


Figure 3-9 – Proposed Works at the Railway Bridge in Craughwell

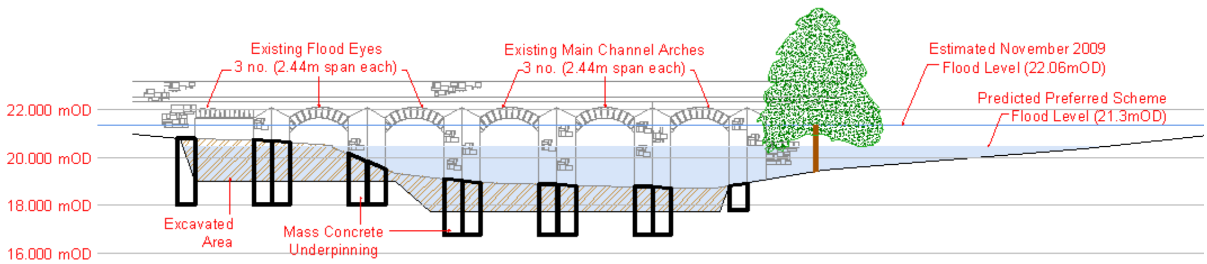


Figure 3-10 – Proposed Works at the Old Pedestrian Bridge in Craughwell

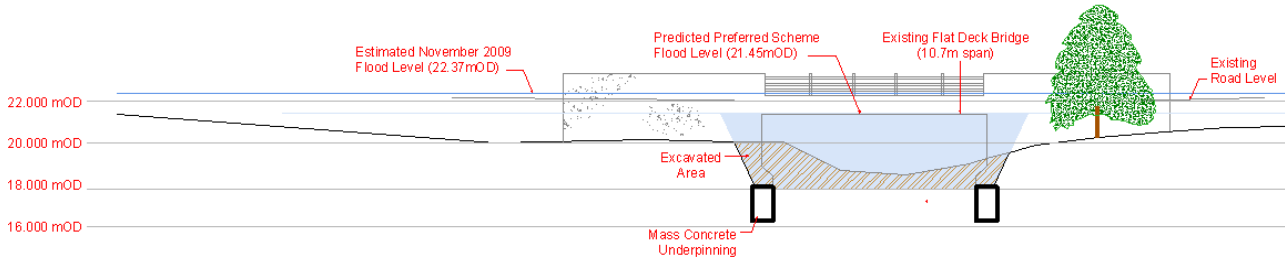


Figure 3-11 – Proposed Works at the R446 Road Bridge in Craughwell

3.4.3 Works Item No. 4 – Works along the By-Pass Channel

It is proposed to regrade the entire length of the bypass channel in Craughwell, from 18.5mOD upstream to 18.0mOD downstream. The regrading works will include a reduction in bed level of approximately 1.5m at the bypass bridge on the R446 road. This deepening will require underpinning of the existing bridge and it is envisaged that this will involve the excavation of material from beneath the foundations of the existing bridge and replacing this with mass concrete. The sequence of work is such that that the stability of the existing structure is not compromised. The work tends to be labour intensive and is normally undertaken in sequential excavations under the bridge abutment.

It is envisaged that this underpinning work can be undertaken in the dry as the bypass channel is normally only utilised when the main channel is in flood. The underpinning of this structure will again be labour intensive as the works will be undertaken by hand because headroom beneath the bridge soffit is minimal and access for heavy plant will be extremely limited.

Figure 3-12 provides an illustration of the works to be undertaken along this section of the bypass channel.

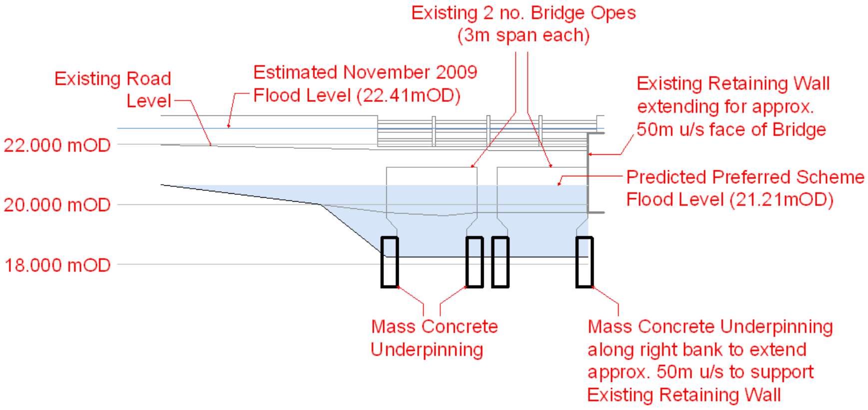


Figure 3-12 – Proposed Works at the By-Pass Channel Bridge in Craughwell

3.5 PROPOSED MAINTENANCE WORKS ALONG THE AGGARD STREAM

The proposed works along the Aggard Stream will consist of culvert replacement works whereby existing blocked and undersized piped crossings will be replaced with larger diameter piped culverts. The proposed works will involve minor localised excavations within the existing stream. The overall proposal for works along the Aggard Stream is to replace blocked culverts (circa 14 No. culverts) with 1500mm diameter precast concrete open jointed pipes.

Photographs No. 24 & 25 provide an illustration of typical culverts which require replacement along the Aggard Stream.

Photograph 24 – Typical Culvert along the Aggard Stream which requires replacement

Photograph 25 – Typical Culvert along the Aggard Stream which requires replacement

The works proposed for the Aggard Stream are minor in nature and consist of maintenance works aimed at the removal of encroachment of vegetation, removal of fallen trees and other obstacles (i.e. gates, minor obstructions, fences in the river poor culvert conveyance etc..), excessive silt deposits and that excavations not include for significant dredging and no channelization/arterial drainage works. Vegetation along the river banks would be managed (i.e. trimming back) rather than being removed, where at all possible.

3.6 ALTERNATIVES CONSIDERED AND OTHER PLANS OR PROJECTS IN THE AREA

3.6.1 Alternatives considered

As noted in Section 3.1 four main strategic schemes were considered during the preliminary design stage of the project. Whilst the fourth scheme includes the preferred scheme flood relief measures, a series of alternative options were considered throughout the study area. These alternatives considered included :

Zone 1 Craughwell Village

a. Pumping of the excess flood river flows was considered at the early stages of the study. Whilst this proved to be an effective technical option the pumps were of a size that did not merit consideration. In addition, the pipework required was also significant in size and the flow velocities had the potential to create a risk of significance ground disturbance at their point of discharge.
b. Whilst demolition of the existing multi-arched stone pedestrian bridge was considered in the initial study, early consultation with statutory bodies indicated that even though the structure was not protected, the bridge was considered to be of archaeological significance and may also be used as a bat roost and as such demolition was not considered to be a viable option.
c. Channel widening of the existing river, within the village of Craughwell, was also considered at an early stage of the study. However, the main hydraulic restriction along this channel reach was the railway bridge. Channel widening would require the construction of a large flood culvert under the railway line. This alternative was not considered to be viable as installation of a large structure would require, for safety & health reasons, closure of the railway line for a significant period of time, a restriction not considered to be possible.
d. The provision of bypass culverts were also considered on each side of the R446 road bridges. However, due to localised access and land acquisition restrictions, the presence of existing utilities such as water mains, gas mains, broadband (fibre optic) facilities, underground power cables and Eircom cabling and the need for road closures on the R446 this option was not considered to be a viable solution.

Zone 2 Rahasane Turlough

a. Channel widening of the existing channel between the mouth of Rahasane Turlough to Rinn Bridge was also considered. Figure 3-13 shows the affect this widening has compared to the preferred scheme, most notably at levels over 15.7m. This alternative scheme is not considered to be viable as it has the potential to reduce the water profile in the Rahasane Turlough cSAC, to levels which would significantly impact on the normal flood regime and therefore impact on the local flora and fauna. This was not considered to be viable as the turlough is a protected habitat and heritage site.

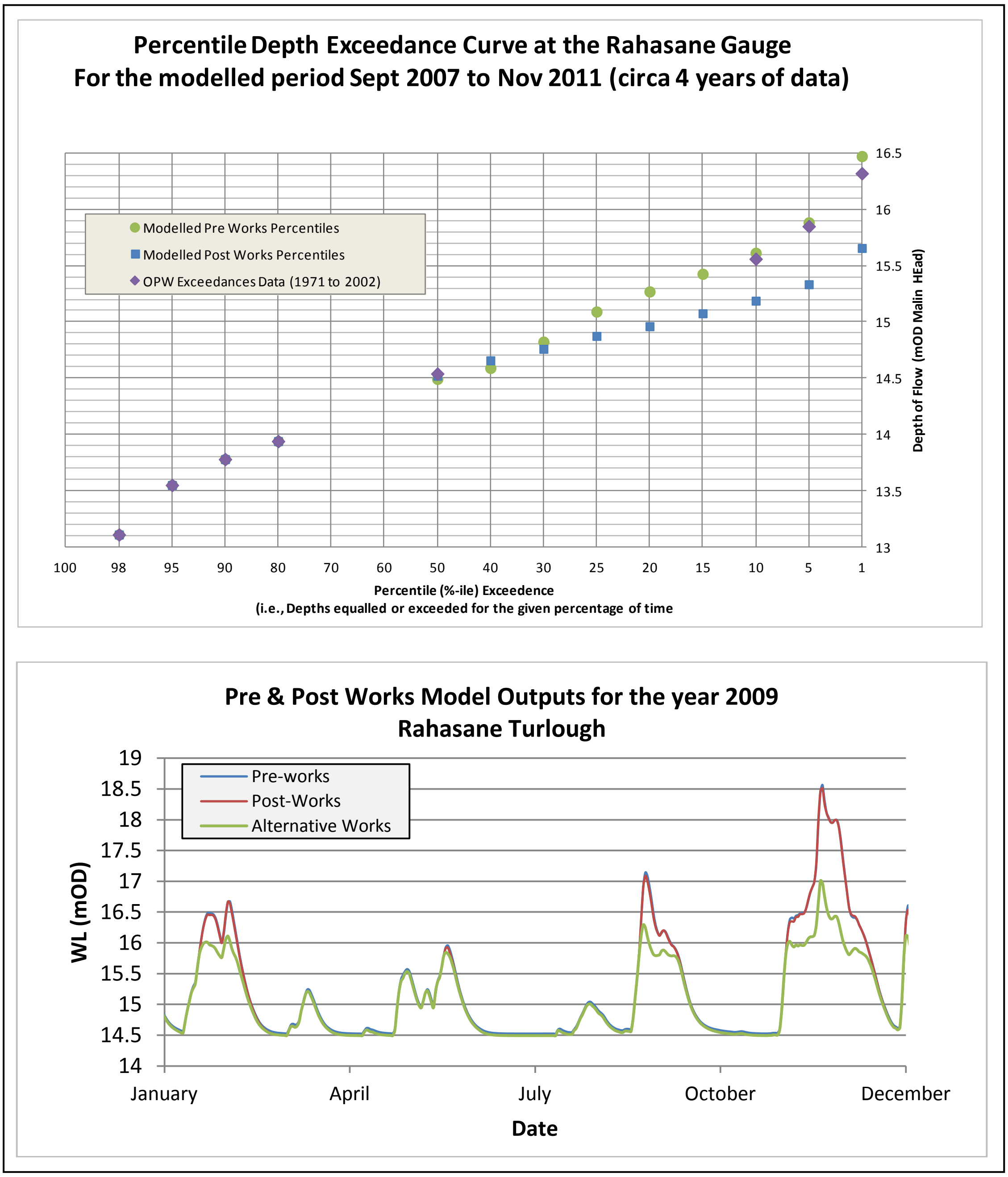


Figure 3-13 – Impact of Alternative Works on the depth ranges in the Rahasane Turlough

<u>Zone 3 Downstream of the Rahasane Turlough to the N18 at Kilcolgan Bridge</u>

a. Channel deepening of the existing river, downstream of the Rahasane Turlough cSAC, was also considered at an early stage of the study. However, the main hydraulic restriction along this channel reach was the water level in the turlough. Channel deepening would result in significant reductions in bed levels throughout this reach of the river. This alternative was not considered to be viable as it has the potential to reduce the water profile in the Rahasane Turlough cSAC, to levels which would significantly impact on the normal flood regime and therefore impact on the local flora and fauna. This was not considered to be viable as the turlough is a protected habitat and heritage site.

3.6.2 Other Plans or Projects in the Area

Work on the construction of new motorway between Gort and Tuam in Co Galway is expected to begin in late 2014/early 2015. The new 57km motorway will consist of a four lane carriageway from Gort in the south to Tuam in the north, and a major junction with the M6 Galway-Dublin route to the east of Galway City. The road will bypass Tuam, Ardrahan, Claregalway, Kilcolgan, Clarinbridge and Gort and the first traffic along the route is expected in 2018. The location of the proposed motorway is detailed on Drawing No's 6408-2201 and 6408-2204.

In preparing the EIS (dated August 2006), for the proposed motorway, a number of studies were undertaken to assess what impacts this road scheme would have on the surface water hydrology of the region. The proposed road crosses two rivers, the Clarinbridge River and the Dunkellin River.

With regard to the proposed Dunkellin and Aggard Flood Relief Scheme the proposed motorway will cross the Dunkellin River at a point approximately 600m upstream of the Dunkellin Bridge and 400m upstream of where the proposed flood relief scheme will commence.

The EIS for the motorway noted that:

In Section 8.2.1.2 under the heading of Effects of Proposed Development

"The proposed crossing point for the new N18 is located approximately 2.5km upstream of the existing N18, between Dunkellin Bridge and Rinn Bridge. The proposed crossing will consist of a three span bridge spanning the main river channel and a portion of the floodplain on either side. The preliminary span sizes used in this study are 35m for the central span, and 25m for side spans on either side. The river channel at the proposed crossing point has a width of approximately 20m. The bridge will therefore span approximately 65m of floodplain beside the river channel. It is possible that the span widths may be adjusted during detailed design. The road approaching the bridge will pass over the Dunkellin flood plain on embankments for approximately 300m."

In Section 8.4.2 of the EIS, under the heading of Hydrology

"Surface water will be attenuated through treatment ponds before entering the watercourse. This will reduce the volume of water entering the river to a peak flow equal to the green field runoff rate. This is not expected to have any significant or measurable impact on the river flows."

In Section 8.4.2.2 of the EIS, under the heading of Hydrology and referring specifically to the Dunkellin Turlough just upstream of the Dunkellin Bridge,

"The proposed crossing of the Dunkellin River requires approximately 300m of embankment to be constructed in the Dunkellin River flood plain. This causes a constriction in the flow at the proposed crossing point, and depending on the degree of constriction, bridge construction can cause considerable afflux, or backwater, upstream of the crossing. The crossing was modelled to estimate the extent of afflux which would be caused"

"The modelling showed that the overall water levels in the Dunkellin floodplain are controlled by the restriction imposed on flow in the river by the existing Dunkellin Bridge, and by a high bed level immediately downstream of the bridge…………..The model predicts a maximum difference in pre and post development water levels of 11mm just upstream of the bridge, reducing gradually to no difference approximately 450m upstream. There is no predicted difference in the downstream water levels from the bridge."

"The construction of the proposed new dual carriageway crossing is therefore expected to have a slight negative impact on the hydrology of the Dunkellin River. This impact will, however, be imperceptible due to the negligible amount of additional land flooded during extreme flood events due to the 11mm rise in water levels."

The proposed motorway has been considered in the overall context of plans and projects in the vicinity of the proposed flood relief works, and because:

a. the proposed Dunkellin and Aggard Flood Relief Scheme commences at a location approximately 400m downstream of the M18 bridge crossing, and
b. the proposed M18 bridge crossing at Dunkellin is not expected to have an impact on water levels downstream of the new motorway bridge,

it is expected, that there will be no additional impact, from the M18, on water levels associated with the proposed Dunkellin and Aggard Flood Relief Scheme.

3.7 ENVIRONMENTAL RIVER ENHANCEMENT PROGRAMME

Inland Fisheries Ireland (IFI) define the Environmental River Enhancement Programme as :

"an Office of Public Works (OPW) funded project that is being co-ordinated and managed by Inland Fisheries Ireland. The programme focuses on the enhancement of drained salmonid rivers in Ireland. These drained rivers are a result of a number of large and small scale arterial drainage schemes which were carried out, across the country, by the OPW since the 1940's. While such works substantially reduced flooding in many areas and brought much benefit to agriculture there were unfortunately some negative impacts on fisheries, angling and on the river corridor habitat."

"Monitoring of the enhancement works by IFI consists of carrying out pre and post works habitat assessments on representative river stretches….. In parallel, pre and post works biodiversity assessments at representative river stretches scheduled for development are also carried out. These include surveys of aquatic insects; river corridor vegetation and other dependent river corridor animals and birds as appropriate"

Galway County Council, in consultation with the OPW, have undertaken to implement, in conjunction with the proposed channel works, a programme of River Enhancement Works along the Dunkellin River.

Two reaches of the Dunkellin River have been identified as areas with high enhancement potential. These are highlighted in Figure 3-14 and are :

1. the channel stretching from the N18 at Kilcolgan to the Rahasane Turlough, and
2. the channel reach stretching from the Rahasane Turlough to the Railway Bridge and upstream to the R446 road bridge in Craughwell Village.

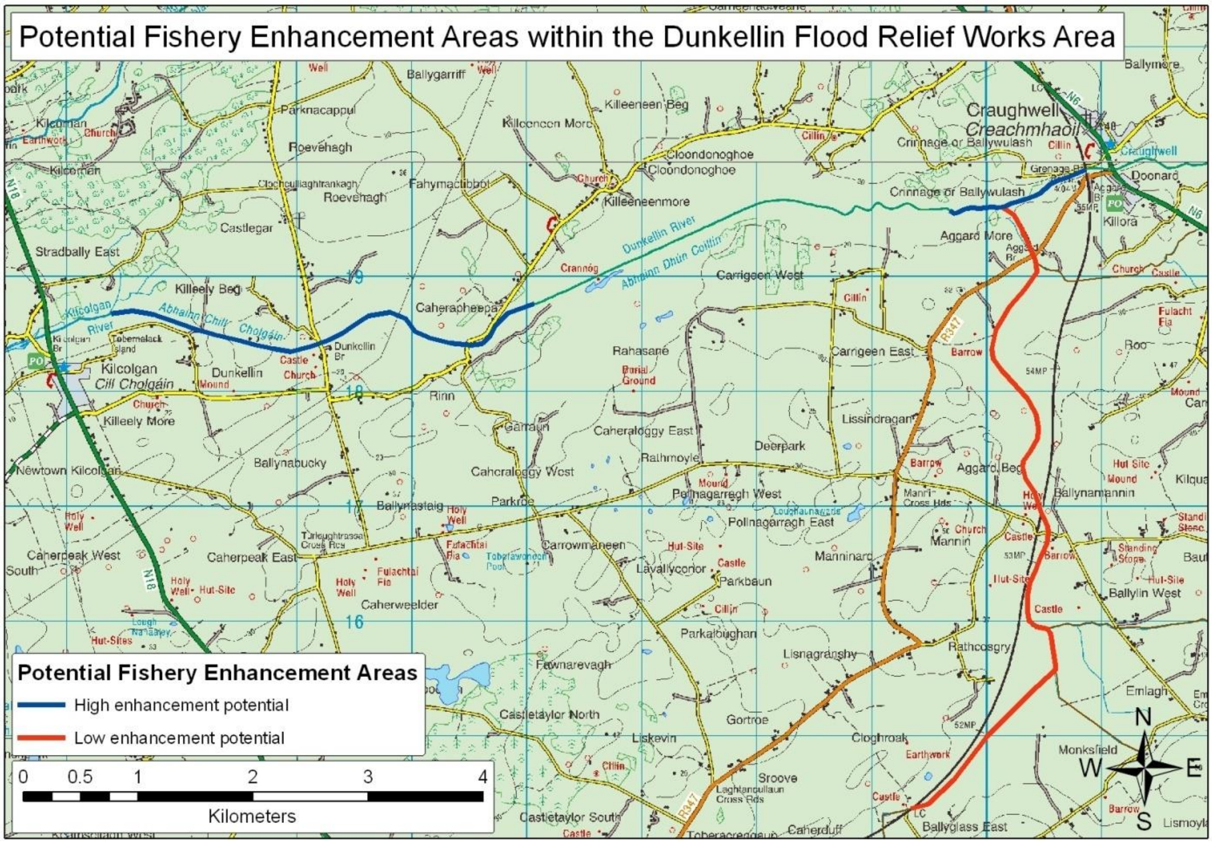


Figure 3-14 – Proposed Locations of River Enhancement Works

The aims of the programme, as defined by the IFI and OPW are to :

1. *“assist in achieving Good Ecological Status of drained rivers, and*
2. *improve biodiversity on drained salmonid rivers in Ireland while also maintaining their drainage function.”*

In the case of the Dunkellin River it is proposed to utilise a number of enhancement details, including the :

1. provision of Centre Channel Pools.
2. provision of Lateral Scour Pools.
3. selected placement of gravel beds.
4. provision of Spawning Gravel at particular locations.
5. provision of rubble mats.
6. provision of paired stone deflectors.
7. Supply of alternating stone deflectors.
8. Vortex Stone Weirs.

With particular regard to the proposed channel deepening at Craughwell Village it is proposed that particular regard will be given to the gradient of the bed and the resultant impact on channel velocities. Following consultation with Inland Fisheries Ireland, the following site specific river enhancement methods will be undertaken between the confluence of the Aggard Stream/Craughwell River and Craughwell Village.

1. It is proposed to retain and store, on-site in designated areas, suitable excavated material such as the natural gravels, boulders, cobbles and sands for the purposes of habitat reinstatement. An area of land for the stockpiled

material and subsequent spreading of surplus material is detailed on Drawing No. 6408-2208.

2. A depth range or additional dredge depth of 500mm below the proposed design hydraulic bed level (water conveyance level) has been designated for the purposes of creating shallower bed levels and riffle/glide/pool sequences along the new channel. This depth range is detailed on Drawing No. 6408-2208.

Further details of the typical enhancements are contained in Appendix 3 of this section of the EIS.

4 HYDRAULIC IMPACT OF THE PROPOSED SCHEME

Following the development of the Preferred Scheme, as outlined in Table 3.1, an examination of the capacity of the proposed channel was undertaken to establish its performance to accommodate a range of flows.

For the purpose of this examination a series of extreme flows up to and including the November 2009 flow, were applied to the *"Preferred Scheme"* hydraulic model. The magnitudes of these flows are shown in Table 4-1.

These flows were provided by the OPW for the hydrometric stations at the R446 Bridge in Craughwell and the Aggard Bridge.

Table 4-1 – Magnitudes of Flow Scenarios Applied to the Hydraulic Model to Evaluate the Performance of the Preferred Scheme

	Hydrometric Station	
Flow Scenario	**Craughwell Station No. 29007 (m^3/s)**	**Aggard Bridge Station No. 29010 (m^3/s)**
Mean Annual Flow	4.205	0.857
10 percentile	12.2	1.9
5 percentile	16.2	2.48
Peak November 2009 Flow	84.8	21.46

4.1 EFFECT OF THE PROPOSED TWO-STAGE CHANNEL WORKS (CHANNEL WIDENING) ON WATER LEVELS IN THE CHANNEL DOWNSTREAM OF THE RAHASANE TURLOUGH CSAC.

Figures 4.1 to 4.3, inclusive, show a series of cross sectional views at a number of locations along the proposed channel downstream of the Rahasane Turlough cSAC. The predicted water surface profile, post works, for the various flow scenarios, as detailed in Table 4-1, are also shown.

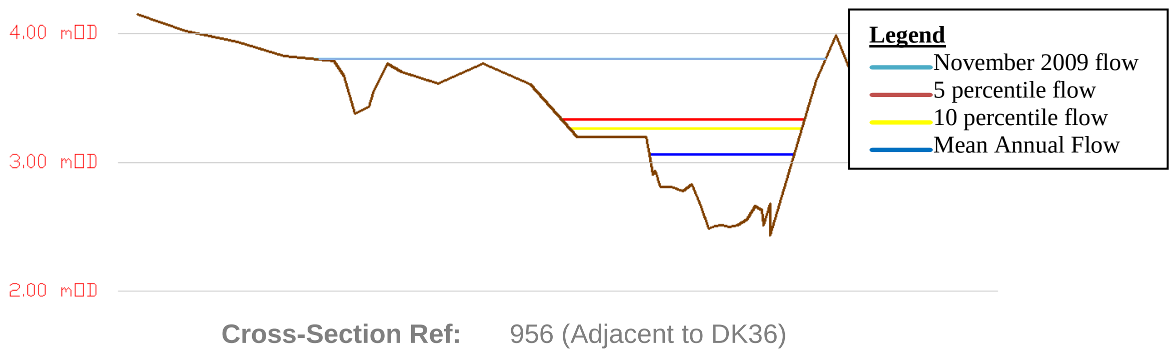
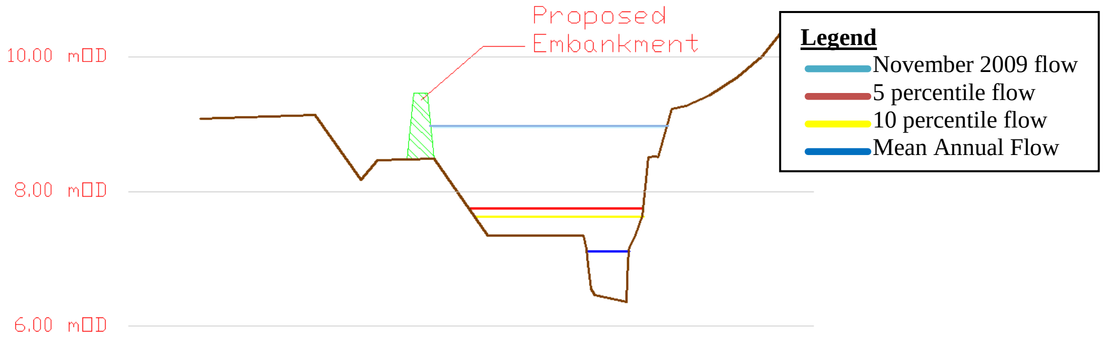
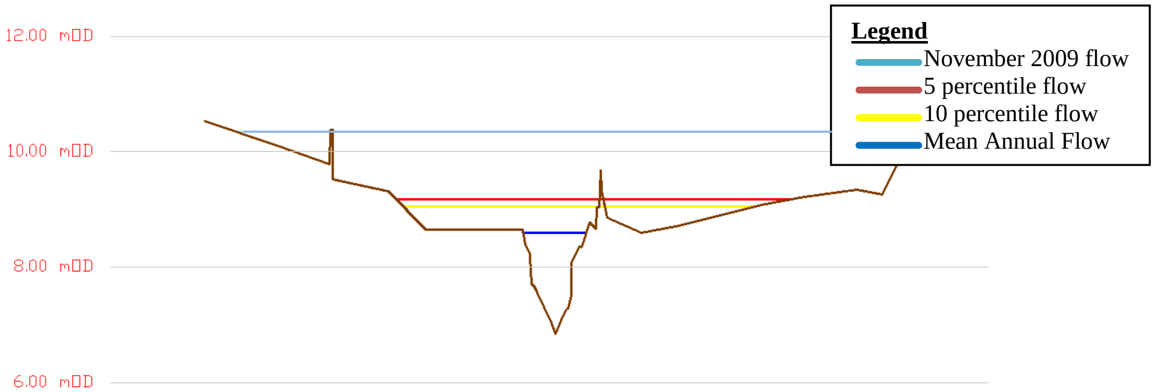


Figure 4-1 – Proposed channel downstream of Killeely Beg Bridge



Cross-Section Ref: 2286 (Adjacent to DK31)

Figure 4-2 – Proposed channel downstream of Dunkellin Bridge



Cross-Section Ref: 2796 (Adjacent to DK27)

Figure 4-3 – Proposed channel downstream of Rinn Bridge

These sample cross sections demonstrate that the post works water surface profile associated with Mean Annual Flow is in most cases contained within the main channel downstream of the Rinn Bridge. Attempting to fully contain the higher 5 and 10 percentile flows within banks would lead to impractical widening and riparian disruption.

4.2 CHANGES TO SURFACE WATER PROFILE WITHIN THE RAHASANE TURLOUGH CSAC FOR A DEFINED RANGE OF FLOWS

The proposed alterations to the Dunkellin River and its bridges have the potential to alter the flow regime of the Rahasane Turlough cSAC. The impact, of the proposed works, across the range of flows detailed in Table 4-1 and the predicted surface water profile for each flow scenario were also examined as part of this stage of the project, albeit with reduced confidence due to the high flow that was used to calibrate the model.

Figure 4-4 shows the predicted surface water profile along the length of the Rahasane Turlough cSAC when the November 2009 flood event (which has been estimated to be a 1 in

122 year return event). Figure 4-5 shows the Rahasane Turlough when a 2 year return flood event is applied to the model of the preferred scheme.

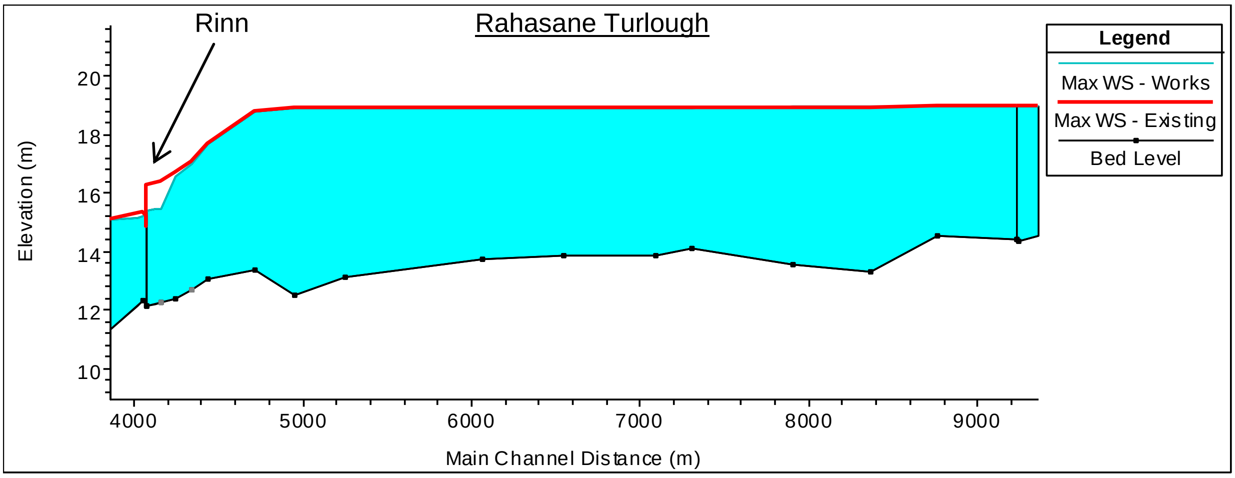


Figure 4-4 – Water Levels in Rahasane Turlough based on November 2009 Flood Flows

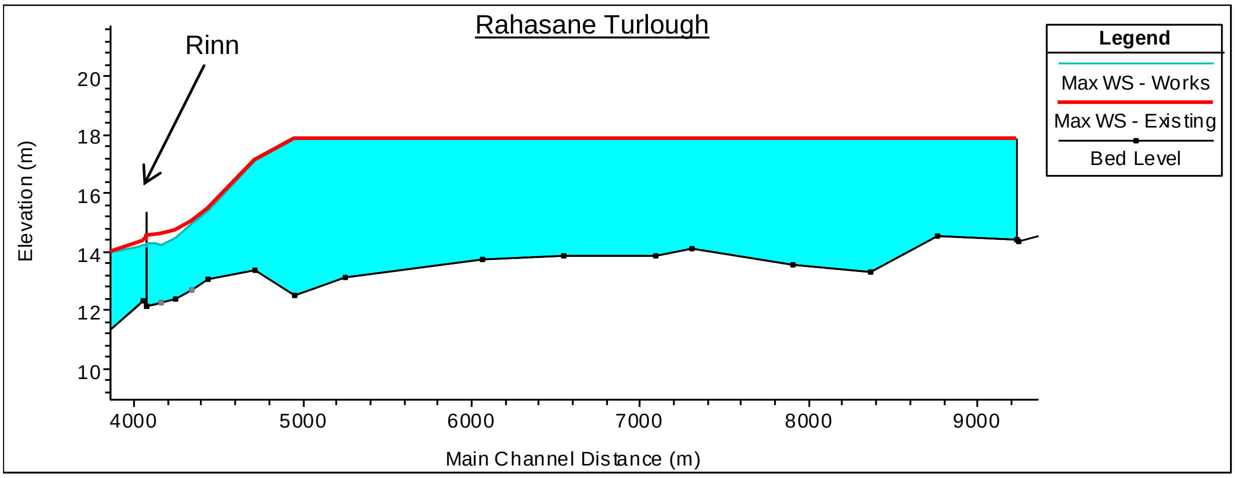


Figure 4-5 – Water Levels in Rahasane Turlough based on a 2-Year Return Period Event

From the diagrams it is clear that there are no changes expected in the water surface profile through the Rahasane Turlough for any magnitude of flood.

Figure 4-6 shows the predicted surface water profile at a cross sectional location within the Rahasane Turlough cSAC when the November 2009 Flood event, the 5%ile and the 10%ile flow events are applied to the model. It is again clear from these figures that there an almost undetectable change in the water levels in the turlough for these events.

In summary, it is predicted that, both average wet weather flows and very high flood flows will give rise to similar water levels on the turlough.

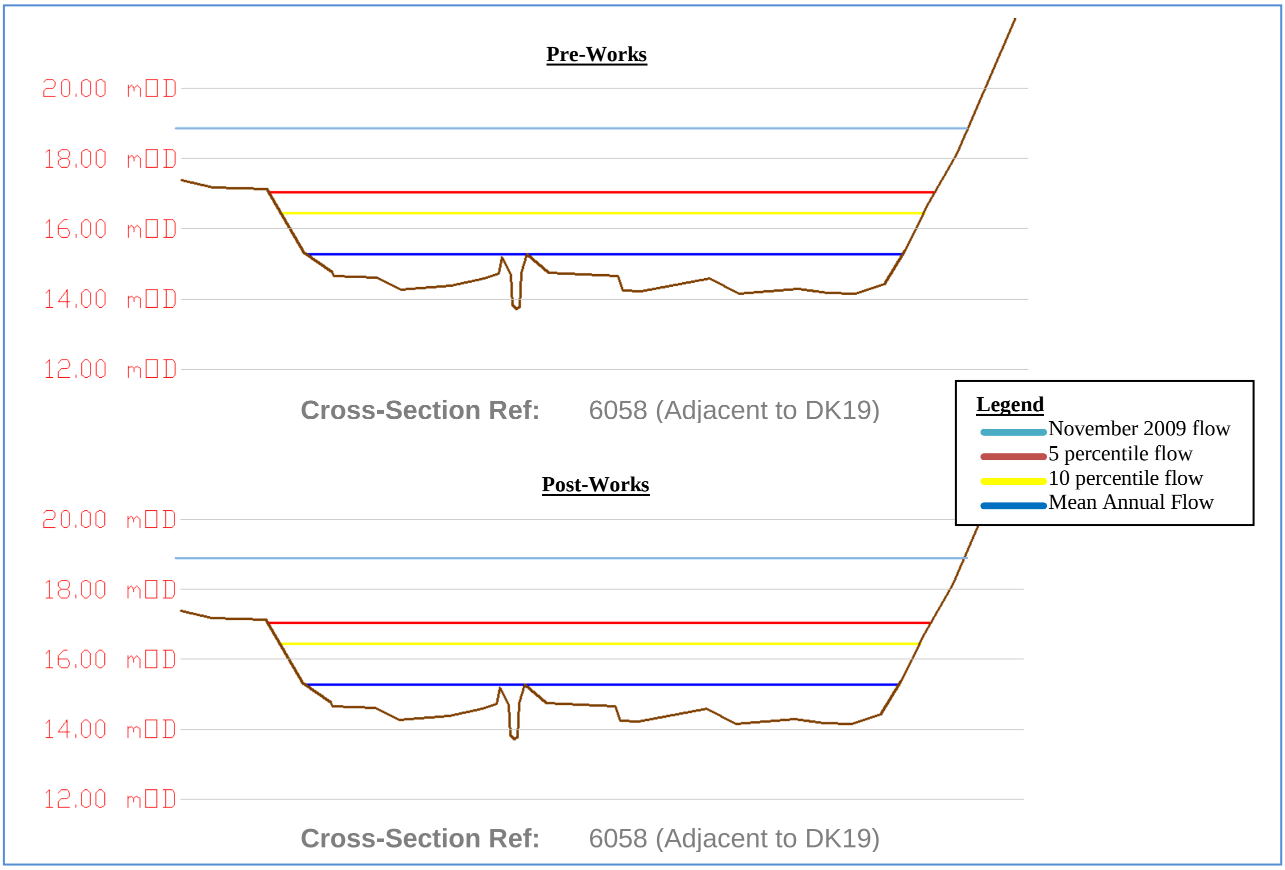


Figure 4-6 – Cross Section through Rahasane Turlough with estimated pre and post works water levels based on various flows

Figure 4-7 shows the estimated outline (in red) of the November 2009 flood event before the proposed works are implemented and also shows the predicted flood outline (in blue) when the same peak discharge 106.2m^3/sec (84.8 + 21.4 m^3/sec) is applied to the preferred scheme (i.e. after flood alleviation works are implemented).

There are no predicted changes in peak water levels, resulting from flood events similar to the November 2009 occurrence.

There is no estimated reduction in plan area for the November 2009 event.

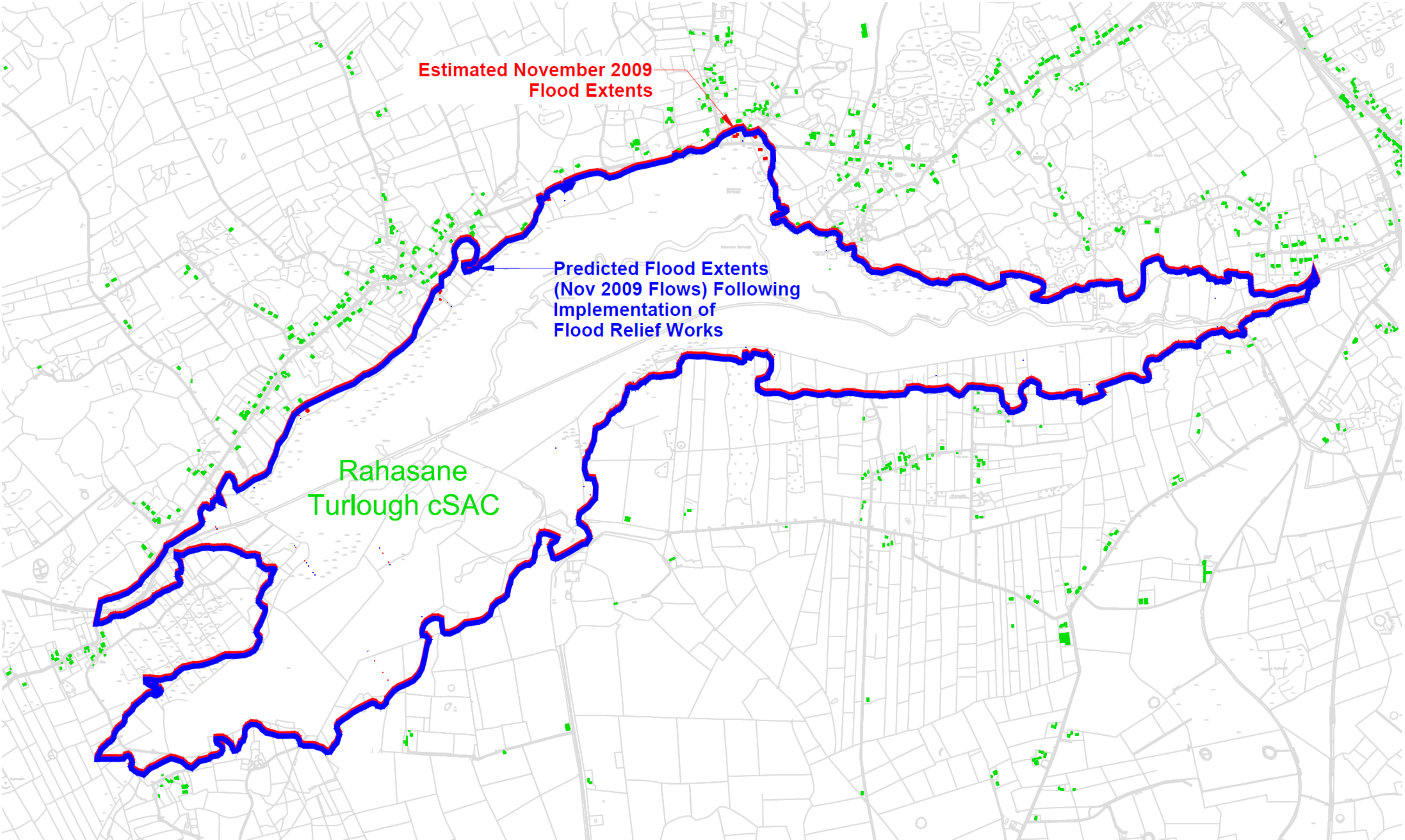


Figure 4-7 – Estimated extent of the flood plain within the Rahasane Turlough as generated by November 2009 Flows (pre and post flood alleviation works)

Figure 4-8 shows the effect of the proposed scheme on the Rahasane Turlough over 4 years of modelled flow between 2008 and 2011. This is further illustrated in Appendix No. 2. Based on this it is predicted that the Turlough will continue to behave as it does naturally at present.

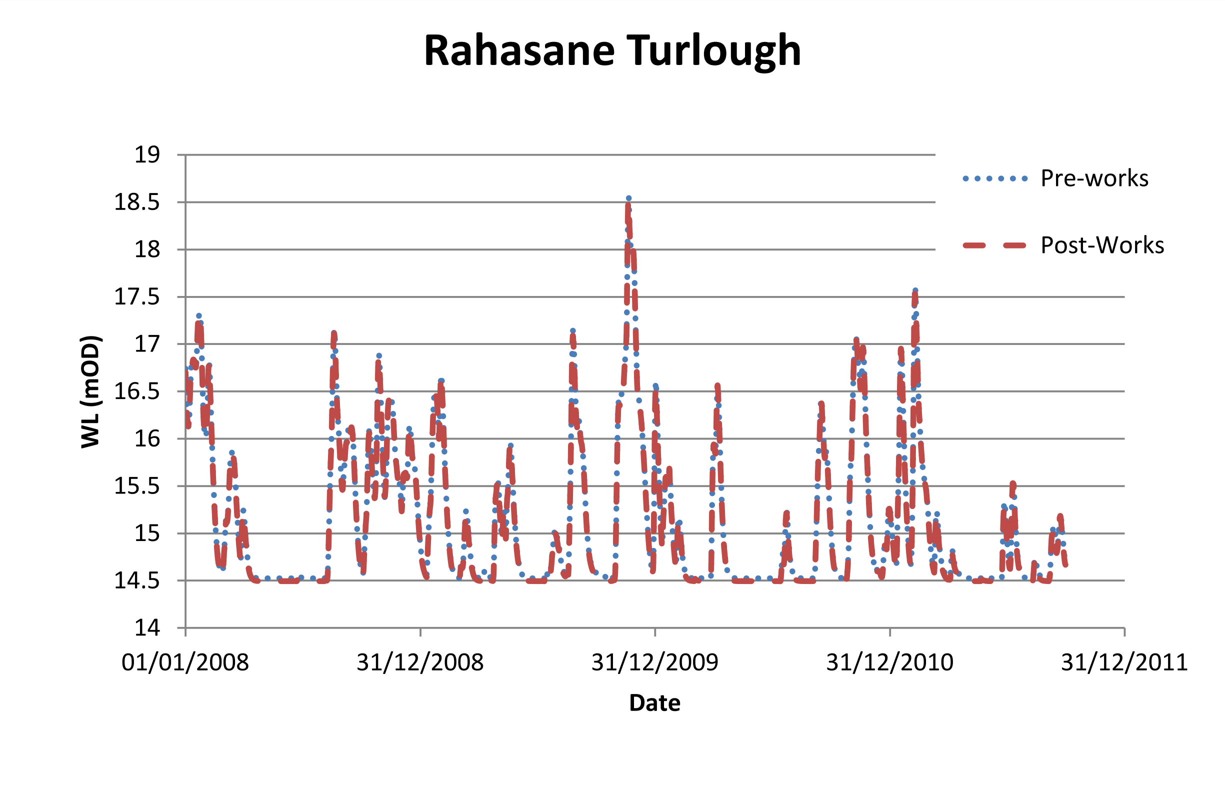


Figure 4-8 – Pre & Post Works Model Output (Depth of Flow at Rahasane)

4.3 IMPACT ON FLOW VELOCITIES

The scouring action of flood waters has the potential to impact on the water quality of the Dunkellin River and Rahasane Turlough cSAC and Galway Bay cSAC. Channel velocities play a significant part in the volume of sediment carried in suspension. During this current planning stage, the changes in flow velocities for the existing channel and proposed channel as modelled for the November 2009 flows were examined. It was found that flow velocities associated with the "Preferred Scheme", were predicted to be slightly higher than those estimated for the November 2009 event.

Open channel velocities during the November 2009 design flood (122 year flood) are in most cases predicted to have increased slightly in the new channel when compared with the existing channel. Table 4-2 summarises the estimated flow velocities at a number of locations along the Dunkellin River, when the November 2009 event is applied to the existing channel and the proposed channel.

Table 4-2 – Peak Velocities along the Dunkellin River for the November 2009 Event as predicted for the Existing Channel and Preferred Scheme

Location	Estimated Channel Velocities (m/s)					
	2009 Event		5 Year		2 Year	
	Pre-Works	Post-Works	Pre-Works	Post-Works	Pre-Works	Post-Works
Between R446 Bridge and Masonry Arch Pedestrian Bridge	1.07	1.08	0.86	1.07	0.95	1.13
Between Masonry Arch Pedestrian Bridge and Railway Bridge	1.05	1.3	0.98	1.78	1.03	1.75
d/s of Railway Bridge	1.67	1.87	1.08	1.13	1.21	1.26
Upper Rahasane Turlough	0.08	0.08	0.03	0.03	0.04	0.04
At Rinn Bridge	2.02	2.06	1.86	1.96	1.98	2.17
d/s of Rinn Bridge	1.72	1.16	1.57	0.83	1.55	0.9
d/s of Dunkellin Bridge	1.54	1.74	1.65	1.17	1.73	1.29
d/s of Killeely Beg Bridge	2.13	2.46	2.08	1.5	2.02	1.72

Examination of the channel velocities in the mathematical model (HEC-RAS) for the existing channel and Preferred Scheme scenario shows that expected changes in flow velocities is minimal.

4.4 IMPACT ON FLOW VOLUMES

The proposed alterations to the Dunkellin River and its bridges have the potential to alter the flow regime of the river system. The impact, of the proposed works, on the November 2009 flood event and the predicted hydrographs were also examined at this stage of the proposed scheme.

For the purpose of this study we have reviewed the peak discharge, hydrograph duration and cumulative volume of water discharged to Galway Bay during the November 2009 event. This examination was limited to a period of 206 hours starting approximately 95 hours before the peak of the November 2009 event.

The time to peak (T_p) is estimated to be reduced from 95 hours to 93 hours.

It is expected that implementation of the Preferred Scheme will result in a marginal increase (less than 1%) in the rate at which water is discharged to Galway Bay during a similar November 2009 flood event and on balance the volume of flood water passing Killeely Beg Bridge will not change significantly.

5 PROGRAMME AND PHASING OF THE WORKS

There are a number of constraints on the phasing and methods of construction works. The most significant constraint is that in general in-river work is only permitted between May and September each year.

This is a requirement resulting from the recommendations of a number of statutory bodies which were consulted during the early scoping stage of the planning stage. These include the Inland Fisheries Ireland, the NPWS and the timing restrictions are required to ensure that fish migration is not impeded during spawning seasons and that works do not impact on the crayfish populations who seek refuge within river banks during the winter months.

This programme is summarised in Figure 5-1 and it must be noted that this is an outline programme of works and may be subject to alterations subject to the timing of planning approvals, the final detailed design stage programme and following the appointment of a Works Contractor.

	No. of Employees	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16
Advanced Works																						
Vegetation Clearance		Vegetation Clearance			No Vegetation Clearance Permitted March to Sept					Vegetation Clearance Permitted Sept to February						No Vegetation Clearance Permitted March to Sept						
Out Of River Works downstream of the Rahasane Turlough																						
River Works Crew No. 1 – Out of River Works or Channel Widening of the Dunkellin River from Kilcolgan Bridge to Killeely Beg Bridge.	6																					
Channel Widening of the Dunkellin River from Killeely Beg Bridge to Dunkellin Bridge.	6																					
River Works Crew No. 1 – Out of River Works or Channel Widening of the Dunkellin River from Dunkellin Bridge to Rinn Bridge.	6																					
River Works Crew No.2 - Out of River Works or Channel Widening of the Dunkellin River from Rinn	6																					
Bridge Works Crew A – Bridge Works at Killeely Beg Bridge.	8																					
Bridge Works Crew B – Out of River Bridge (Left Bank Works) /Culvert Works at Dunkellin Bridge.	8																					
Bridge Works Crew C – Out of River Bridge (Left Bank Works) /Culvert Works at Rinn Bridge.	8																					
In River Works upstream of the Rahasane Turlough																						
Bridge Works Crew D– In River Works or Channel Deepening downstream of the Railway Bridge (Rock Removal).	4																					
Bridge Works Crew E– In River Works or Channel Deepening in Craughwell.	4																					
Bridge Works Crew F – In River Works or Underpinning at the Railway Bridge in Craughwell.	4																					
Out Of River Works on the Bypass Channel followed by works on main R446 bridge & Multi-Arched Bridge																						
Works Crew No. 1 – Out of River Works or Channel deepening and underpinning along the bypass channel and retaining walls	4																					
Works Crew No. 2 – Out of River Works or Underpinning of the Old Stone Multi-arched bridge (Extended Programme to cater for variability in river flows)	4											Restrictions Apply to Works within this Time Period										
Works Crew No. 3 – Out of River Works or Underpinning of the main R446 bridge in Craughwell (Extended Programme to cater for variability in river flows).	4																					
Landscaping																						
Completion/Snagging and Handover																						

Estimated Max Number of Employees on Site	**44**

Figure 5-1 – Outline Construction Programme

6 EXCAVATIONS AND EXCAVATED MATERIALS

All river regrading and widening will be undertaken using tracked vehicles travelling along the temporary works area along the bank of the Dunkellin River.

It is anticipated that approximately 70,000m³ of overburden, rock and riverbed will be removed from the river and its surroundings as a result of channel deepening and widening.

This is broken down in Table 6-1.

It is envisaged that different techniques will be adopted with regard to the reuse or disposal of excavated material. However, the overall intention will be to reuse the excavated material as side slope protection, creation of flood embankments, creation of bankside spoil embankments and the creation of extended spoil heaps where initial treatment will require removal of topsoil, spreading of excavated material and reinstatement of the topsoil, undertaken with a view to minimising the transport of material off-site.

It is proposed that the use of bank side spoil heaps will be of the order of the dimensions detailed in Figure 6-1 where the estimated cross sectional area of the spoil heap (outside areas where flood embankments are used) is not expected to exceed $6m^2$.

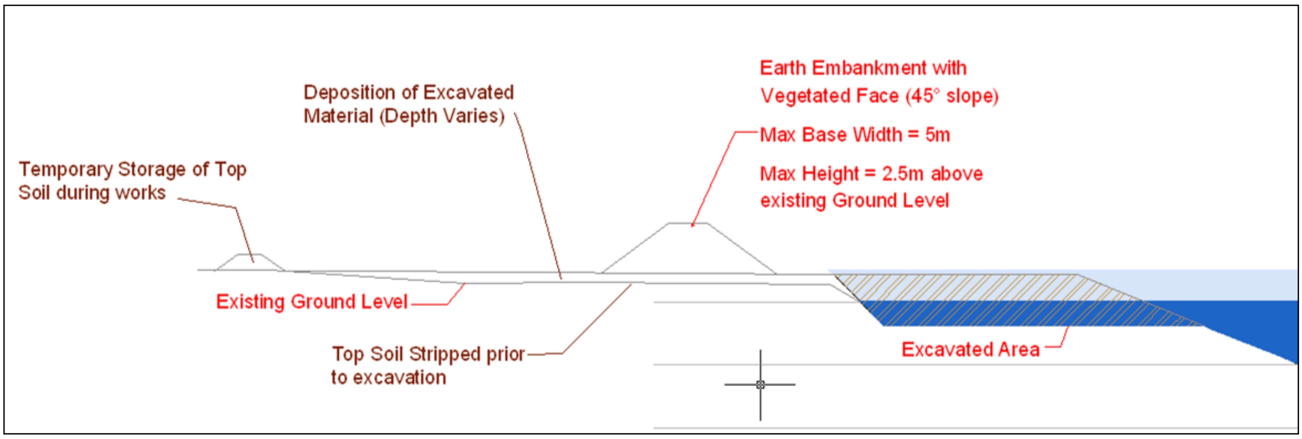


Figure 6-1 – Typical Detail of the Proposed Bank Side Spoil Heaps

Table 6-1 – Estimated Volumes of Excavated Materials

Area	Location	u/s Reference		d/s Reference	Distance (m)	Average X-Sectional Area to be excavated (m^2)	Typical Two-Stage Channel Width (m)	Typical Depth (m)	Volume (m^3)	Sub-Total (m^3)	Area Available for Spreading Spoil (m^2)	Approx. Depth of Land Spread (m)
Upstream of Rahasane Turlough	Craughwell Main Channel	10306		10285 (R446 Bridge)	36.00	12.69	-	1.50	457	5,233	45,002	0.12
		10285 (R446 Bridge)		10253 (Old Masonry Arch bridge)	31.97	13.94	-	1.00	446			
		10253 (Old Masonry Arch bridge)		10120	134.66	6.66	-	1.25	897			
		10120		10040 (Railway Bridge)	126.50	7.05	-	0.75	892			
		10040 (Railway Bridge)		9231	612.80	4.15	-	0.75	2,542			
	Bypass Channel	PYP 345		PYP 145 (R446 Bridge)	190.00	42.13	-	2.25	8,006	11,698		
		PYP 145 (R446 Bridge)		PYP 0	161.66	22.84	-	2.25	3,693			
										16,932		
Downstream of Rahasane Turlough	Rinn Bridge	4144		4119	25.00	19.99	10.00	2.00	500	5,318	21,906	0.24
		4119		4068 (Rinn Bridge)	50.00	39.98	20.00	2.00	1,999			
		4068 (Rinn Bridge)		4013	58.00	39.98	20.00	2.00	2,319			
		4013		3988	25.00	19.99	10.00	2.00	500			
	Upstream of Dunkellin Bridge	3045		2716	328.93	13.74	20.00	0.75	4,518	7,040	59,967	0.12
		2716		2666	50.00	23.65	25.00	1.00	1,182			
		2666		2626 (Dunkellin Bridge)	39.91	33.56	30.00	1.25	1,339			
	Dunkellin Bridge to Killeely Beg Bridge	2626 (Dunkellin Bridge)		2569	58.00	33.56	30.00	1.25	1,946	31,888	81,743	0.39
		2569		2519	50.00	32.52	25.00	1.50	1,626			
		2519		1709	810.00	31.49	20.00	1.75	25,507			
		1709		1659	50.00	29.22	17.00	1.75	1,461			
		1609		1559 (Killeely Beg Bridge)	50.00	26.96	14.00	2.00	1,348			
	Downstream of Killeely Beg Bridge	1559 (Killeely Beg Bridge)		1509	56.00	26.96	14.00	2.00	1,510	8,612	198,648	0.04
		1509		1459	50.00	17.17	17.00	1.25	858			
		1459		1059	400.00	7.37	20.00	0.50	2,949			
		1059		165	894.00	3.69	10.00	0.50	3,295			
										52,858		

Total Volume for Excavation = 69,790 m^3

The techniques are summarised items a) to f) over the following paragraphs.

a. Within the village of Craughwell, upstream of the railway bridge, it is expected that channel deepening along the Dunkellin and the bypass channel, will require the excavation of approximately 5,200m^3 of sandy/silty gravel with cobbles and boulders. It is expected that c. 3,500m^3 of this material can be reused in creating a flood defence embankment along the right bank of the Dunkellin River upstream of Craughwell as indicated in Figure 6-2. The remaining material will require disposal, at a licensed facility, in accordance with the Waste Management Act 1996.

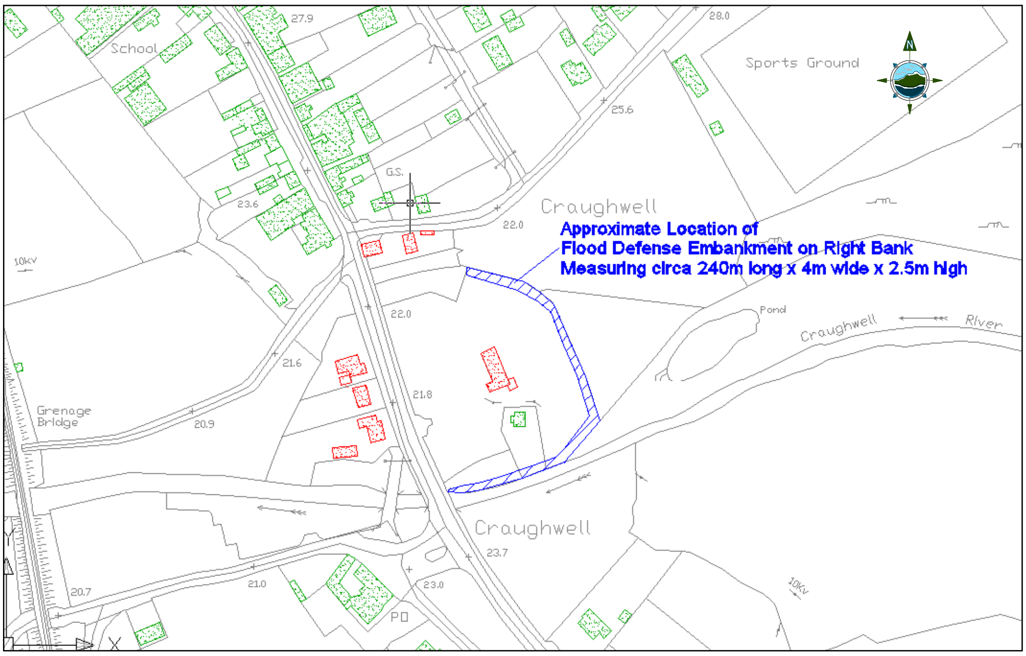


Figure 6-2 – Approximate Location of Flood Defence Embankment upstream of Craughwell

b. Downstream of Craughwell and the railway bridge, it is expected that channel deepening along the Dunkellin, will require the excavation of approximately 11,600m^3 of gravel with cobbles and boulders and a significant amount of rock. It is expected that c. 5,000m^3 of rock will be excavated and that this can be reused in creating side slope protection along the proposed channel deepening. It is expected that the remaining material which will consist of sandy gravels can be reused along the left & right banks. This technique will involve removal of tree growth on the banks, topsoil stripping (and storage) on the banks in advance of channel works, spreading of the excavated material across the works area and final reinstatement of the banks with the stored topsoil and final landscaping (tree planting) with native species. Alternatively, an embankment, constructed from excavated material may be created along the banks to minimise the need for transport of the excavated material away from the works area.

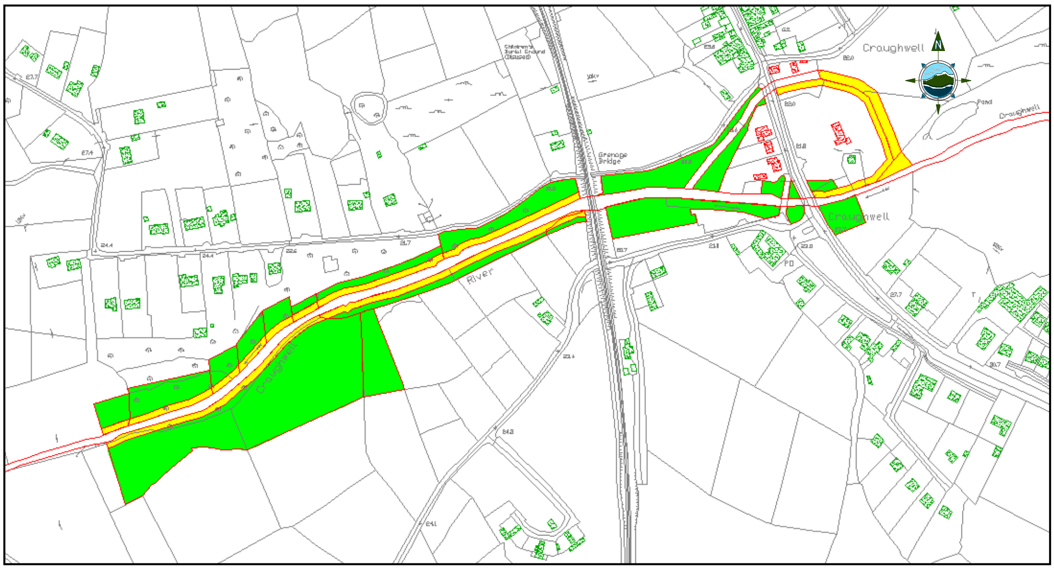


Figure 6-3 – Approximate Location of Lands required for temporary storage (River Enhancement Works) and deposition of excavated material (green) downstream of Craughwell Village (yellow indicates spoil heaps/embankments)

Photograph No. 26 – Approximate Location of Lands required for reuse of excavated material downstream of Craughwell Village

c. Downstream of the Rahasane Turlough cSAC but upstream of Rinn Bridge, it is expected that channel widening along the Dunkellin, will require the excavation of approximately 5,000m^3 of gravels and an amount of rock. It is expected that at least 3,500m^3 of rock will be excavated and that over 50% of this material can be reused in creating side slope protection along the lower reaches of the Dunkellin River, downstream of the Dunkellin Bridge. This will require significant traffic movement in the area to cater for this reuse of material. It is expected that the remaining material (circa 1,500m^3) which will consist of overburden or sandy gravels can be reused along the left bank. This technique will again involve topsoil stripping (and storage) on the left bank in advance of channel works, spreading of the excavated material across the stripped works area and reinstatement of the left bank with the stored topsoil. Alternatively, an embankment, constructed from excavated material may be created along the left bank to minimise the need for transport of the excavated material away from the works area.

Figure 6-4 – Approximate Location of Lands required for deposition of excavated material (green) upstream of Rinn Bridge (Yellow Areas indicate extent of channel excavations)

Photograph No. 27 – Location of Channel Works upstream of Rinn Bridge

d. Downstream of the Rinn Bridge but upstream of the Dunkellin Bridge, it is expected that channel widening along the Dunkellin, will require the excavation of approximately 7,000m^3 of gravels and rock. It is expected that circa. 5,500m^3 of rock will be excavated and that over 50% of this material can be reused in creating side slope protection along the lower reaches of the Dunkellin River, downstream of the Dunkellin Bridge. This will require significant traffic movement in the area to cater for this reuse of material. It is expected that the remaining material (circa 1,500m^3) which will consist of overburden or sandy gravels can be reused along the left bank to create an embankment along the outer extremes of the proposed channel widening. This technique will again involve topsoil stripping (and storage) on the left bank in advance of channel works, spreading and shaping of the excavated material across the stripped works area and reinstatement of the embankment left bank with the stored topsoil.

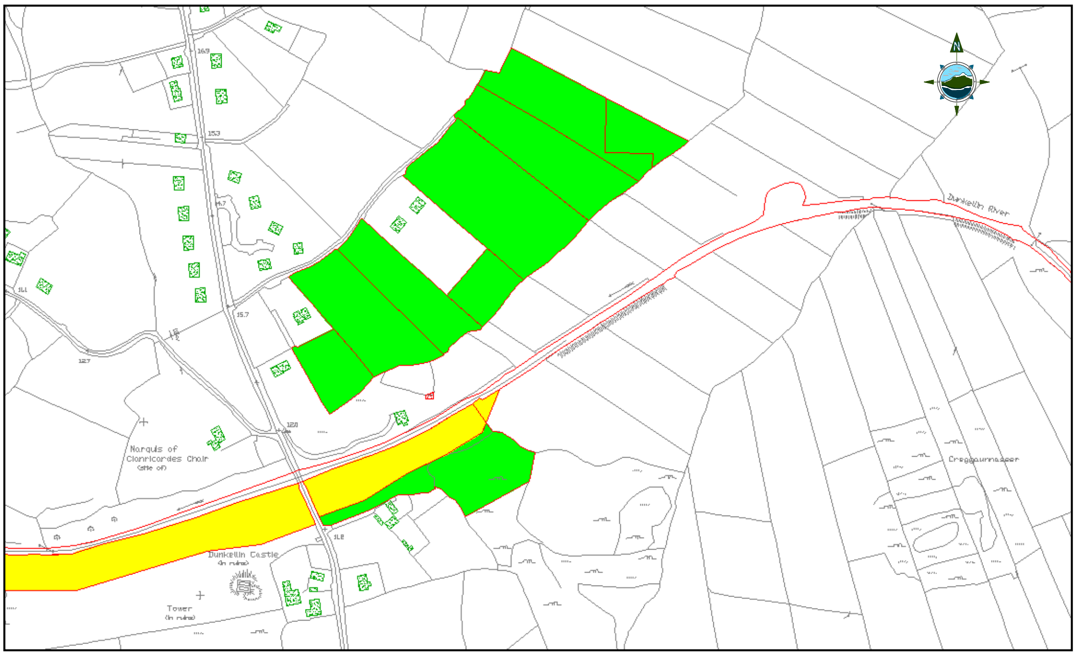
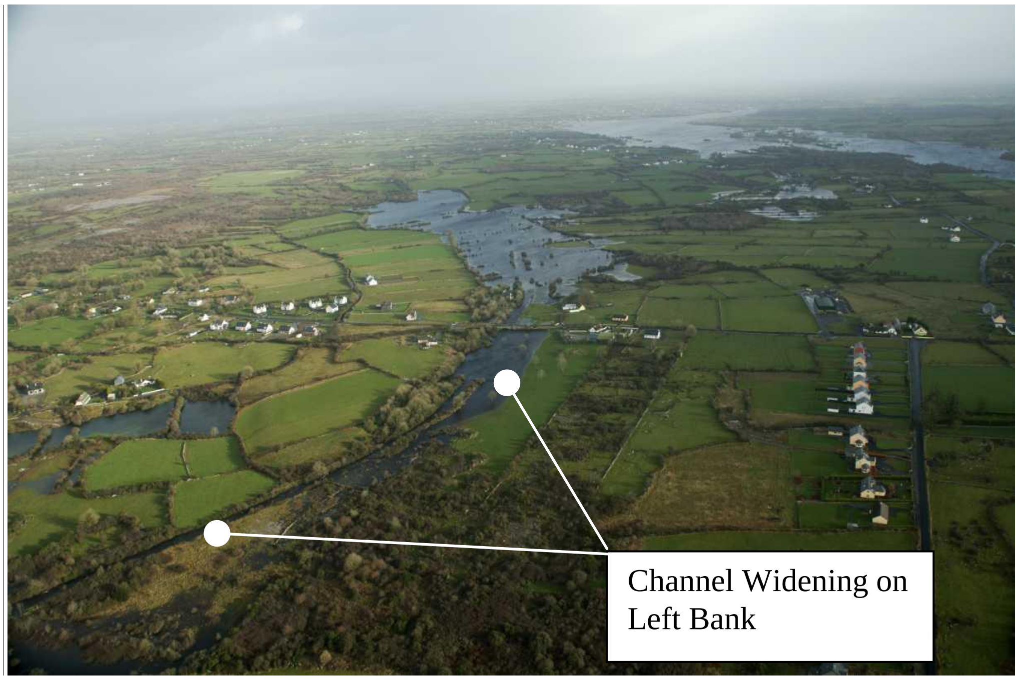


Figure 6-5 – Approximate Location of Lands required for deposition of excavated material (green) upstream of the Dunkellin Bridge (yellow areas indicate extent of channel works)

e. Downstream of the Dunkellin Bridge but upstream of the Killeely Beg Bridge, it is expected that channel widening along the Dunkellin River, will require the excavation of approximately 32,000m^3 of gravels and a significant amount of rock. It is expected that at least 20,000m^3 of gravels and rock will be excavated and that majority of this material can be reused in creating a left bank spoil embankment. This technique will again involve topsoil stripping (and storage) on the left bank in advance of channel works, spreading and or mounding of the excavated material across the stripped works area and reinstatement of the left bank with the stored topsoil. This technique will minimise the need for transport of the excavated material away from the works area.

Figure 6-6 – Approximate Location of Lands required for reuse of excavated material (green) upstream of Killeely Beg Bridge (yellow areas indicate extent of channel widening)



Photograph No. 28 – Location of Channel Works upstream of Killeely Beg Bridge

f. Downstream of the Killeely Beg Bridge but upstream of the N18, it is expected that channel widening along the Dunkellin River, will require the excavation of approximately 8,600m^3 of overburden, gravels and a portion of rock. It is expected that at least 6,000m^3 of gravels and rock will be excavated and that majority of this material can be reused in creating a left bank spoil embankment. This technique will again involve topsoil stripping (and storage) on the left bank in advance of channel works, spreading and or mounding of the excavated material across the stripped works area and reinstatement of the left bank with the stored topsoil. This technique will minimise the need for transport of the excavated material away from the works area.

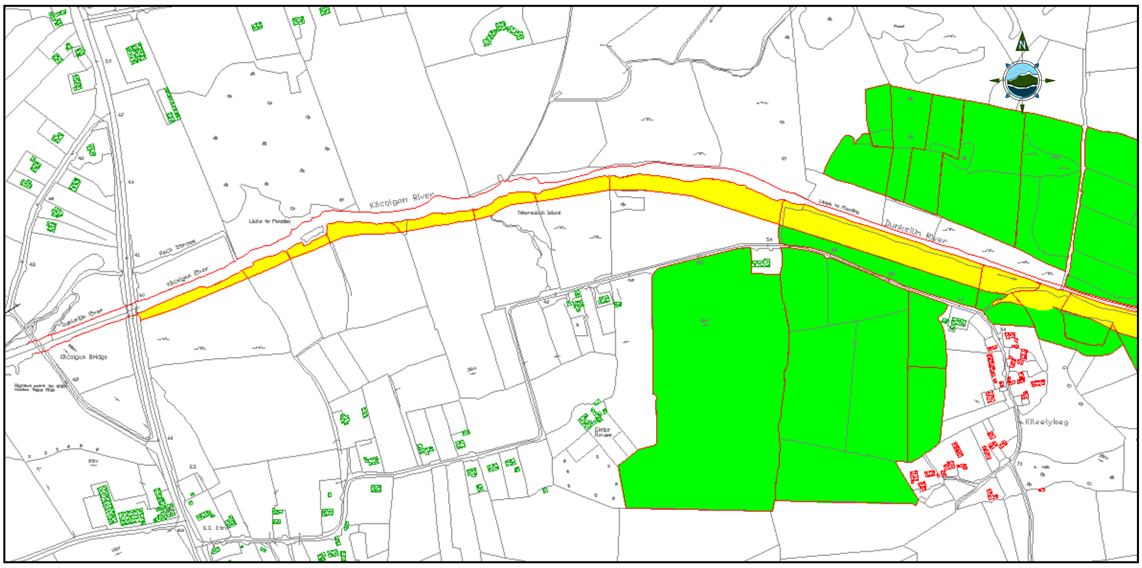
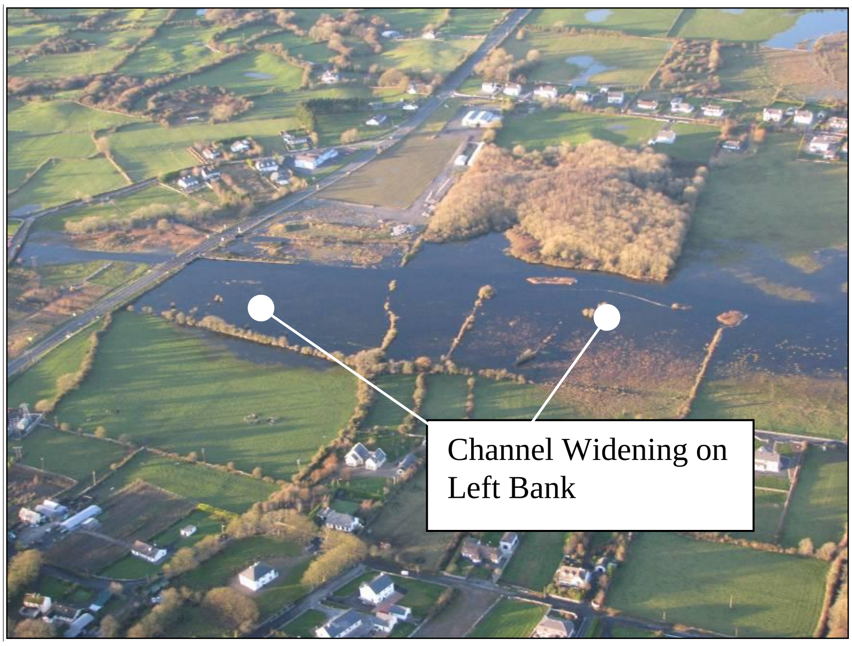


Figure 6-7 – Approximate Location of Lands required for deposition of excavated material (green) downstream of Killeely Beg Bridge (yellow areas indicate extent of channel works



Photograph No. 29 – Location of Channel Works downstream of Killeely Beg Bridge

7 ANCILLARY WORKS ITEMS & SITE ACCESS

7.1 WORKS ACCESS

It is envisaged that the construction of the proposed flood relief works will require the following ancillary works:-

i) Site compound at Killeely Beg Bridge.
ii) Site compound at Dunkellin Bridge.
iii) Site compound at Rinn Bridge.
iv) Provision of an access point into the Dunkellin River at Killeely Beg Bridge.
v) Provision of access point into the Dunkellin River at the Dunkellin Bridge.
vi) Provision of an access point into the Dunkellin River at Rinn Bridge
vii) Temporary access road to Killeely Beg Bridge to facilitate the movement of large precast bridge beams.
viii) Site compound at Craughwell Village.

As noted above it is envisaged that there will be four main site compounds which include short term staff welfare facilities and plant & materials storage for the proposed works.

An access point to the proposed river works will required at the three main locations detailed above. It is envisaged that these will consist of a temporary surface which will be provided along the river bank to allow vehicles to enter and travel to the proposed excavation sites.

It is envisaged that this track will be formed from stone excavated from the proposed works and will be constructed ahead of the excavation plant as work progresses.

7.2 DEALING WITH WATER WITHIN EXCAVATED WORKS

A number of the proposed works will require the use of dewatering pumps in order to maintain dry conditions within the excavations. It is envisaged that the construction of the proposed flood relief works will require the use of up to two (2) *"6 Inch"* dewatering pumps.

Such dewatering pumps have a capacity of up to 90l/sec and with two pumps in operation the maximum expected rate of trench/excavation dewatering could be of the order 180l/sec.

The use of such dewatering pumps will require the use of temporary constructed silt ponds for the disposal of excavated water.

8 EMERGENCY PROCEDURE DURING FLOOD EVENTS DURING CONSTRUCTION

With flooding events having occurred in January 2005 and November 2009 the likelihood of a flood event occurring during construction could be considered to be relatively high.

Although the proposed channel works are designed to provide flood relief, their construction may cause a temporary flow restriction along the channel particularly where bridge underpinning works are proposed. The contractor must therefore ensure that the risk of flooding is not increased as a result of the proposed works. Whilst rainfall in the catchment can result in significant flows, in the Dunkellin River, advance warning of such flood events is possible and the contractor will be required to monitor both long and short term weather forecasts so that machinery and personnel can be prevented from entering the channel during periods of peak flow. Monitoring of the flow in the upstream catchment may be used as an aid to predict high flow events.

Works in Craughwell and reduction of flooding risk can be facilitated by phasing of the proposed works as detailed in the Programme.

No machinery shall be left in the river overnight or outside of normal working hours.

9 OPERATION OF THE PROPOSED FLOOD RELIEF SCHEME

When fully implemented, the proposed flood relief scheme will provide a defence against the 1 in 100 year flood event with allowance made for climate change. This will accommodate November 2009 flood flows.

However, the Dunkellin River channel will require regular maintenance to prevent vegetation becoming overgrown thus increasing the risk of future flooding. This will be managed by Galway County Council as part of their overall maintenance responsibilities for the Dunkellin Drainage District

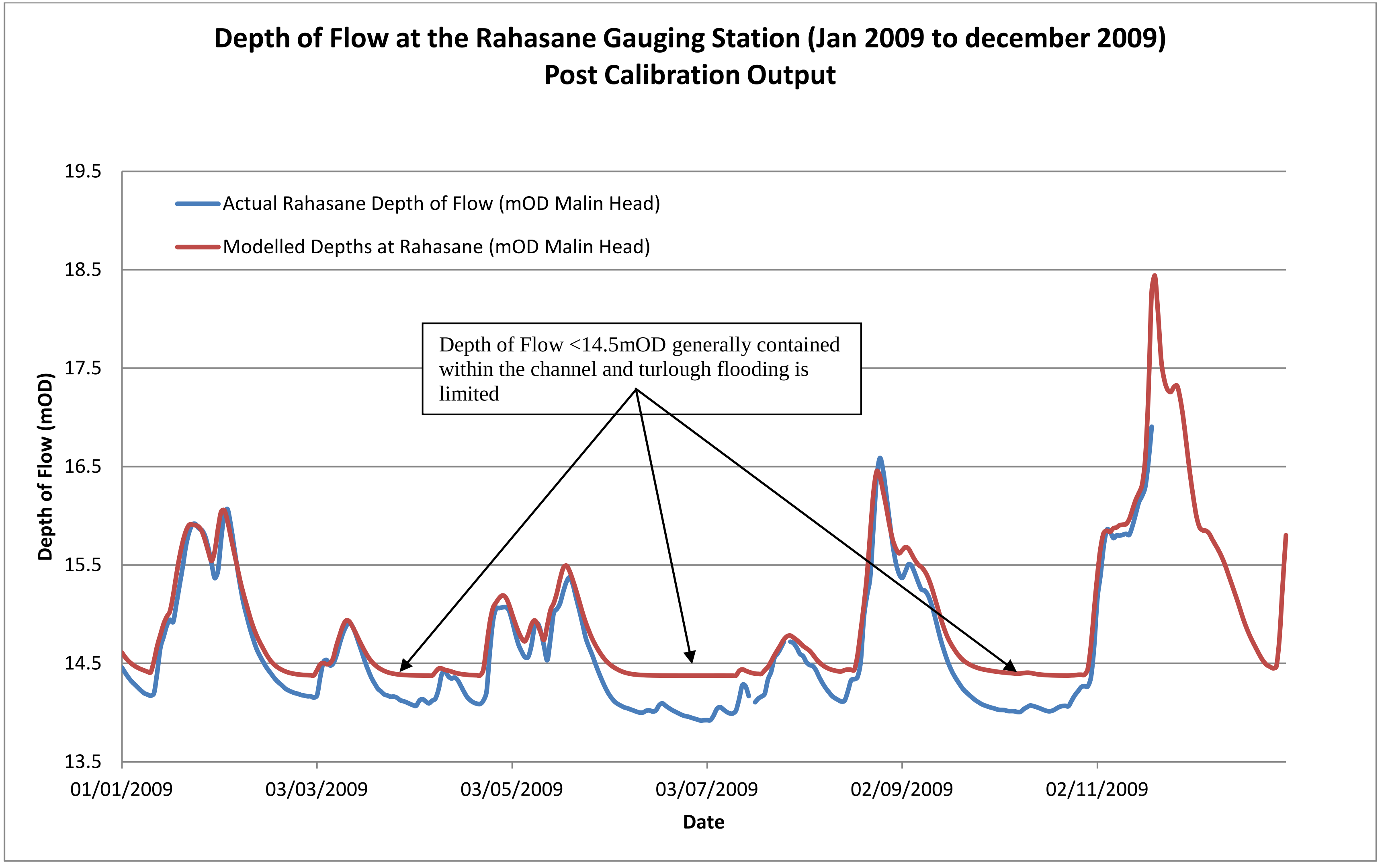
Galway County Council propose to undertake maintenance over a 5 year maintenance programme with activities being carried out as follows:

On a 5 year basis

- Light trimming of vegetation
- Non invasive cleaning of the river to remove excess silt or debris which may have gathered in the river.

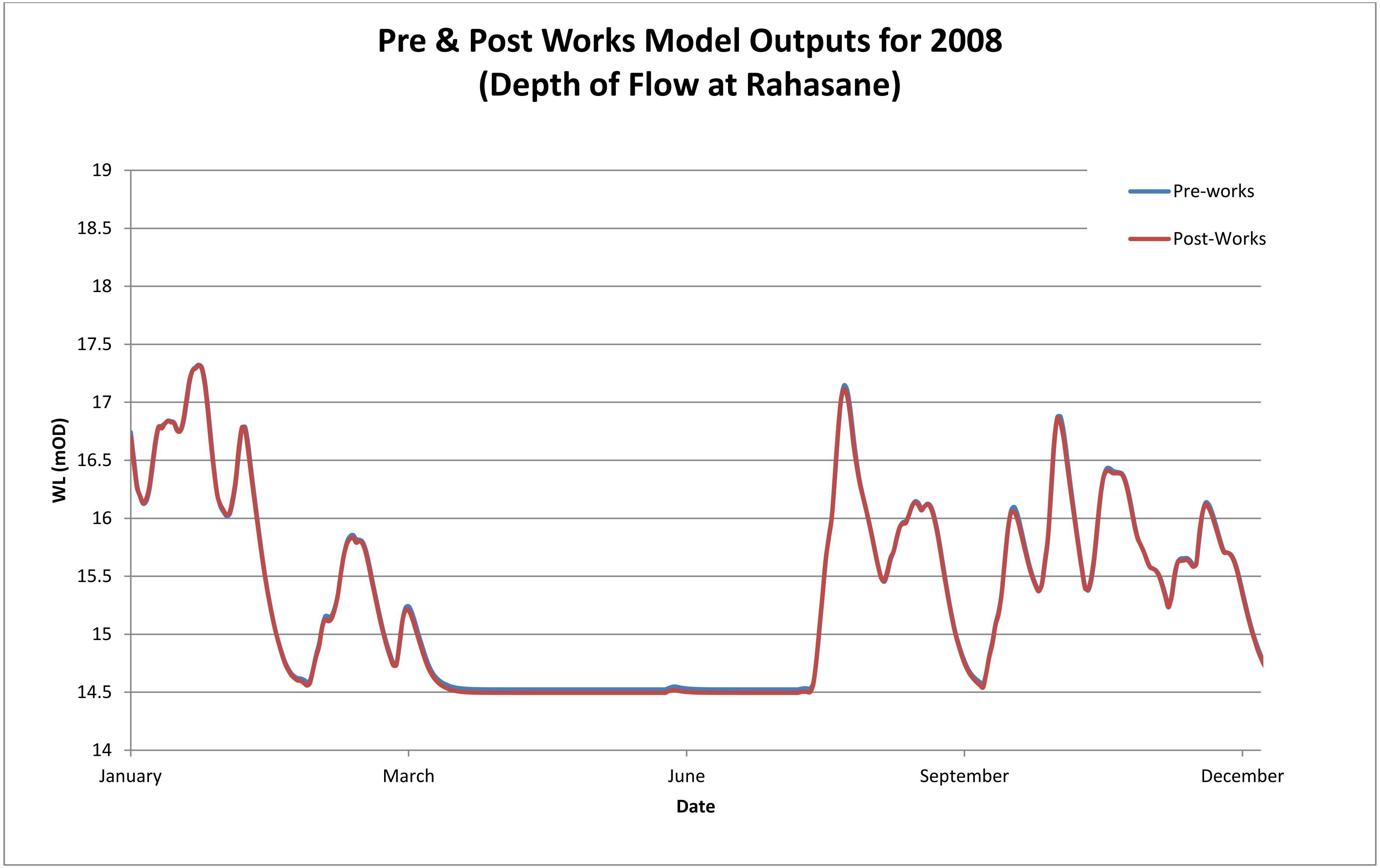
Appendix No. 1

Calibrated Output from the Mathematical Model

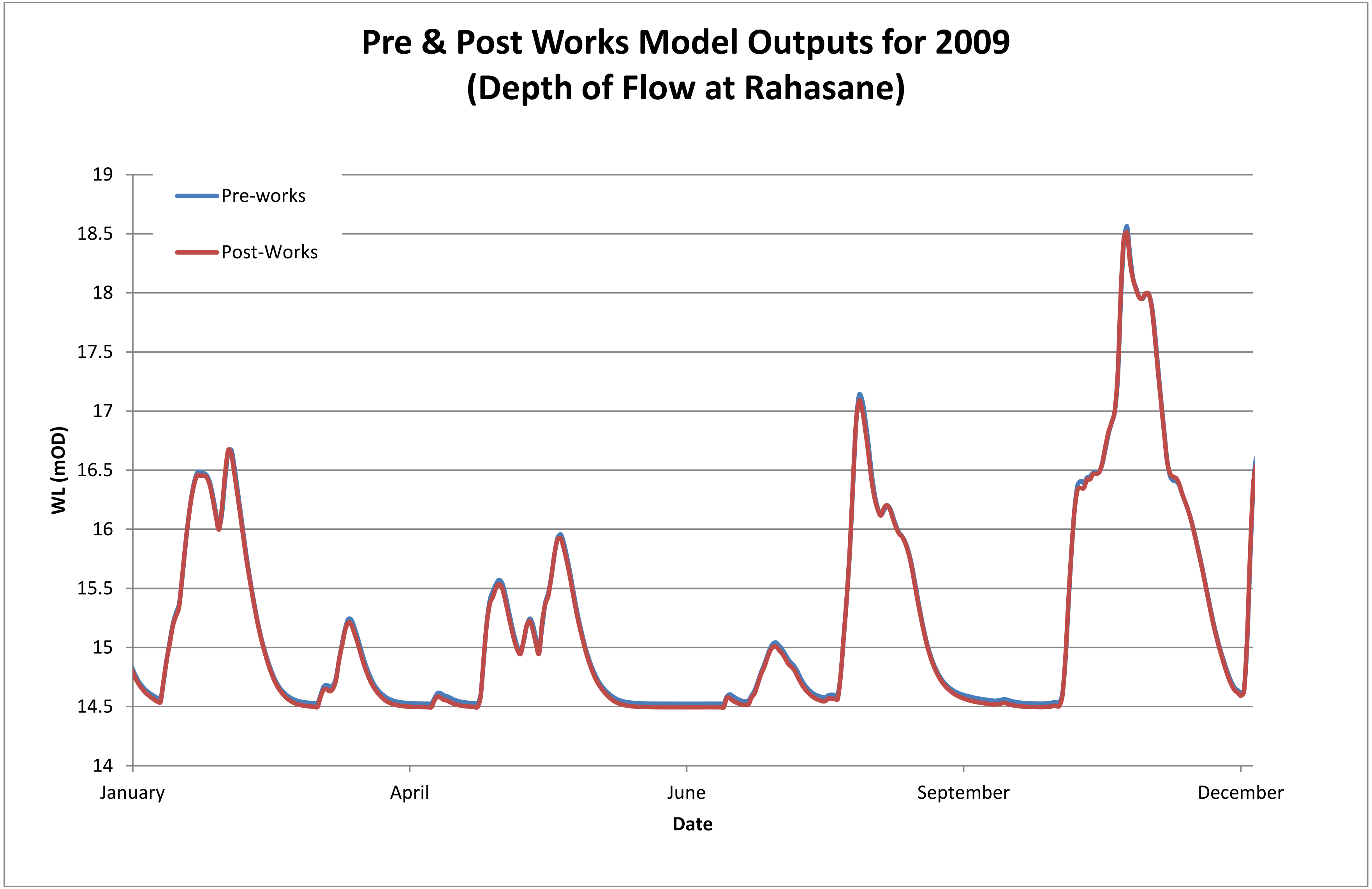

Depth of Flow at the Rahasane Gauging Station (Jan 2009 to december 2009)
Post Calibration Output
19.5
18.5
17.5
16.5
15.5
14.5
13.5
Depth of Flow (mOD)
Actual Rahasane Depth of Flow (mOD Malin Head)
Modelled Depths at Rahasane (mOD Malin Head)
Depth of Flow <14.5mOD generally contained within the channel and turlough flooding is limited
01/01/2009
03/03/2009
03/05/2009
03/07/2009
02/09/2009
02/11/2009
Date

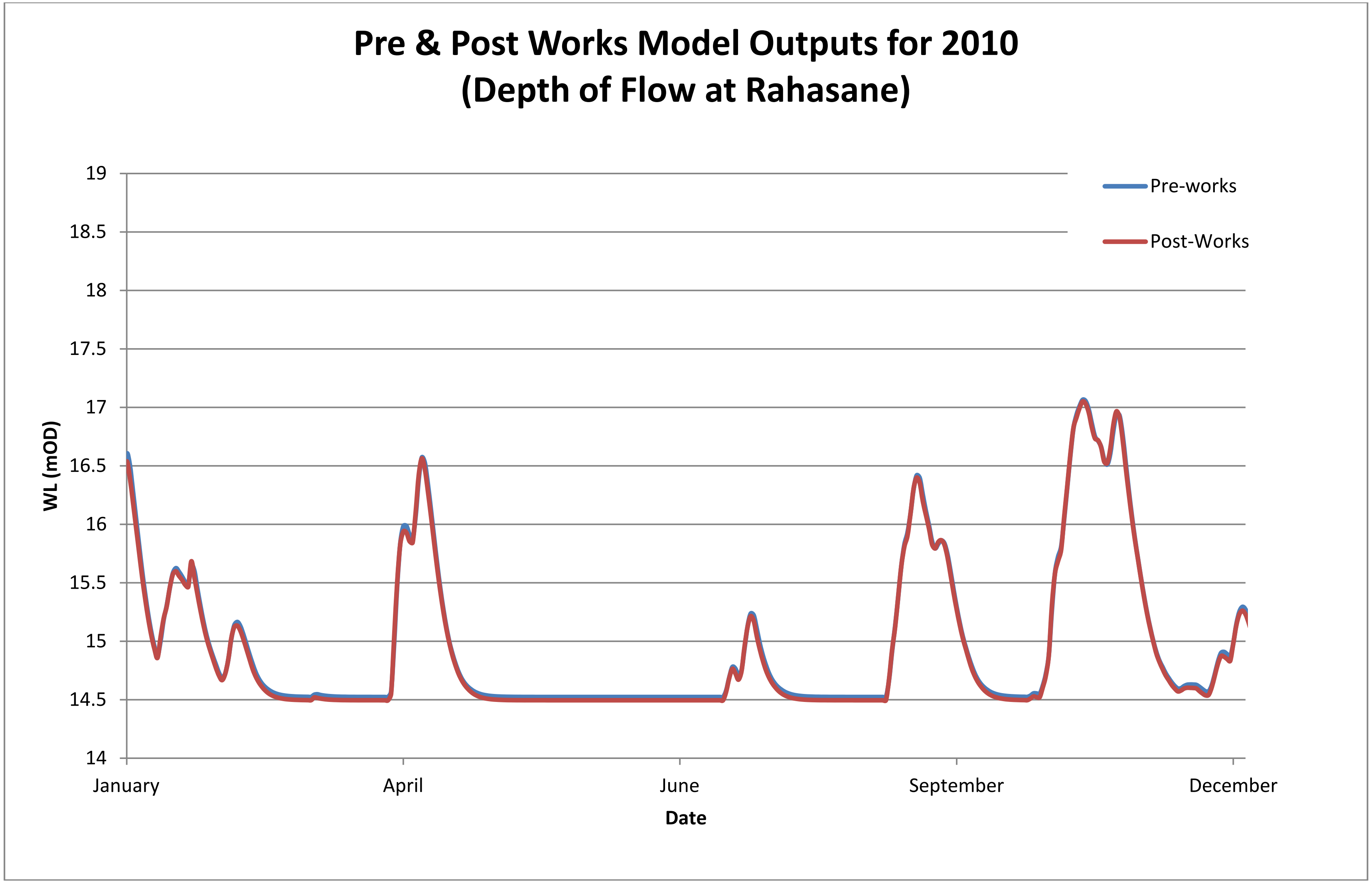
Appendix No. 2

Predicted Pre and Post Works Depth of Flow Output from the HEC-RAS Model

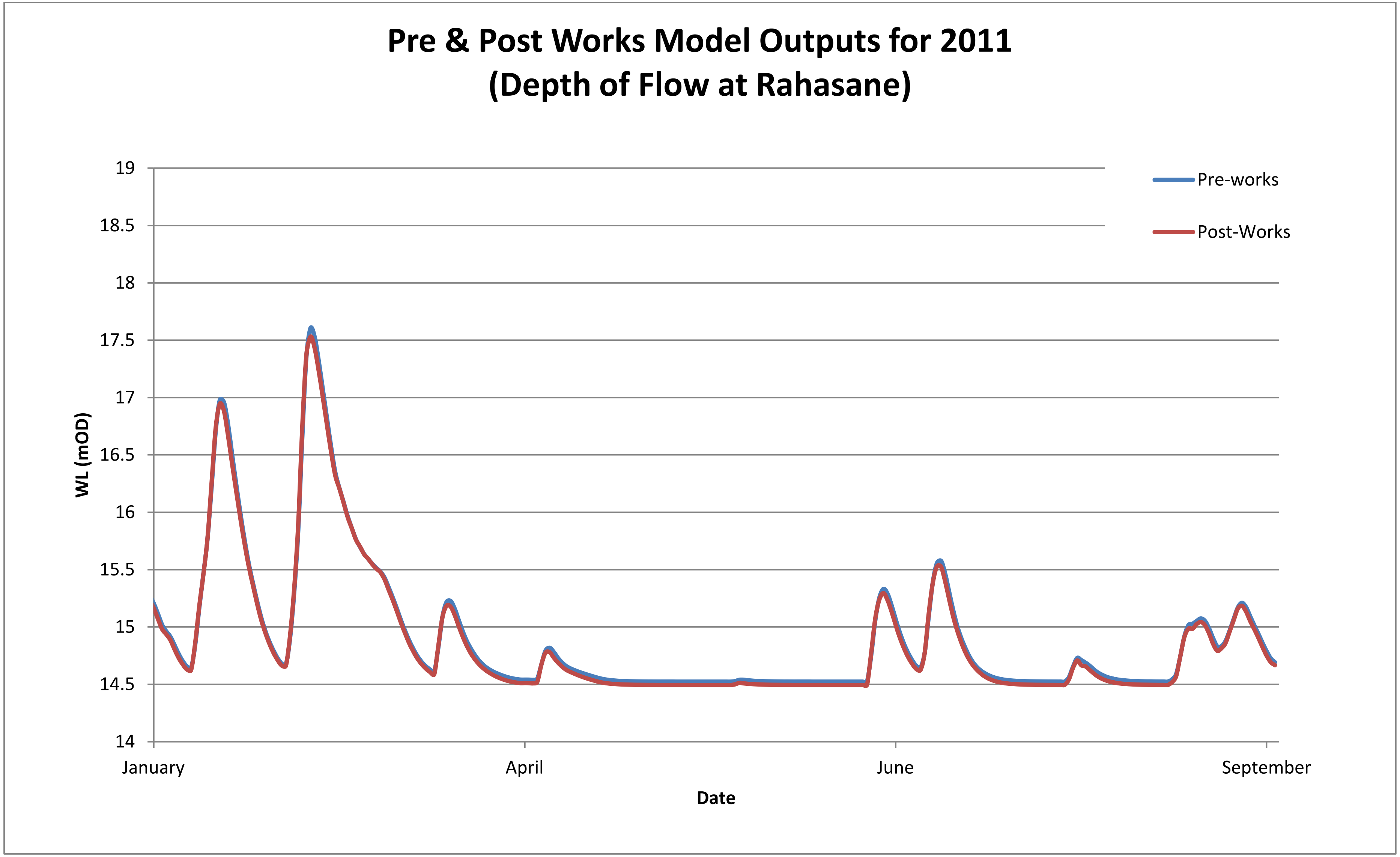


Pre & Post Works Model Outputs for 2008
(Depth of Flow at Rahasane)
19
18.5
18
17.5
17
16.5
16
15.5
15
14.5
14
WL (mOD)
January
March
June
September
December
Date
Pre-works
Post-Works


Pre & Post Works Model Outputs for 2009
(Depth of Flow at Rahasane)
Pre-works
Post-Works
WL (mOD)
19
18.5
18
17.5
17
16.5
16
15.5
15
14.5
14
January
April
June
September
December
Date



Pre & Post Works Model Outputs for 2010
(Depth of Flow at Rahasane)
WL (mOD)
19
18.5
18
17.5
17
16.5
16
15.5
15
14.5
14
January
April
June
September
December
Date
Pre-works
Post-Works

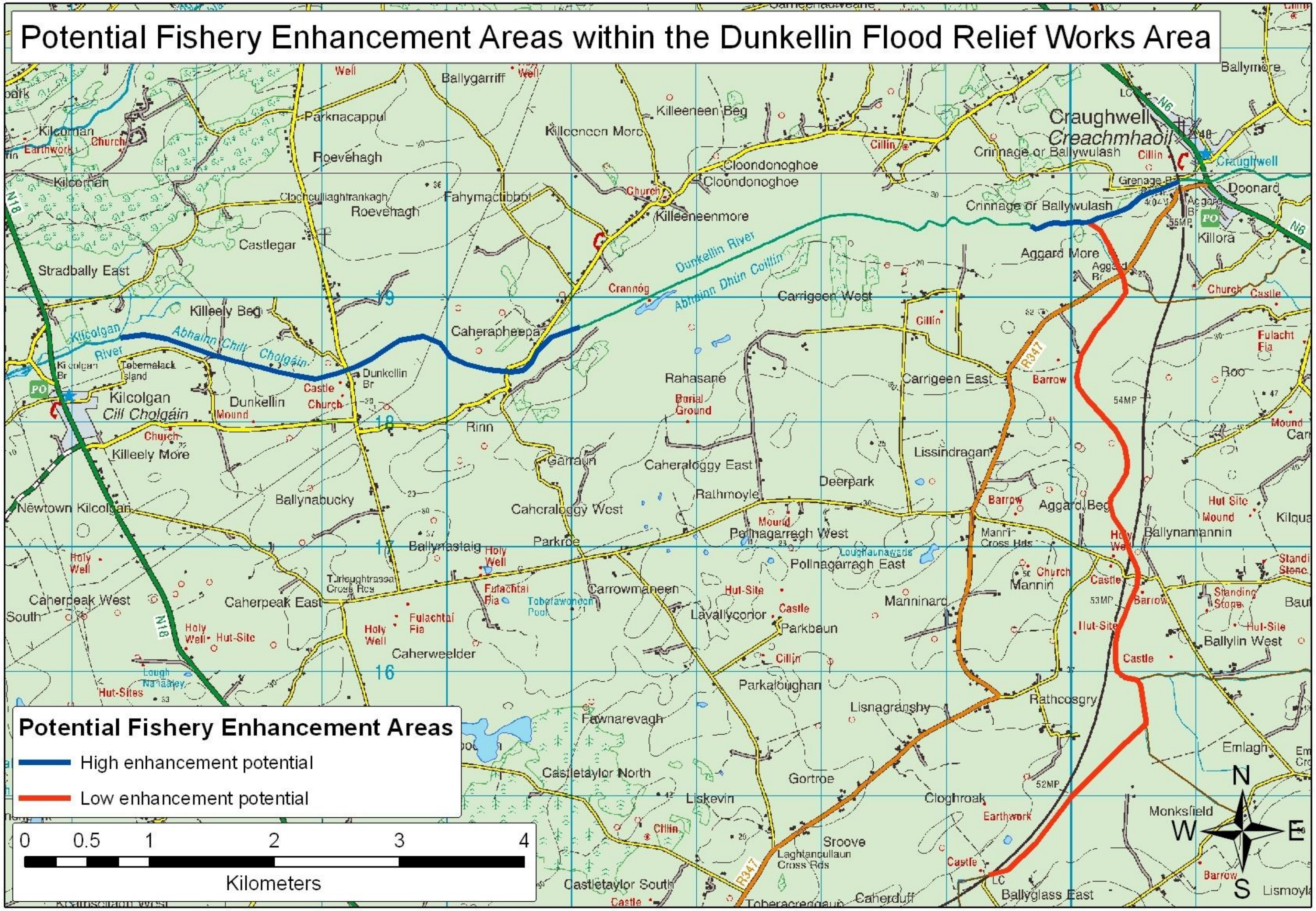

Pre & Post Works Model Outputs for 2011
(Depth of Flow at Rahasane)
19
18.5
18
17.5
17
16.5
16
15.5
15
14.5
14
WL (mOD)
January
April
June
September
Date
Pre-works
Post-Works

Appendix No. 3

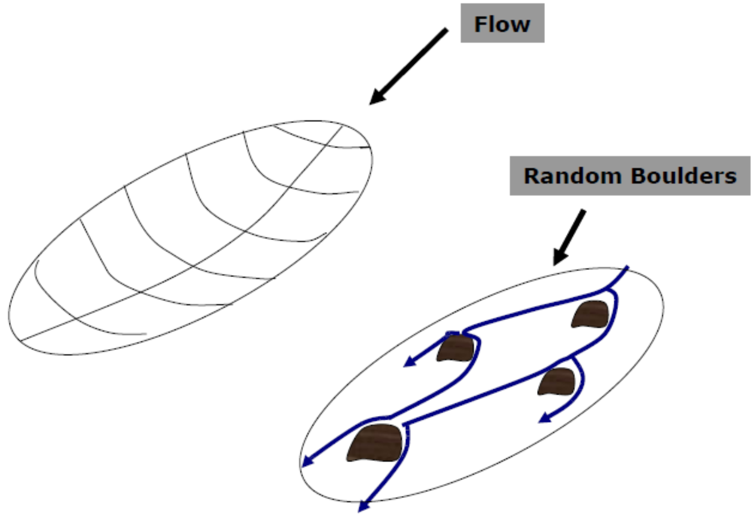
Outline Typical Details of Proposed River Enhancement Works along the Dunkellin River as provided by Inland Fisheries Ireland

(Final Design & Location to be confirmed at Detailed Design Stage)

Potential Fishery Enhancement Areas within the Dunkellin Flood Relief Works Area



Detail 1. Centre Channel Pool



Key Features

Pool should be egg-shaped.

Pool Length 1.5 times channel width.

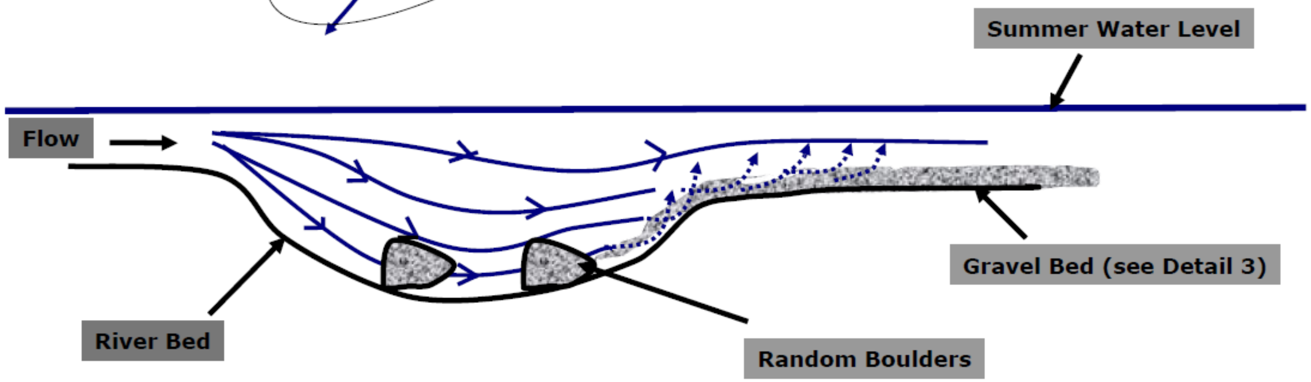
Gradually slope down to the deepest point (1.5m) in the centre and taper back up towards the tail.

Should also taper down from either side towards the centre.

Should occupy the central 2/3 area of the channel cross section.

Place a number of boulders in the pool.
Boulders should be placed in a triangular or diamond shaped pattern

Pool should be placed on average 5-7 channels widths in distance apart



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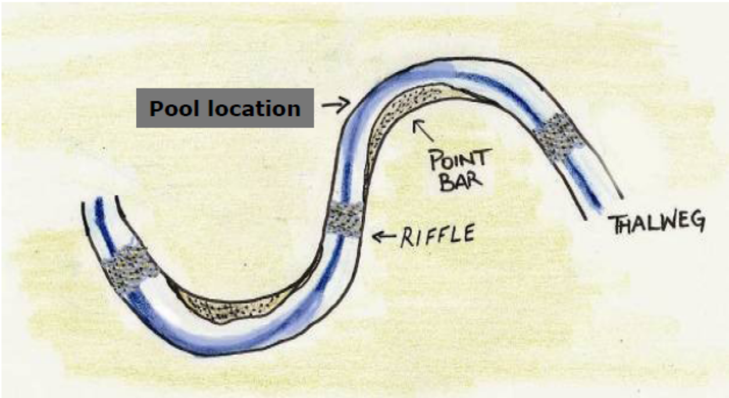
Detail 2. Lateral Scour Pool



Key Features

Pool should be placed on the **eroding side of bends** in a meadering channel.

Pool should be banana-shaped.

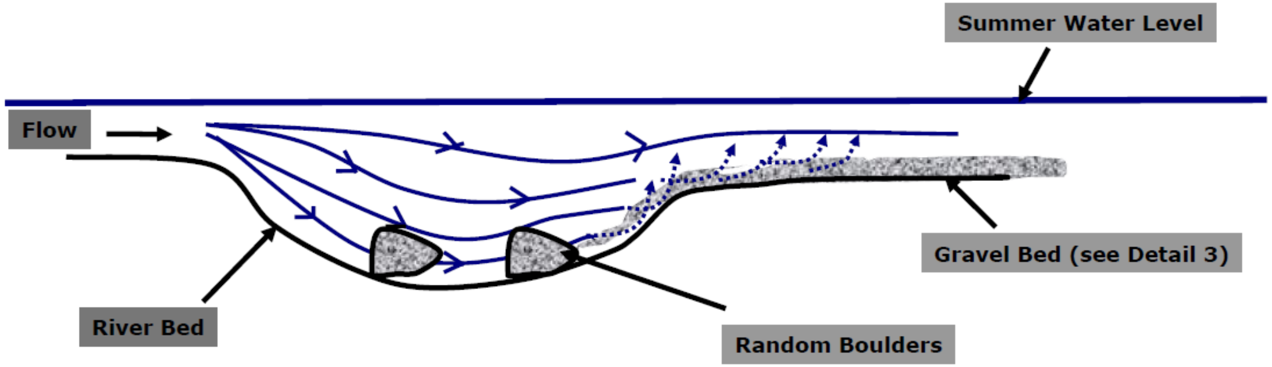
Pool length 1.5 times channel basewidth.

Pool width approximately 1/3 of the channel basewidth placed on eroding side of channel.

Gradually slope down to the deepest point (1.5m) in the centre of the pool and taper back up towards the tail.

Should also taper down from either side width deepest point leaning towards the eroding bank.

Place a number of boulders in the along the pool.



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Detail 3. Gravel Placement

Key Features

Pool and gravel bed should be approx same length (1.5 times channel width).

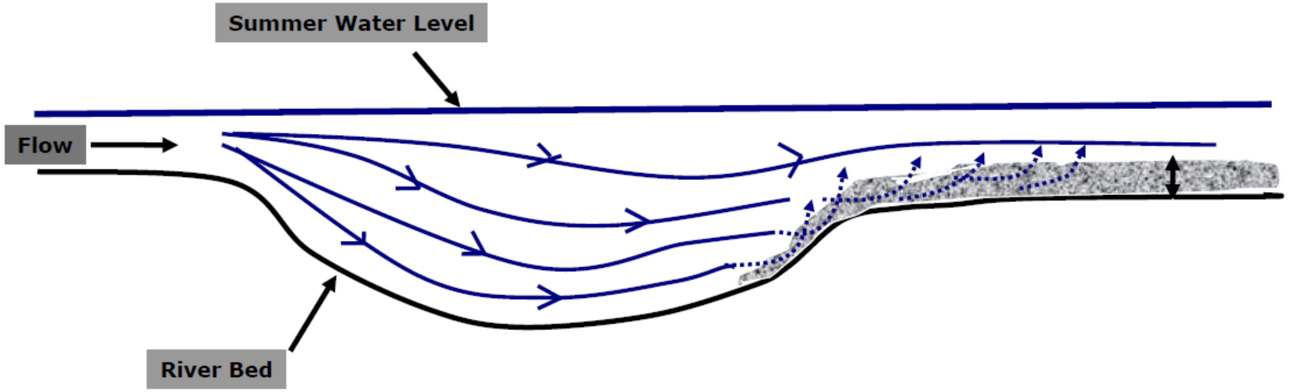
Should occupy the central 2/3 area of the channel cross section.

Start to place gravel at tail of pool (downstream end).

Gravel bed should be 35 to 40cm deep.

Gravel Size (see Detail 4 spawning gravels).

Up-welling of water through the gravels is essential.



Detail 4. Spawning Gravel

Table 4.1

Type	Grade	% Composition
Cobble	64 - 190mm	10%
Very coarse gravel	32 - 64mm	35%
Coarse gravel***	16 – 32mm	25%
Medium gravel***	8 - 16mm	20%
Fine gravel***	4 – 8mm	10%

Table 4.2

Type	Grade	% Composition
Cobble	64 - 190mm	0%
Very coarse gravel	32 - 64mm	15%
Coarse gravel***	16 – 32mm	35%
Medium gravel***	8 - 16mm	30%
Fine gravel***	4 – 8mm	15%

Key Features

Wide variation in particle size.

Washed, rounded stones.

See table 4.1 below for range and % composition of stones required for **Irish salmon** and **sea trout** spawning gravels.

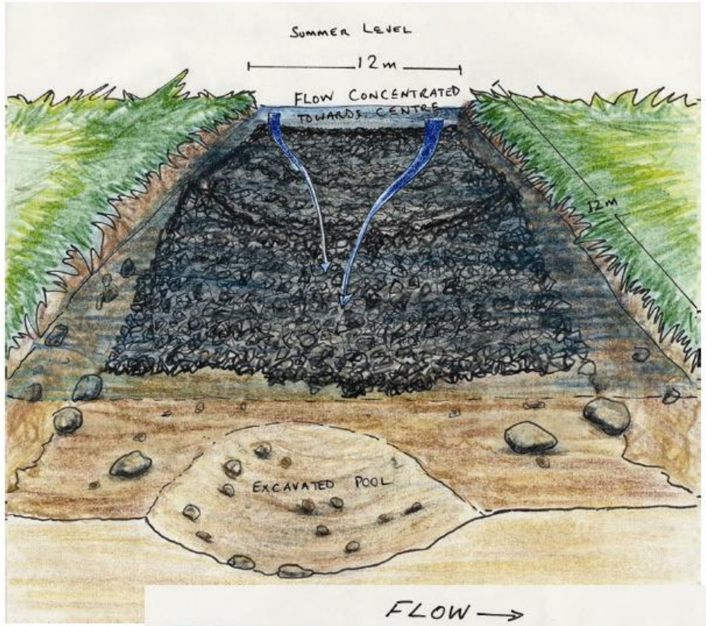
See table 4.2 below for range and % composition of stones required for **brown trout** spawning gravels.

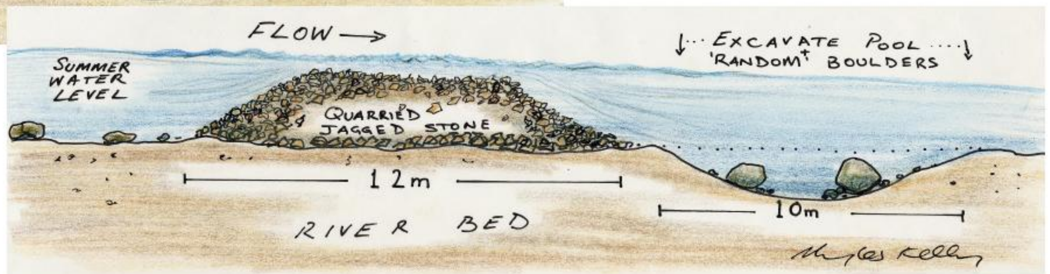
***Least critical component of this mix as they will settle naturally once the cobble and very coarse gravel is placed.

Ratio of cobble to very coarse gravel to be placed - 50:50 .

For placement of gravel see Detail 3.

Detail 5. Rubble Mat





Key Features

Broken quarried stone (150 - 250mm).

Rubble mat Length equal to one channel width.

Stone placed below summer low water level from bank to bank.

Gulley should be made through the rubble mat concentrating flow towards centre of channel.

Excavate pool downstream of rubble mat (Detail 1)

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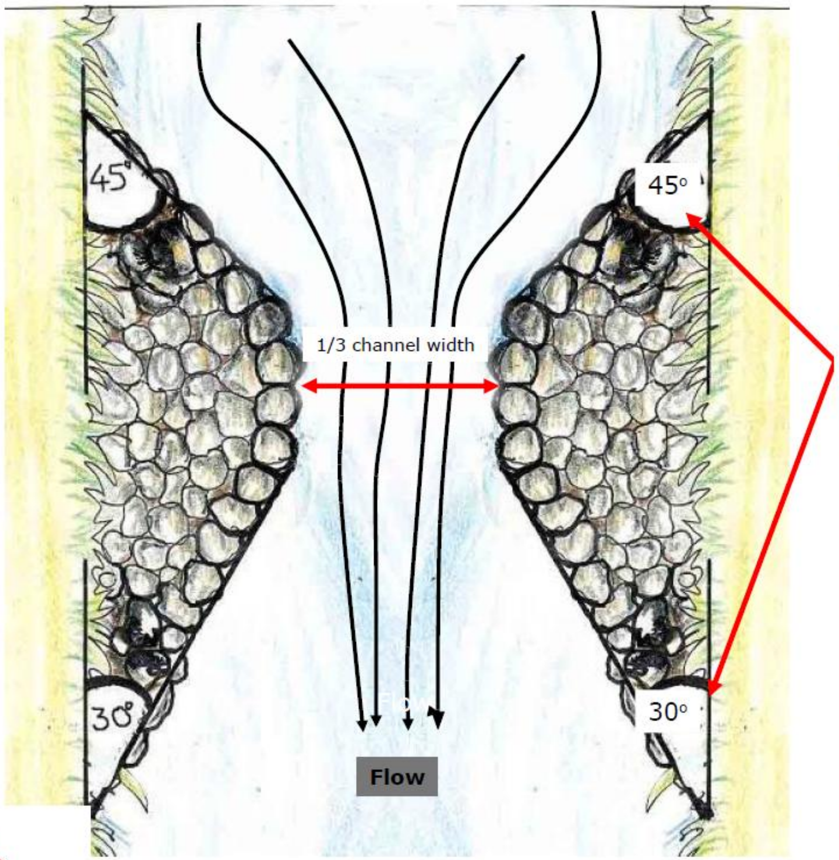
Detail 6. Paired Stone Deflectors



Key Features

The largest heaviest stones available should be used at the outer tip of each deflector where the maximum erosive pressure will be generated by river flows.

Outer stones should be buried a little more than the others as the structure must slope out and down from the bank, ie. the stones at the outer tip of the deflector need to be at the lowest point of the structure.

The outer tip of each deflector should be no higher than summer water level.

45° angle on upstream slope and 30° angle on downstream slope (as detailed in drawing) required to generate appropriate flow regime.

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Detail 7. Alternating Stone Deflectors

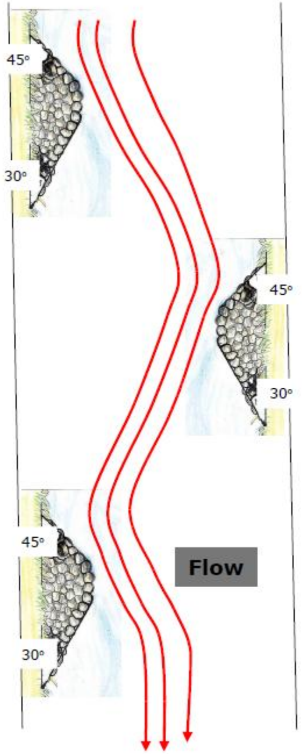

Figure 7.1

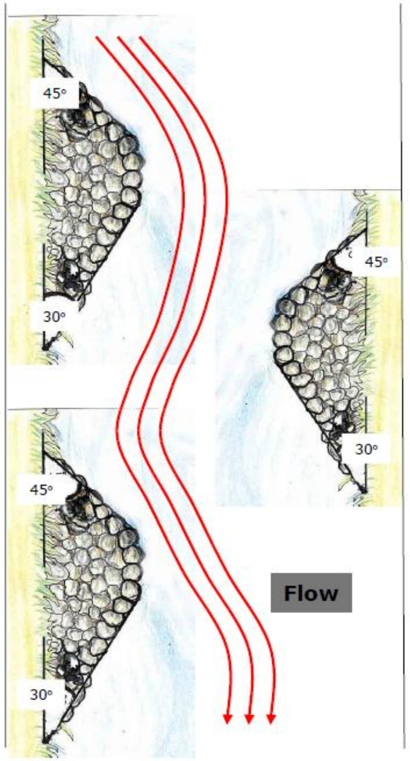

Figure 7.2

Key Features

The largest heaviest stones available should be used at the outer tip of each deflector where the maximum erosive pressure will be generated by river flows.

Outer stones should be buried a little more than the others as the structure must slope out and down from the bank, ie. the stones at the outer tip of the deflector need to be at the lowest point of the structure.

The outer tip of each deflector should be no higher than summer water level.

45° angle on upstream slope and 30° angle on downstream slope required to generate appropriate flow regime.

In fast-flowing channels, deflectors do not overlap (figure 7.1).

In slow-flowing, wide channels, deflectors may overlap (figure 7.2)

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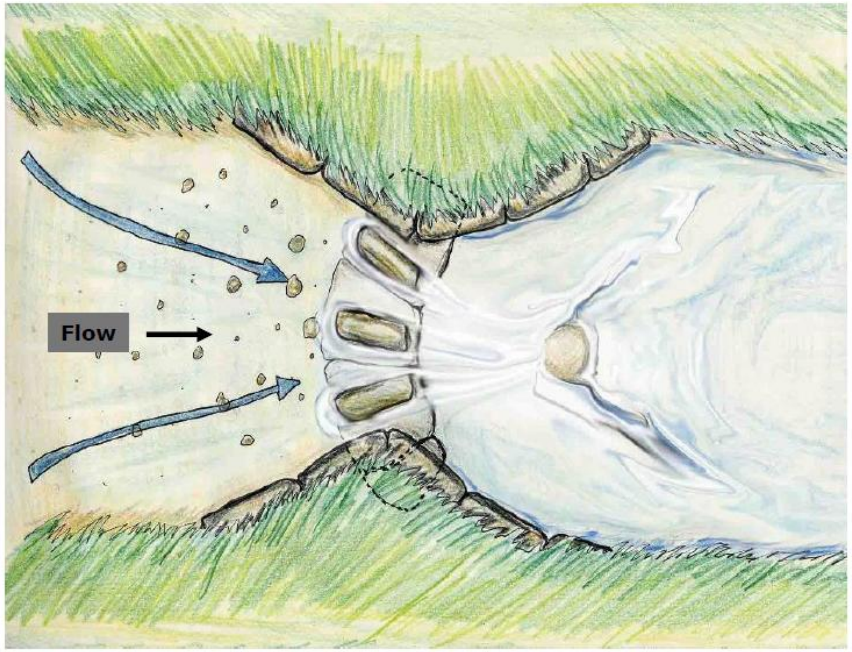
Detail 8. Vortex Stone Weir



Key Features

A series of rocks are built into both backs to direct flow towards centre of channel.

A line of footer stones, arched upstream are buried across the central channel area. The surface of these stones should be flush with the bed of the stream.

Three rocks are placed on top of the footer stones. The top of these rock are exposed by a few centimetres in summer low flow and are fully sumberged in high flows.

Excavate a pool dowmstream of the weir (see Detail 1 Centre Channel Pool)

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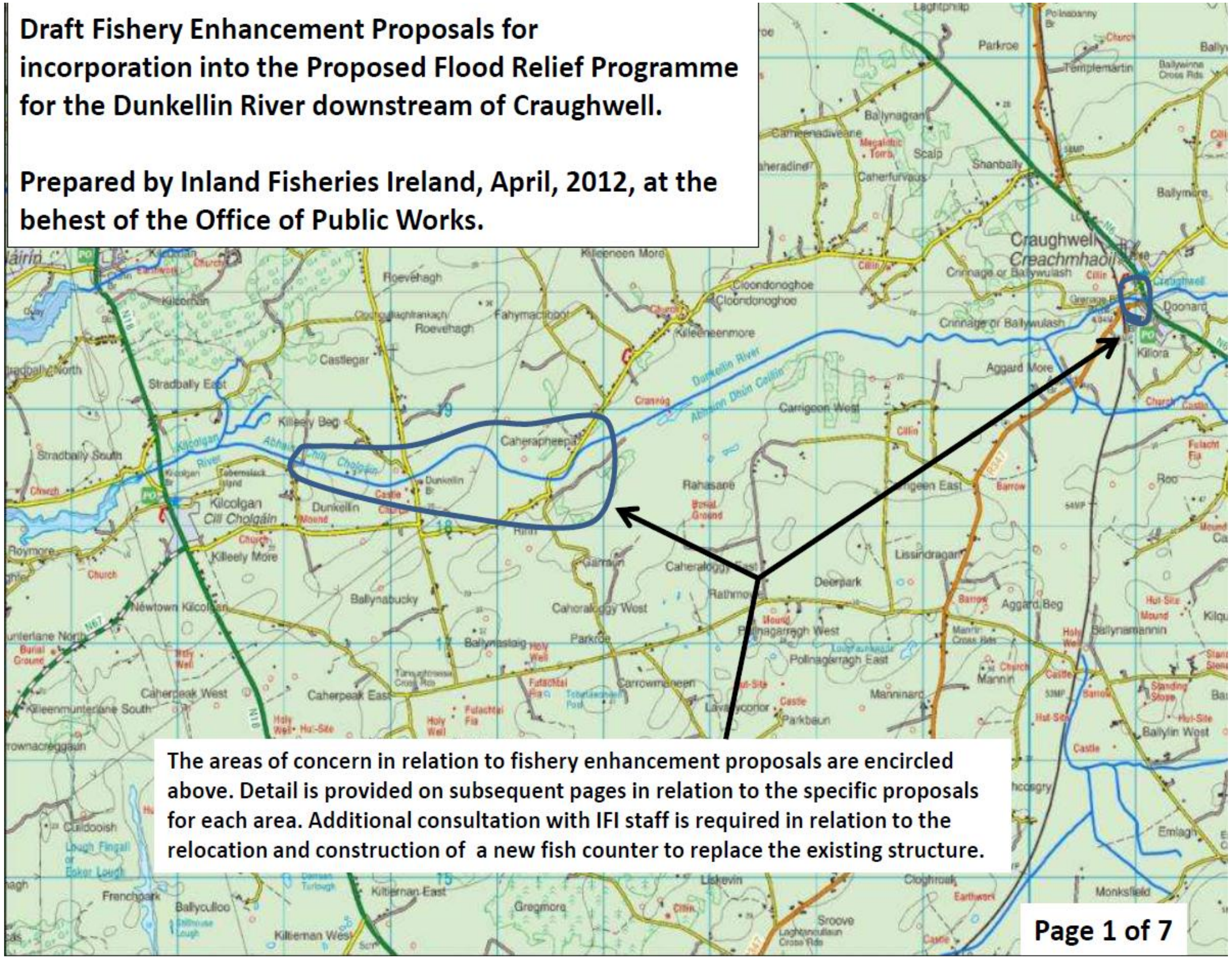
Draft Fishery Enhancement Proposals for incorporation into the Proposed Flood Relief Programme for the Dunkellin River downstream of Craughwell.

Prepared by Inland Fisheries Ireland, April, 2012, at the behest of the Office of Public Works.

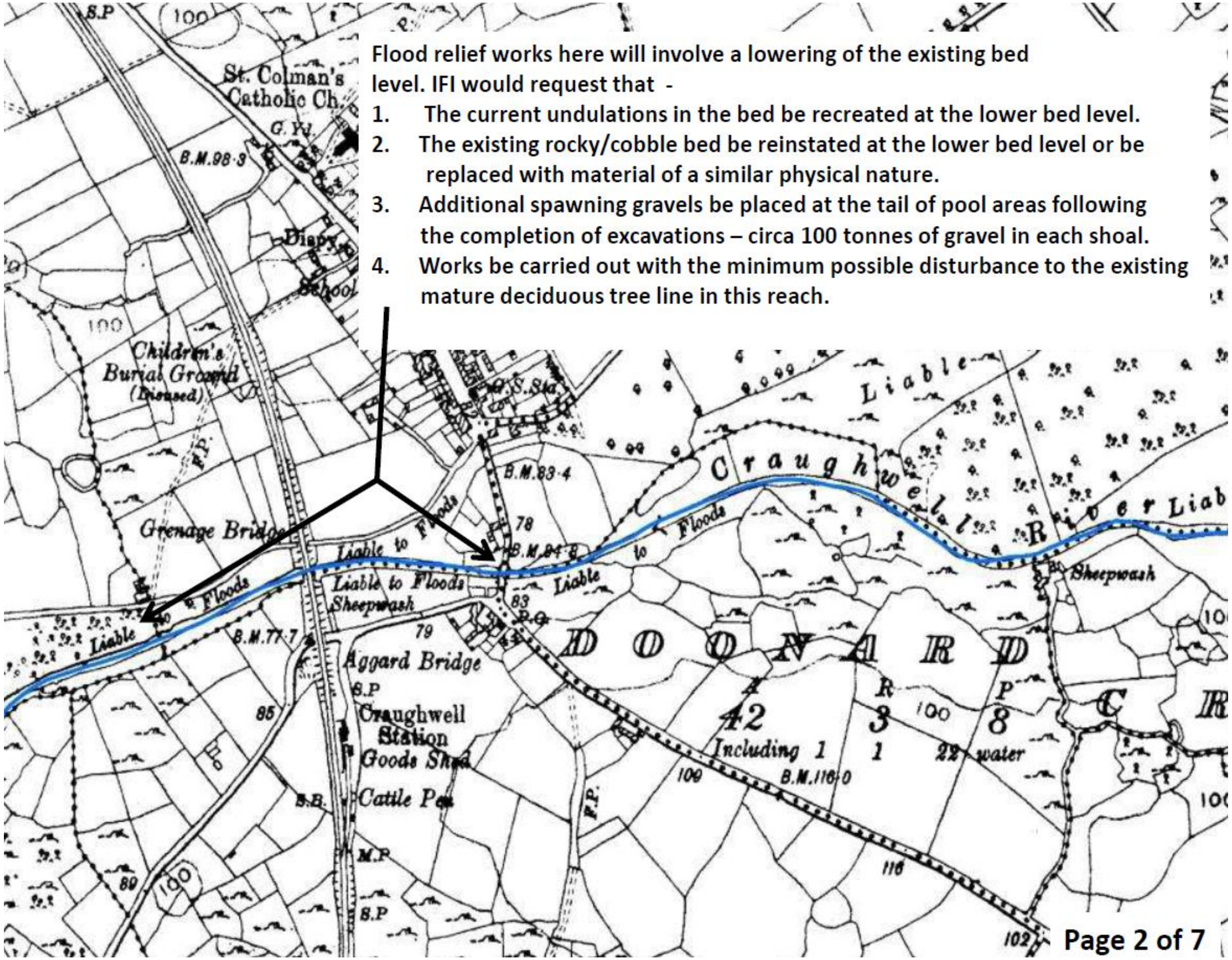


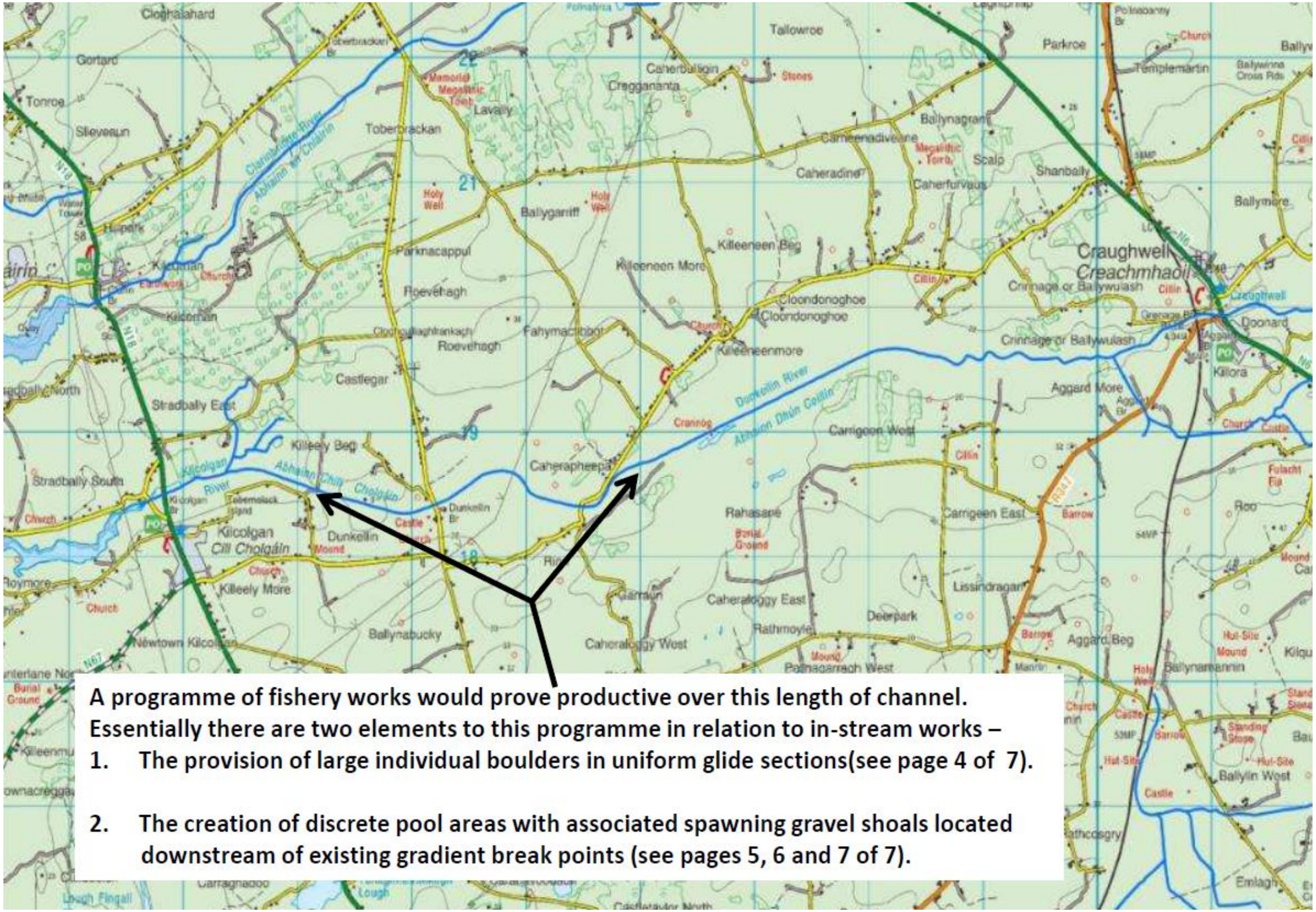
The areas of concern in relation to fishery enhancement proposals are encircled above. Detail is provided on subsequent pages in relation to the specific proposals for each area. Additional consultation with IFI staff is required in relation to the relocation and construction of a new fish counter to replace the existing structure.

Page 1 of 7

Flood relief works here will involve a lowering of the existing bed level. IFI would request that -

1. The current undulations in the bed be recreated at the lower bed level.
2. The existing rocky/cobble bed be reinstated at the lower bed level or be replaced with material of a similar physical nature.
3. Additional spawning gravels be placed at the tail of pool areas following the completion of excavations – circa 100 tonnes of gravel in each shoal.
4. Works be carried out with the minimum possible disturbance to the existing mature deciduous tree line in this reach.

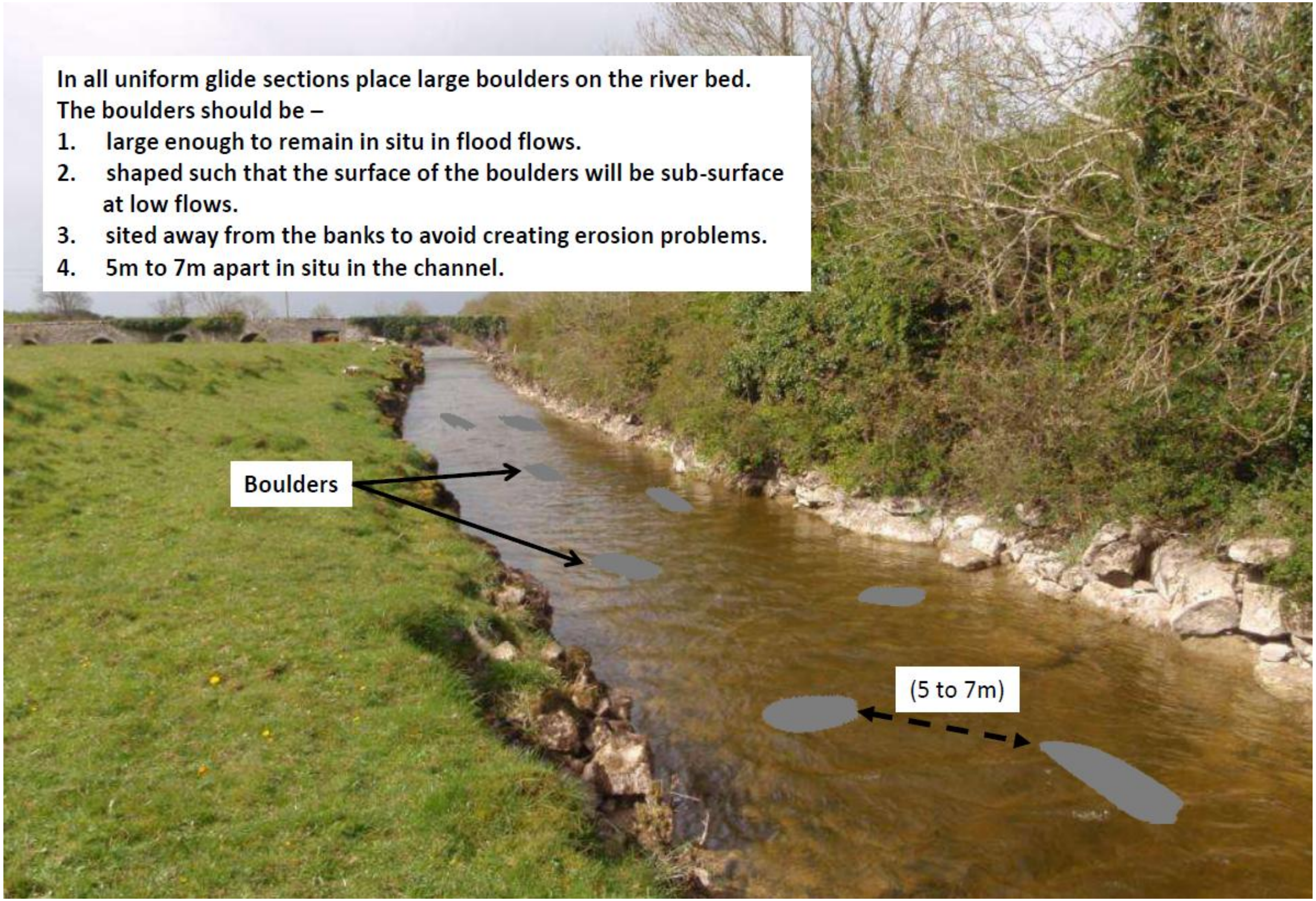


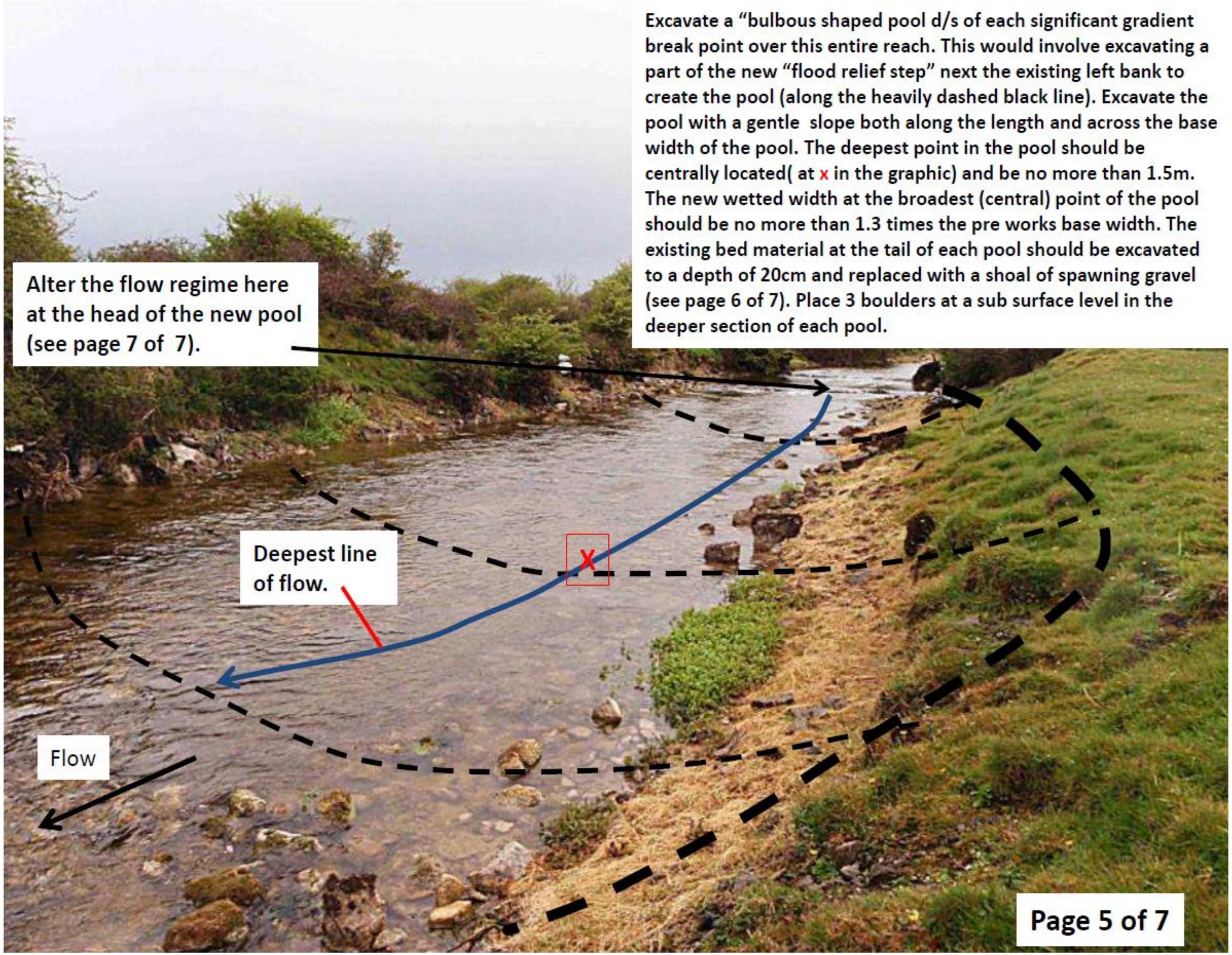


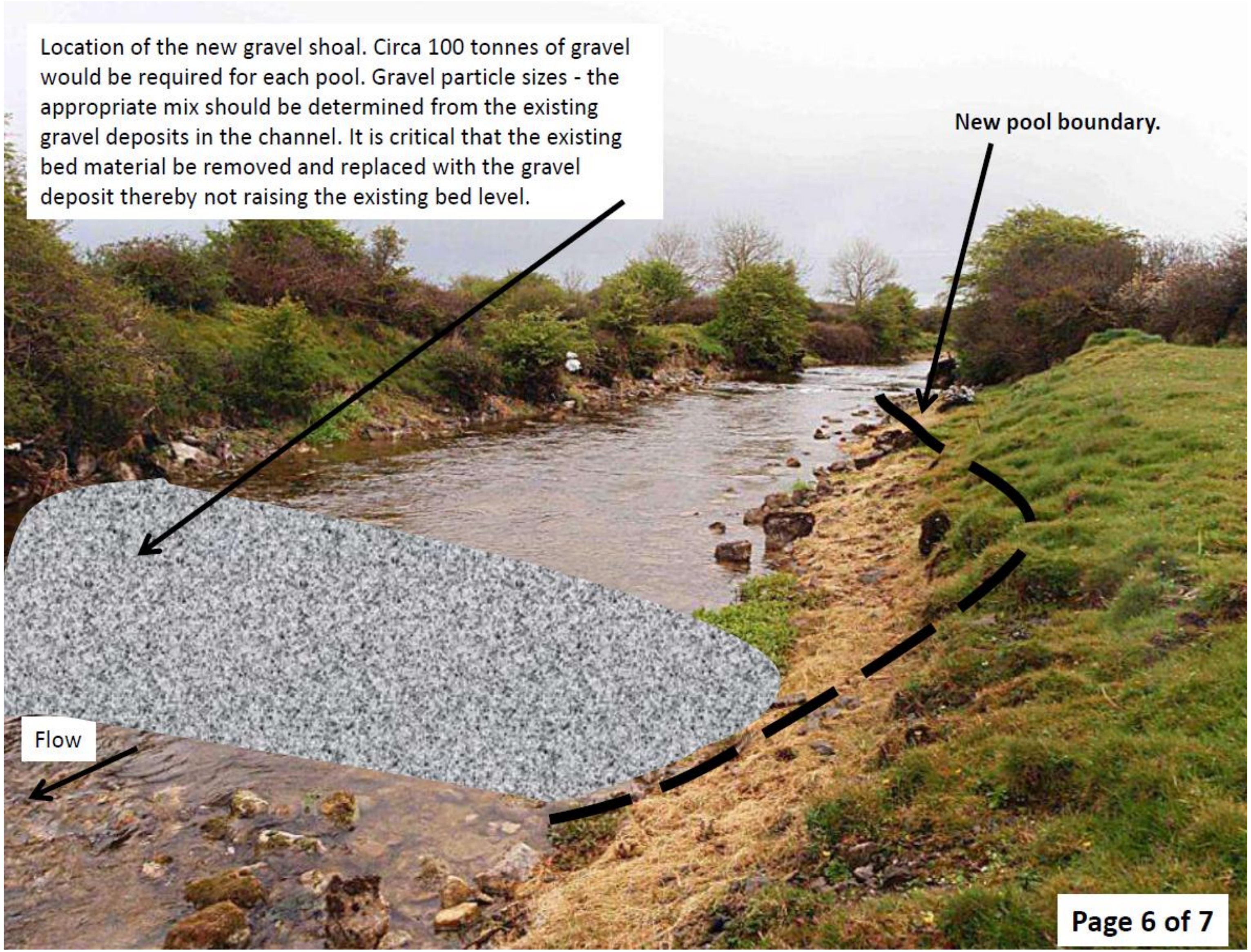
A programme of fishery works would prove productive over this length of channel. Essentially there are two elements to this programme in relation to in-stream works –

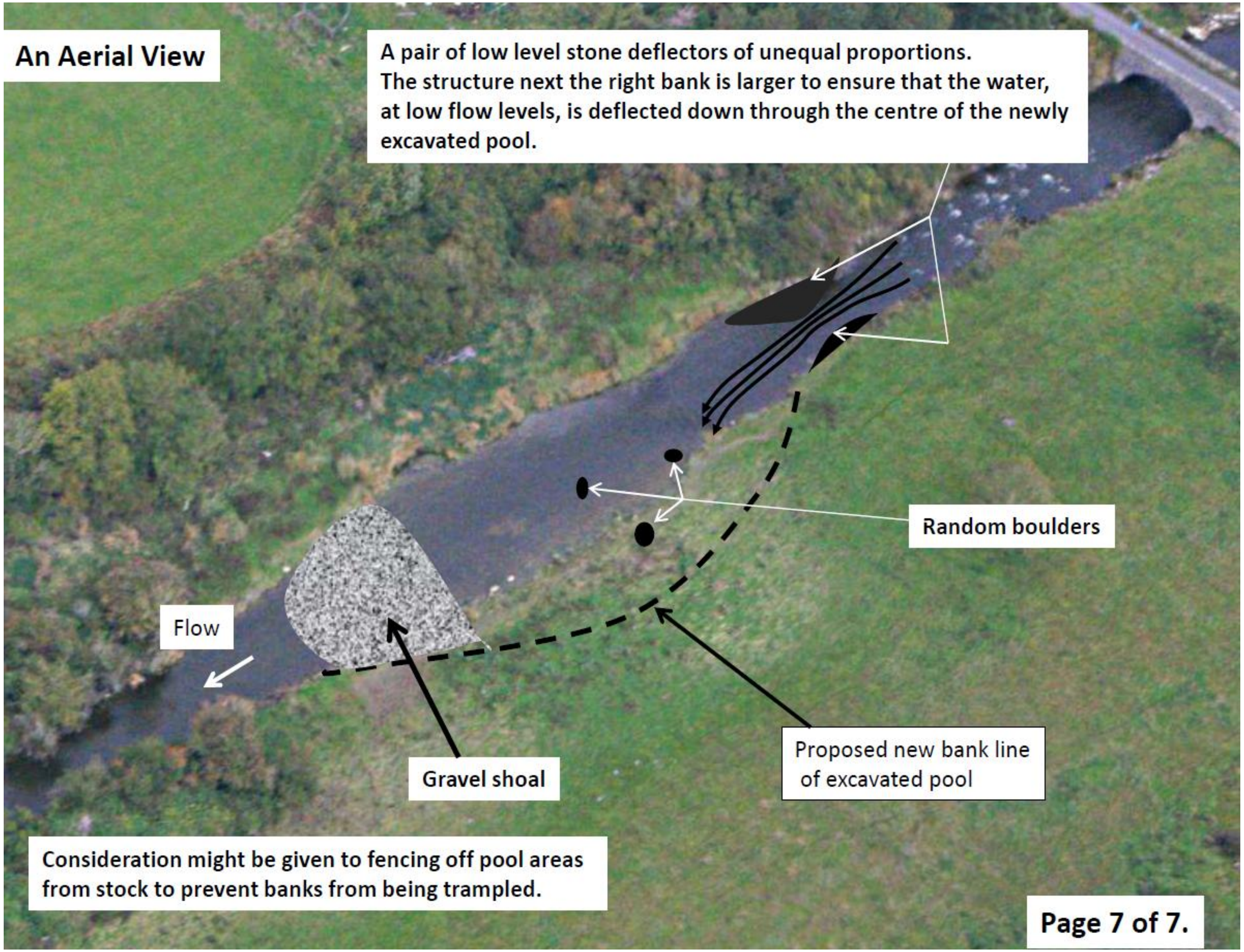
1. The provision of large individual boulders in uniform glide sections(see page 4 of 7).

2. The creation of discrete pool areas with associated spawning gravel shoals located downstream of existing gradient break points (see pages 5, 6 and 7 of 7).


In all uniform glide sections place large boulders on the river bed.
The boulders should be –
1. large enough to remain in situ in flood flows.
2. shaped such that the surface of the boulders will be sub-surface at low flows.
3. sited away from the banks to avoid creating erosion problems.
4. 5m to 7m apart in situ in the channel.
Boulders
(5 to 7m)


Excavate a "bulbous shaped pool d/s of each significant gradient break point over this entire reach. This would involve excavating a part of the new "flood relief step" next the existing left bank to create the pool (along the heavily dashed black line). Excavate the pool with a gentle slope both along the length and across the base width of the pool. The deepest point in the pool should be centrally located(at x in the graphic) and be no more than 1.5m. The new wetted width at the broadest (central) point of the pool should be no more than 1.3 times the pre works base width. The existing bed material at the tail of each pool should be excavated to a depth of 20cm and replaced with a shoal of spawning gravel (see page 6 of 7). Place 3 boulders at a sub surface level in the deeper section of each pool.
Alter the flow regime here at the head of the new pool (see page 7 of 7).
X
Deepest line of flow.
Flow
Page 5 of 7


Location of the new gravel shoal. Circa 100 tonnes of gravel would be required for each pool. Gravel particle sizes - the appropriate mix should be determined from the existing gravel deposits in the channel. It is critical that the existing bed material be removed and replaced with the gravel deposit thereby not raising the existing bed level.
New pool boundary.
Flow
Page 6 of 7


An Aerial View
A pair of low level stone deflectors of unequal proportions.
The structure next the right bank is larger to ensure that the water, at low flow levels, is deflected down through the centre of the newly excavated pool.
Random boulders
Flow
Gravel shoal
Proposed new bank line of excavated pool
Consideration might be given to fencing off pool areas from stock to prevent banks from being trampled.
Page 7 of 7.

FURTHER DETAIL OF RIVER ENHANCEMENT WORKS AT CRAUGHWELL (IFI Proposals)

An Ecological Evaluation of the likely impacts of a proposed flood relief scheme on a reach of the Craughwell River at Craughwell, Co. Galway.

1.The Flood Relief Proposal

Details of this flood relief proposal are provided in Figure 1.Proposed works involve a continuous deepening of the existing channel from a point 160 metres upstream of Craughwell Village downstream to a point 912 metres below the village. No widening of any channel section within this reach is proposed. The proposal will incorporate a fishery enhancement "layer" designed to protect fish stocks and also improve general ecological diversity in the river corridor. To accommodate these objectives the design incorporates a deepening of dredging operations by 0.5m below the flood relief design bed level to allow one to provide morphological diversity (riffle/glide/pool sequences) in the channel post-dredging where possible.

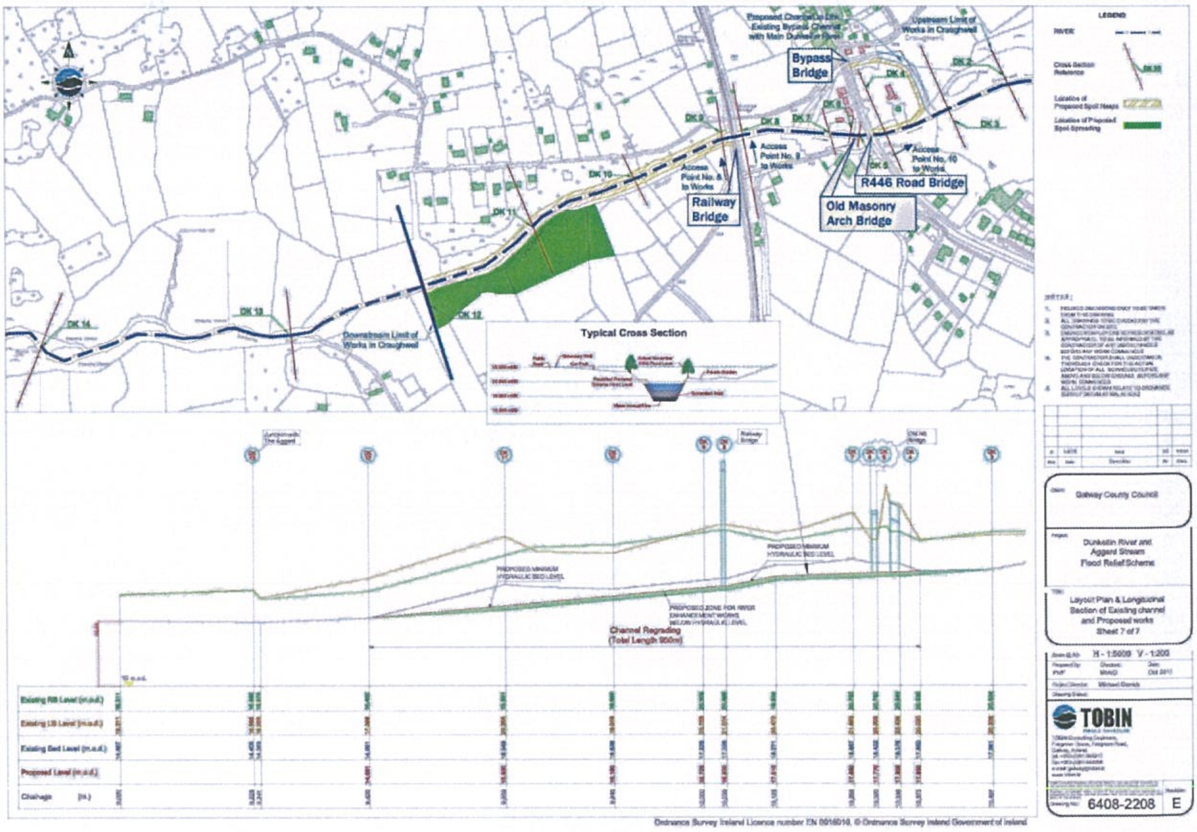


Figure 1. Detail in relation to the flood relief proposal.

2.The Current Status of this Channel Reach from a fluvial geomorphological and ecological perspective.

In fluvial geomorphological terms the Craughwell River would be classified as a "C Type" channel (after Rosgen, 1996). An undisturbed "C Type" channel would have well defined pool areas, on average, at intervals of 7 channel widths in distance apart with associated gravelled riffle areas adjacent to each pool. One would expect to find shallow glide areas between the pools. The current physical form of the Craughwell River reach in question does not fit this description. Clearly at some time in the past this river reach was dredged and partially canalised. Currently most reaches are either deep flats or uniform shallow glides. There is only one significant gravelled riffle throughout the entire reach (see Fishery Enhancement Plan, page 3).

In summary the existing channel can be described as;-

- having very little salmonid and lamprey spawning habitat.
- a dearth of well-defined pool areas which means that;-
  a – adult trout habitat is very limited.
  b – resting places for adult salmon and sea trout returning to spawn are restricted.
  c – significant fine silt deposits which would normally be found along the margins of well defined pool areas are not present which means that this reach currently cannot accommodate a significant juvenile lamprey population.
- the dearth of gravelled riffles will also limit the diversity of both the aquatic flora and macroinvertebrate fauna.
- the overall biological productivity of this river zone, downstream of the village, is limited because of excessive shading – currently significant river bed areas are devoid of algal, moss and macrophytic plant colonies because of excessive shade.

3.Likely Impacts of the Flood Relief Scheme once the Fishery Enhancement Proposals are Implemented as part of this Programme.

The incorporation of the fishery enhancement proposals (attached), as part of this flood relief scheme, will address some of the current morphological and ecological imbalances in this channel reach as outlined in Section 2.

- a total of 13 new pool areas with associated gravelled riffles will be in place – currently there is only one gravelled riffle and one well defined pool area in this entire zone.
- the fish carrying capacity of deeper glide areas will be enhanced by the proposed addition of random boulders.
- the proposed partial and targeted reduction in bankside vegetation will significantly improve the biological diversity and overall productivity of this channel reach for the aquatic flora, macroinvertebrate fauna and fish stocks.

The author has been involved in designing and monitoring the effectiveness of river enhancement programmes, like this proposal, for over 30 years. To-day there is a significant body of evidence to show that the projected long-term positive impacts of this programme, as outlined above, are the most likely outcome once the proposed fishery enhancement scheme is adopted as part of the programme (some of the authors relevant scientific publications in this area are appended).

Professor Martin O'Grady, B.Sc., M.Sc., Ph.D., F.Z.S.I.

Senior Research Officer,

Inland Fisheries Ireland.

July 15th, 2014.

Some of the author's scientific publications of relevance to this document.

BYRNE, C., IGOE, F., COOKE, D., O'GRADY, M. and GARGAN, P. (1998) The Distribution of the Brook Lamprey (*Lampetra planeri*, Bloch) in the Lough Corrib Catchment in the West of Ireland and some aspects of its biology and ecology. Presented at the S.I.L. Conference, Dublin, August 1998.

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O'GRADY, M.F. (1989) Rehabilitation of salmonid habitats in a drained Irish river system. In Steer (ed.) Irish Rivers: - Biology and Management. *Royal Irish Academy*, Dublin.

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O'GRADY, M.F. (1997) Enhancing a Salmonid Spawning and Nursery Stream. The Irish Scientist, No. 5. page 48.

O'GRADY, M.F. (1998) Salmonid Stream Enhancement Programmes in Ireland. *The Salmon Net*, No. XXIX, pages 27-33.

O'GRADY, M.F. (1998) The Boyne. In: Studies of Irish Rivers and Lakes. Ed. C. Moriarty – Essays on the occasion of the XXVII Congress of Societas Internationalis Limnologiae (S.I.L.), Dublin.

O'GRADY, M.F. (1999) The restoration of salmonid habitats in Ireland. *Primera Semena del Salmon Atlantico en la Peninsula Iberica. Oviedo*, p.173-178.

O'GRADY, M.F. (2002) Salmonid Riverine Enhancement in Ireland, Past, Present and Future. Went Memorial Lecture. Annual Papers in Irish Science and Technology, No. 26, Royal Dublin Society.

O'GRADY, M.F. (2006) Channels and Challenges. Enhancing Salmonid Rivers. Irish Freshwater Fisheries Ecology and Management Services : Number 4, Central Fisheries Board, Dublin, Ireland. ISSN: 1649-265X.

O'GRADY, M.F. and CURTIN, J. (1993) The Enhancement of Drained Salmonid Rivers in Ireland - A Bio-engineering perspective. *Hydroecologie Applique., Tome 5,* Vol. 2, pp.7-26.

O'GRADY, M.F. and CURTIN, J. (1993) The Enhancement of Drained Salmonid Rivers in Ireland - A Bio-engineering perspective. *Hydroecologie Applique.*, Tome 2 : 7-26.

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O'GRADY, M.F. and KING, J.J. (1992) Ecological changes over 30 years caused by drainage of a salmonid stream, the Bunree River. *IR. Fish. Invest. Ser. A.* No. 34.

O'GRADY, M.F., KING, J.J. and CURTIN, J. (1991) The effectiveness of two physical in stream works programmes in enhancing salmonid stocks in a drained Irish lowland river. Atlantic Salmon Trust/I.F.M. Conference, London, 1990.

O'GRADY, M.F., KING, J.J. and CORBETT, K. (1993) The ecological impact of drainage scheme design on salmonid stocks in the River Bonet with particular reference to newly created shallow areas .Water of Life. *Royal Dublin Society Seminar Proceedings, Number 5 p.163-166.*

O'GRADY, M.F., O'NEILL, J. and MOLLOY, S. (1997) Optimising Natural Production. Atlantic Salmon Trust / Atlantic Salmon Foundation Conference – Managing Wild Atlantic Salmon : New Challenges, New Techniques – Galway, September, 1997.

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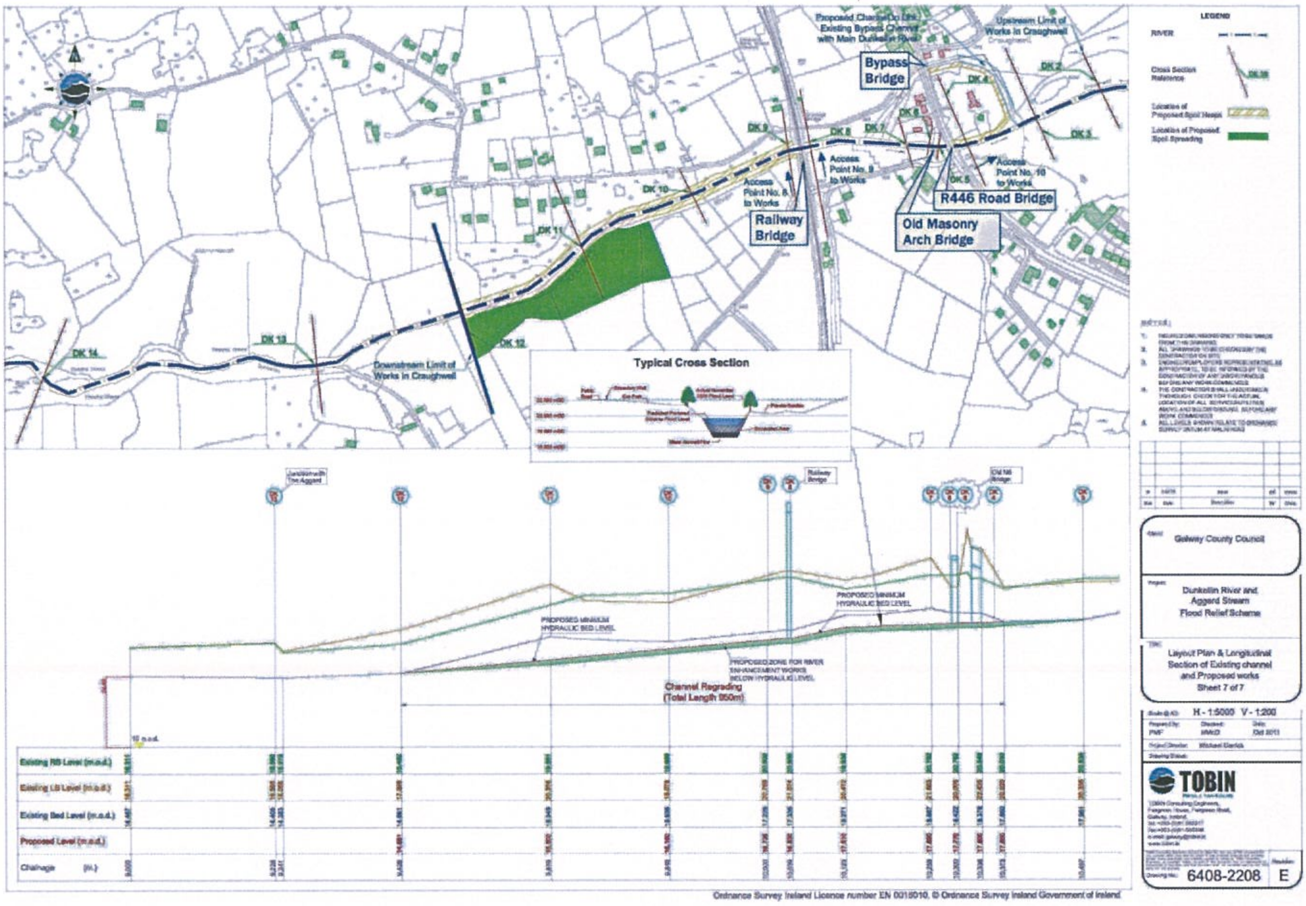
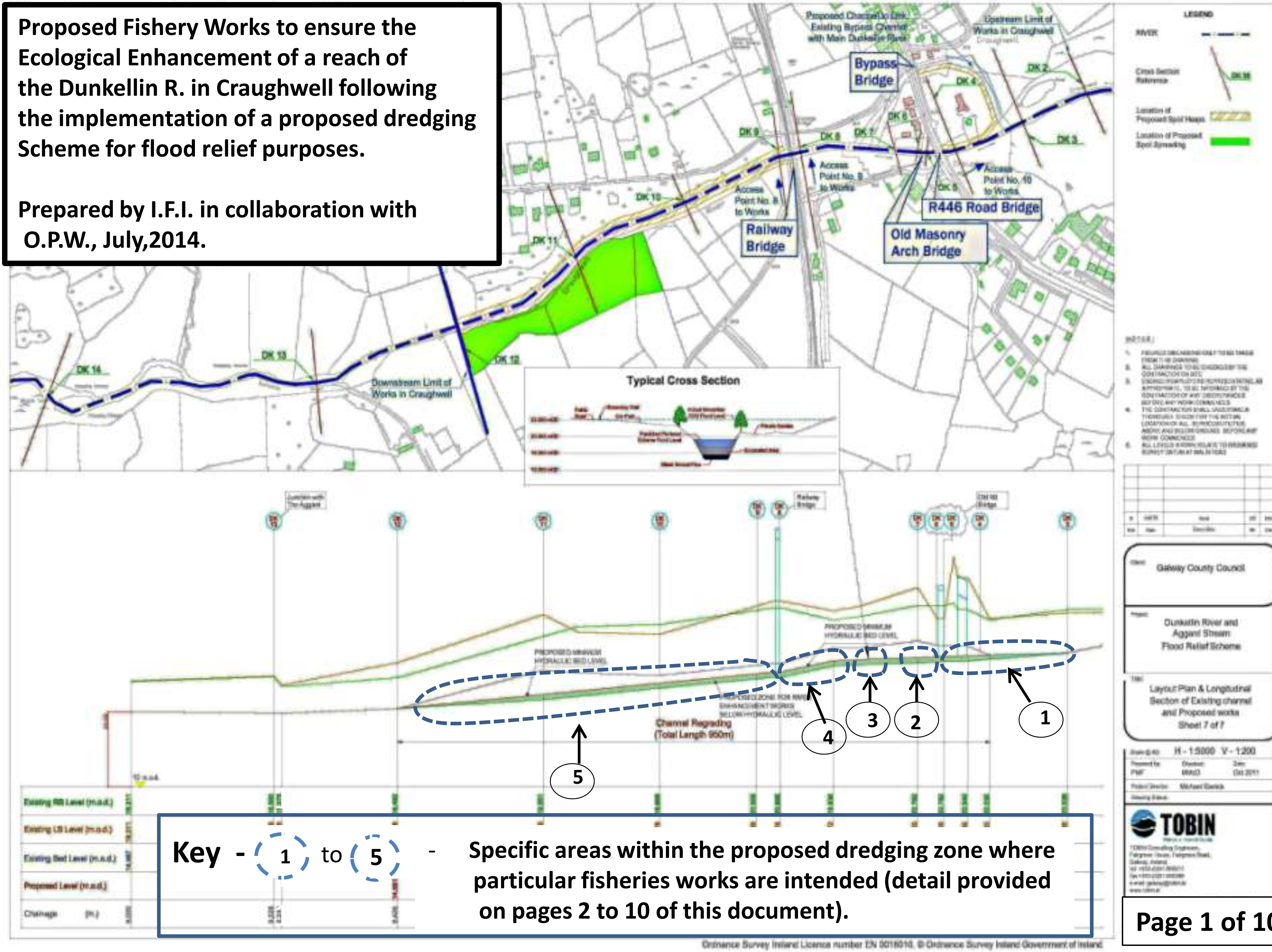


Figure 1. The location, nature and extent of the proposed flood relief scheme on the Craughwell River.

Proposed Fishery Works to ensure the Ecological Enhancement of a reach of the Dunkellin R. in Craughwell following the implementation of a proposed dredging Scheme for flood relief purposes.

Prepared by I.F.I. in collaboration with O.P.W., July,2014.

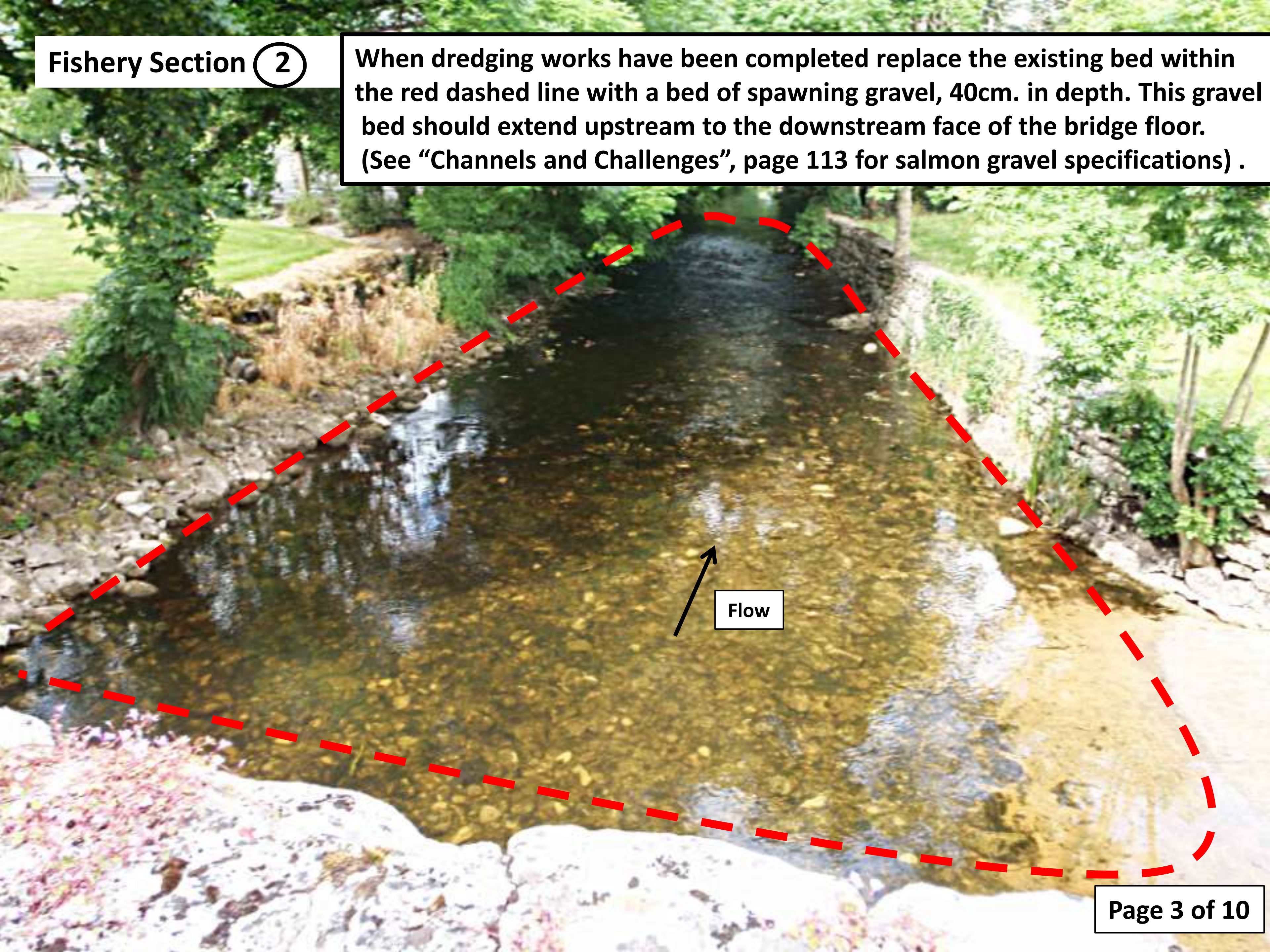


Key - 1 to 5 - Specific areas within the proposed dredging zone where particular fisheries works are intended (detail provided on pages 2 to 10 of this document).


Fishery Section 1
When dredging is complete in Zone 1. place the existing heavy cobble material currently on the bed back in situ or, replace it with similar material .
Keep any disturbance to the riparian zone to a minimum.
Flow
Looking u/s from the R446 Bridge.

Fishery Section 2

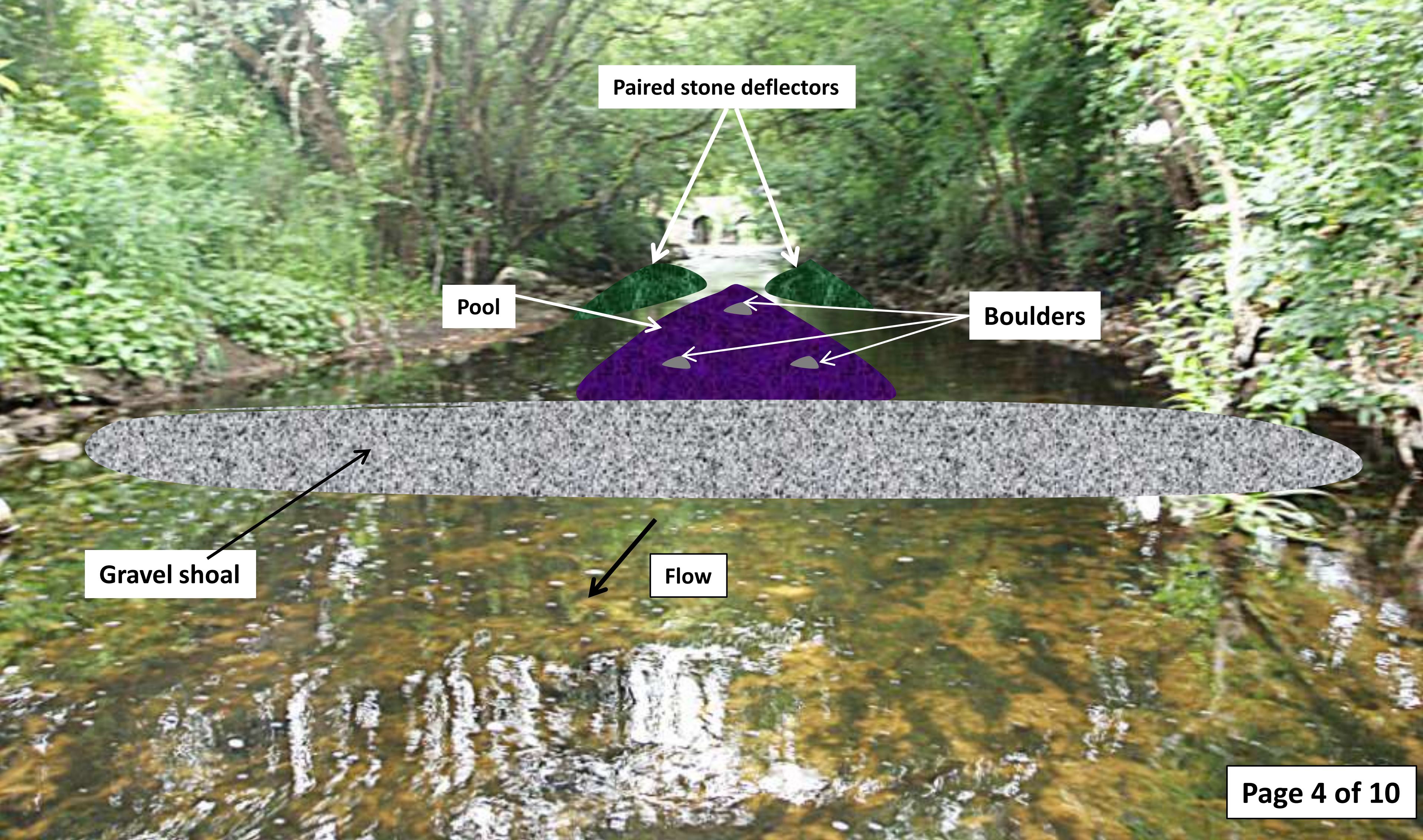
When dredging works have been completed replace the existing bed within the red dashed line with a bed of spawning gravel, 40cm. in depth. This gravel bed should extend upstream to the downstream face of the bridge floor. (See “Channels and Challenges”, page 113 for salmon gravel specifications) .



Not to scale

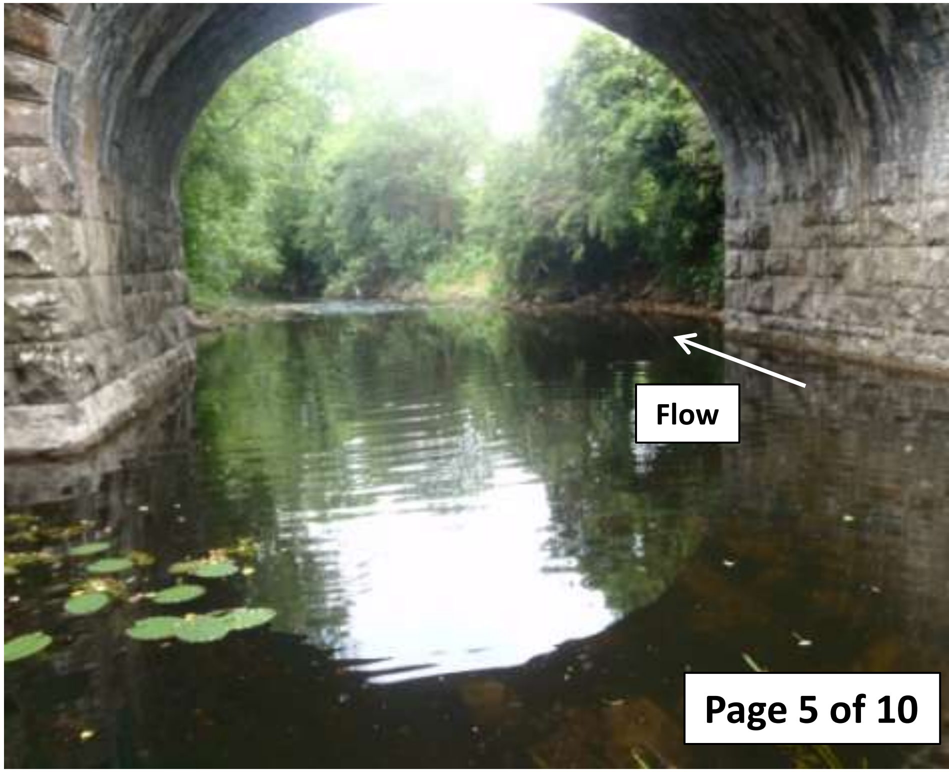
Fishery Section 3

Construct a paired stone deflector with associated pool and gravel spawning shoal at this location. (See appendix for details). The specifications for all proposed paired deflectors, associated pools , boulders and gravel shoals throughout this scheme are the same.



Fishery Section 4
Sequential views looking d/s through Fishery Section 4 from it's upper reaches to the end of this zone at the Railway Bridge.

Following dredging cover the bed of this channel reach with the type of heavy cobble presently in situ and place large boulders (1.5 to 2.0 tonnes) in the channel at 10m. centres.



Fishery Section 5

Currently the morphology of Fishery Section 5 is relatively uniform in nature with a cobbled bed throughout. There is only one high point on the bed in the middle of this reach (illustrated in this photo). Following the proposed flood relief dredging operation there will be a moderate gradient through a uniform glide over the entire length of Fishery Section 5 (circa 540m.). This will allow one to construct 12 paired stone deflectors with associated pools and gravel shoals, equidistant from one another, over this entire reach. The river bed sections, in between these structures, should be covered with a single layer of large cobbles like those evident along the margins in this photo.

Tunnelling Problems

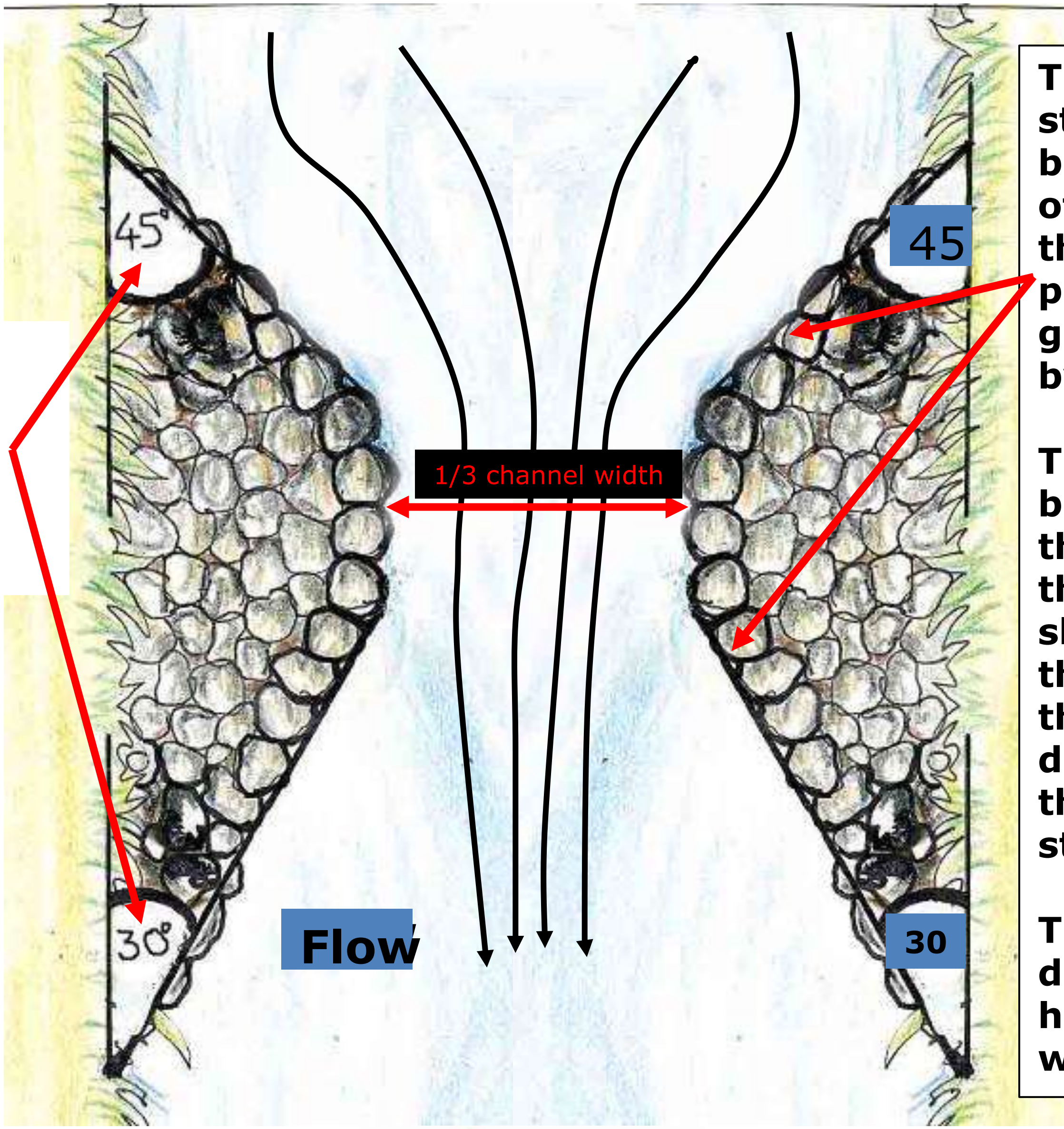
Long sections of this channel reach are heavily tunnelled from the “old masonry bridge” downstream to the end of the proposed dredging reach – note the paucity of ---The overall ecological diversity of flora and fauna in the channel would benefit from a pruning programme carried out along the right bank. Selected areas for pruning should increase the incident light levels on the newly established riffle areas following the proposed physical enhancement of the channel.

Appendix

Key construction features of paired stone deflectors With associated pools and gravel shoals.

A Paired Deflector – Key Features Irrespective of Channel Size

These angles are important to generate the proper flow regime.



The largest heaviest stones available should be used at the outer tip of each deflector where the maximum erosive pressure will be generated by river flows.

These stones will have to be buried a little more than the others because the structure needs to slope out and down from the bank ie. the stones at the outer tip of the deflector need to be at the lowest point of the structure.

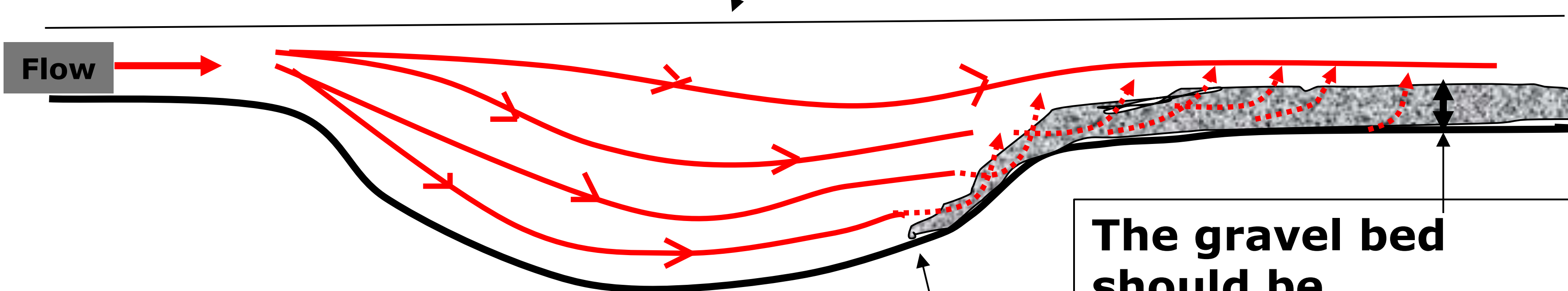
The outer tip of each deflector should be no higher than summer water level.

Iascach Intíre Éireann
Inland Fisheries Ireland

Key Features of Gravel Placement.

Summer Water level

Upwelling of water through the gravels **is essential.**



The gravel bed should be 35 to 40 cm. deep. See "Channels and Challenges" for dimensions

River Bed

The pool and gravel bed should be about the same length – about 1.5 times the channel width.

Start to place gravel in the "tail" of the pool.

GALWAY COUNTY COUNCIL

Comhairle Chontae na Gaillimhe

DUNKELLIN RIVER AND AGGARD STREAM FLOOD RELIEF SCHEME

WORKS DESCRIPTION DRAWINGS

SEPTEMBER 2014

TOBIN
Consulting Engineers

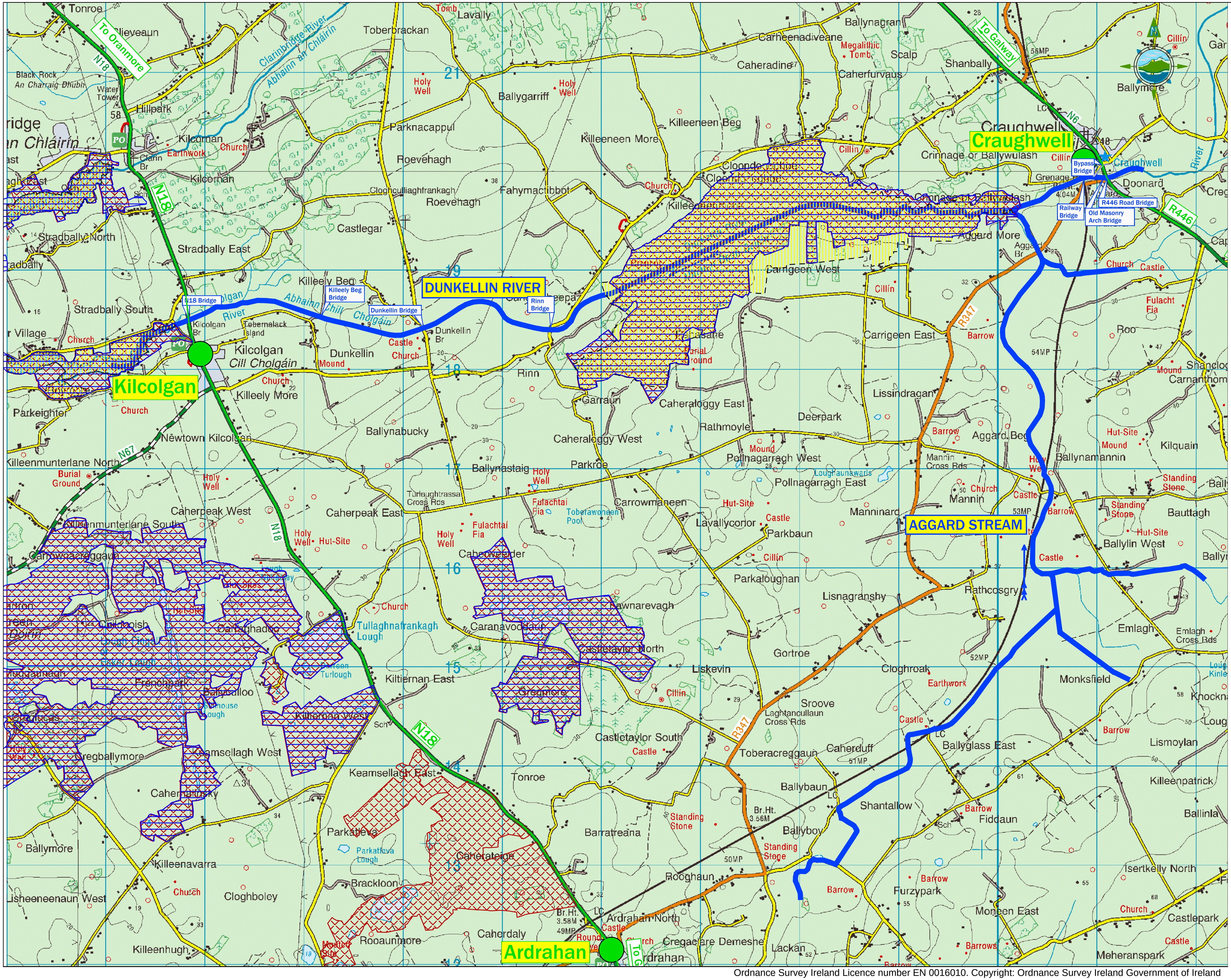
DUNKELLIN RIVER AND AGGARD STREAM FLOOD RELIEF SCHEME

TOBIN
Consulting Engineers

WORKS DESCRIPTION DRAWINGS

SEPTEMBER 2014

DRAWING	Rev	DESCRIPTION
6408-2200	A	Study Area Location
6408-2201	B	November 2009 Flood Event Estimated Flood Extents Based on Aerial Photography after the Event
6408-2202	F	Layout Plan and Longitudinal Section of Existing channel & Proposed Works Sheet 1 of 7
6408-2203	G	Layout Plan and Longitudinal Section of Existing channel & Proposed Works Sheet 2 of 7
6408-2204	G	Layout Plan and Longitudinal Section of Existing channel & Proposed Works Sheet 3 of 7
6408-2205	D	Layout Plan and Longitudinal Section of Existing channel & Proposed Works Sheet 4 of 7
6408-2206	C	Layout Plan and Longitudinal Section of Existing channel & Proposed Works Sheet 5 of 7
6408-2207	C	Layout Plan and Longitudinal Section of Existing channel & Proposed Works Sheet 6 of 7
6408-2208	F	Layout Plan and Longitudinal Section of Existing channel & Proposed Works Sheet 7 of 7
6408-2210	C	Proposed Works at Bridges on the Dunkellin River Sheet 1 of 2
6408-2211	C	Proposed Works at Bridges on the Dunkellin River Sheet 2 of 2
6408-2215	E	Proposed Works at Bridges on the Dunkellin River Sheet
6408-2216	D	Predicted Water Levels for 5%-ile Flows Pre & Post Flood Alleviation Works
6408-2217	D	Predicted Water Levels for 10%-ile Flows Pre & Post Flood Alleviation Works
6408-2218	D	Predicted Water Levels for Mean Annual Flow Conditions Pre & Post Flood Alleviation Works
6408-2220	A	Layout Plan of Proposed Works Along Aggard Stream
6408-2221	C	Locations of Proposed Culvert Replacement along Aggard Stream Sheet 1 of 2
6408-2222	C	Locations of Proposed Culvert Replacement along Aggard Stream Sheet 2 of 2
6408-2250	A	Location of Site Notices



LEGEND

- RIVER
- SPECIAL PROTECTION AREAS (SPA's)
- PROPOSED NATURAL HERITAGE AREAS (pNHA's)
- NATURAL HERITAGE AREAS (NHA's)
- SPECIAL AREAS OF CONSERVATION (SAC's)

NOTES:

1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE
3. ENGINEER/EMPLOYERS REPRESENTATIVE, AS APPROPRIATE, TO BE INFORMED BY THE CONTRACTOR OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES
4. THE CONTRACTOR SHALL UNDERTAKE A THOROUGH CHECK FOR THE ACTUAL LOCATION OF ALL SERVICES/UTILITIES, ABOVE AND BELOW GROUND, BEFORE ANY WORK COMMENCES
5. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Rev	Date	Description	By	Chkd.
A	Oct'11	First Issue	PMF	MMcD

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Study Area Location

Scale @ A1: 1:17,500
Scale @ A3: 1:35,000

Prepared by:	Checked:	Date:
PMF	MMcD	Oct 2011

Project Director: Michael Garrick

Drawing Status:

TOBIN
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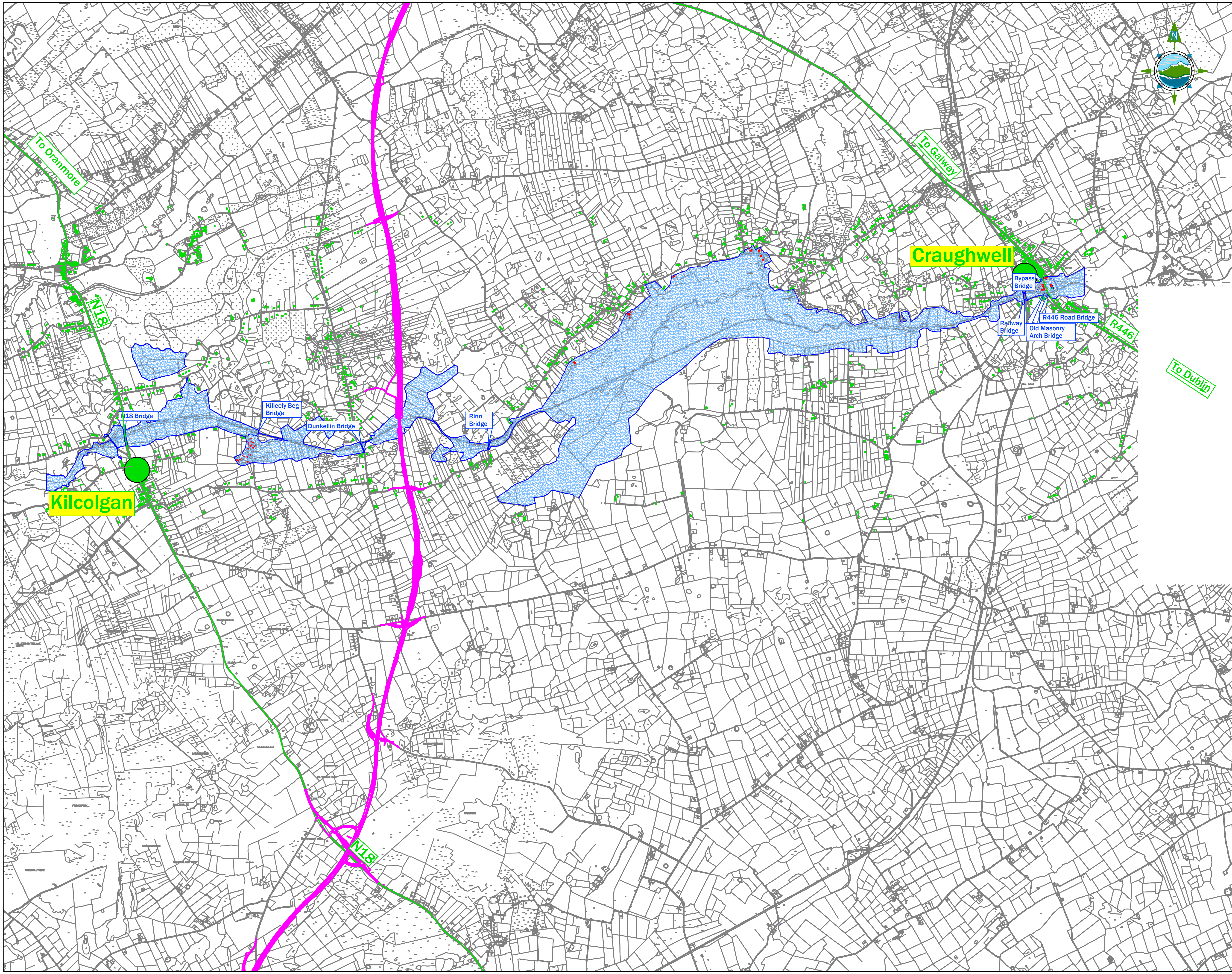
Drawing No.: 6408-2200
Revision: A



LEGEND

Estimated flood extent based on aerial photography after the November 2009 event

Proposed M18 Motorway

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5. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Rev	Date	Description	By	Chkd.
B	July/14	Issue	CK	MMcD

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: November 2009 Flood Event Estimated Flood Extents Based on Aerial Photography after the Event

Scale @ A1: 1:17,500
Scale @ A3: 1:35,000

Prepared by: PFM
Checked: MMcD
Date: Oct 2011

Project Director: Michael Garrick

Drawing Status:

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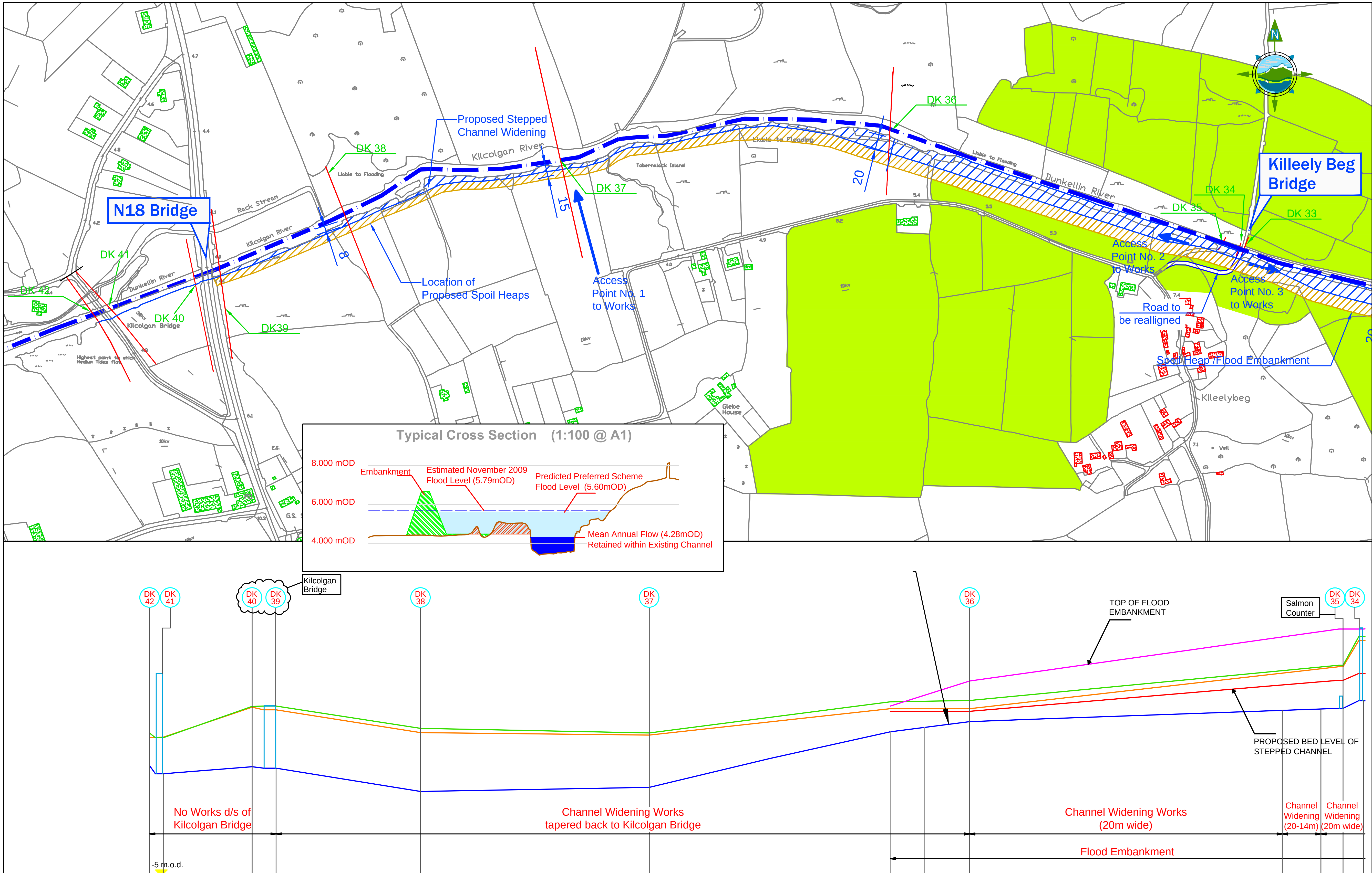
Drawing No.: 6408-2201
Revision: B



Existing RB Level (m.o.d.)	2.369	2.130	3.749	3.769	2.614	2.376	3.988	4.018	4.059	5.574	5.780	5.872	7.353
Existing LB Level (m.o.d.)	2.154	2.162	3.707	3.576	2.393	2.270	3.635	3.635	3.635	5.466	5.691	7.151	7.151
Existing Bed Level (m.o.d.)	0.683	0.269	0.636	0.559	-0.642	-0.427	2.437	2.664	2.967	3.547	3.619	3.652	4.043
Proposed Stepped Channel Level (m.o.d.)							3.500	3.500	3.500	4.855	5.023	5.100	5.450
Top of Proposed Embankment (m.o.d.)							3.769	4.323	5.060	7.338	7.614	7.750	7.750
Chainage (m.)	0	17	132	163	350	645	956	1.000	1.058	1.462	1.512	1.540	1.567

LEGEND

- RIVER
- Cross Section Reference (DK 38)
- Proposed Stepped Channel Widening
- Location of Proposed Spoil Heaps / Flood Embankments
- Location of Proposed Spoil Spreading

NOTES:

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5. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Rev	Date	Description	By	Chkd.
F	Sept/14	Issue	CK	MMcD

Client: Galway County Council

Project: Dunkellin River and and Aggard Stream Flood Relief Scheme

Title: Layout Plan & Longitudinal Section of Existing channel and Proposed works Sheet 1 of 7

Scale @ A1: H - 1:2500 V - 1:100
Scale @ A3: H - 1:5000 V - 1:200

Prepared by:	Checked:	Date:
PFM	MMcD	Oct 2011

Project Director: Michael Garrick

Drawing Status:

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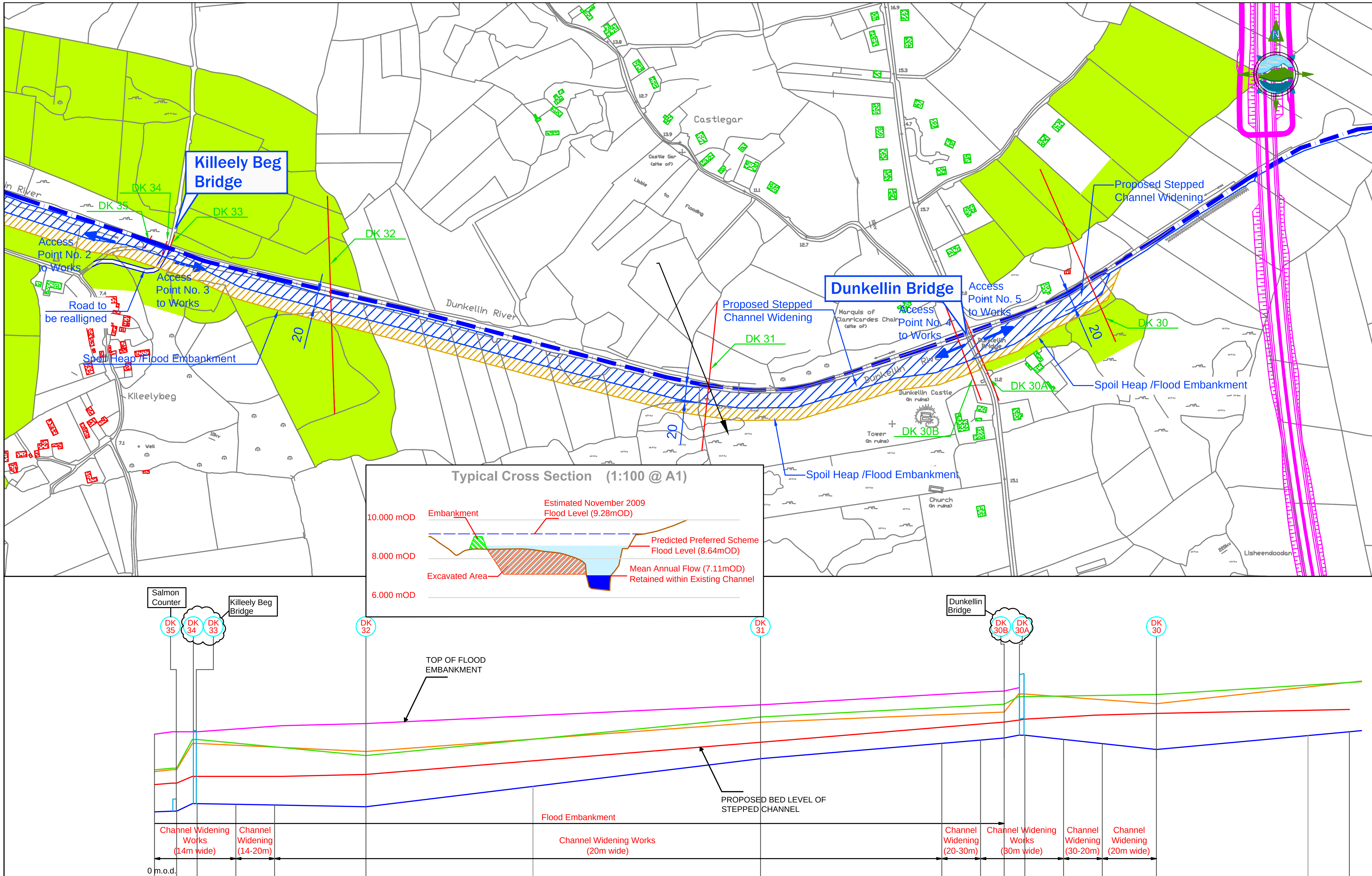
Drawing No.: 6408-2202 Revision: F



Existing RB Level (m.o.d.)	5.780	5.872	7.353	7.162	6.971	6.521	7.364	8.513	9.002	9.107	9.170	9.563	9.595	9.627	9.671	10.063	10.298
Existing LB Level (m.o.d.)	5.691	7.151	7.151	7.056	6.960	6.735	7.364	8.237	8.631	8.716	8.766	9.699	9.552	9.405	9.200	10.063	10.298
Existing Bed Level (m.o.d.)	3.619	3.652	4.043	4.006	3.970	3.883	4.931	6.359	7.154	7.323	7.426	7.572	7.355	7.137	6.833	7.552	7.748
Proposed Stepped Channel Level (m.o.d.)	5.023	5.100	5.450	5.450	5.450	5.550	6.252	7.210	7.983	8.148	8.250	8.400	8.508	8.613	8.700	8.857	8.900
Top of Proposed Embankment (m.o.d.)	7.614	7.750	7.750	7.892	8.035	8.170	8.580	9.140	9.686	9.802	9.850	10.014					
Chainage (m.)	1,512	1,540	1,567	1,567	1,667	1,785	2,000	2,294	2,528	2,578	2,608	2,635	2,685	2,735	2,804	3,000	3,053

LEGEND

- RIVER
- Cross Section Reference (DK 38)
- Proposed Stepped Channel Widening
- Location of Proposed Spoil Heaps / Flood Embankments
- Location of Proposed Spoil Spreading
- Proposed M18 Motorway

NOTES:

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5. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Rev	Date	Description	By	Chkd.
G	Sept/14	Issue	CK	MMcD

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Layout Plan & Longitudinal Section of Existing channel and Proposed works Sheet 2 of 7

Scale @ A1: H - 1:2500 V - 1:100
Scale @ A3: H - 1:5000 V - 1:200

Prepared by:	Checked:	Date:
PFM	MMcD	Oct 2011

Project Director: Michael Garrick

Drawing Status:

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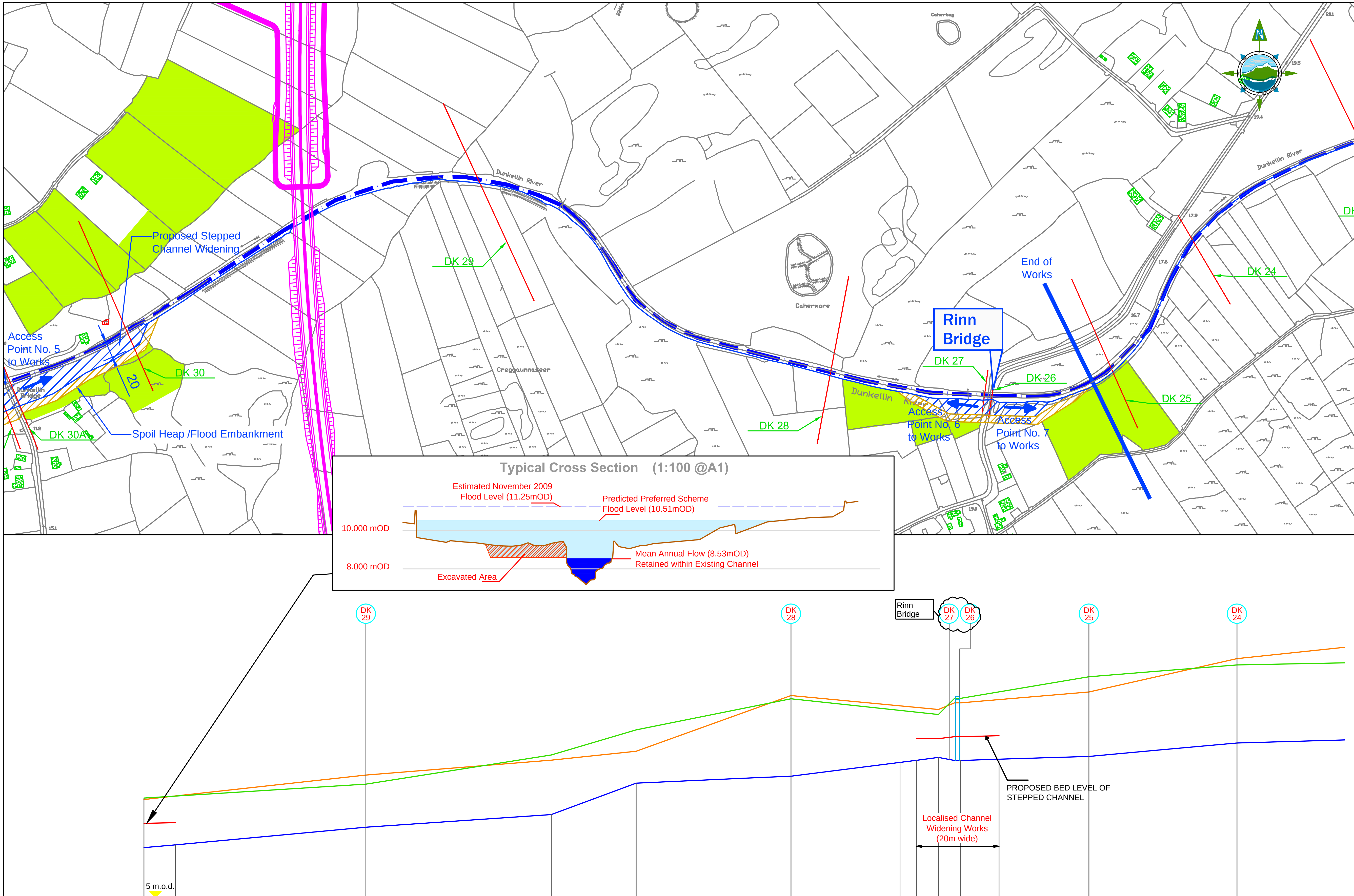
Drawing No.: 6408-2203
Revision: G



Existing RB Level (m.o.d.)	10.298	10.919	12.443	13.751	15.382	15.012	14.680	14.556	15.406	15.741	16.527	17.152
Existing LB Level (m.o.d.)	10.298	11.395	12.172	12.634	15.548	15.012	14.931	14.822	15.167	15.337	15.736	17.477
Existing Bed Level (m.o.d.)	7.748	8.664	9.323	10.969	11.333	12.052	12.160	12.312	12.155	12.220	12.370	13.070
Proposed Stepped Channel Level (m.o.d.)	8.900						13.300	13.300	13.400	13.450		
Chainage (m.)	3,053	3,302	3,544	3,655	3,858	4,000	4,021	4,050	4,079	4,129	4,247	4,440

LEGEND

- RIVER
- Cross Section Reference (DK 38)
- Proposed Stepped Channel Widening
- Location of Proposed Spoil Heaps
- Location of Proposed Spoil Spreading
- Proposed M18 Motorway

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Rev	Date	Description	By	Chkd.
G	Sept/14	Issue	CK	MMcD

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Layout Plan & Longitudinal Section of Existing channel and Proposed works Sheet 3 of 7

Scale @ A1:	H - 1:2500	V - 1:100
Scale @ A3:	H - 1:5000	V - 1:200

Prepared by:	Checked:	Date:
PMF	MMcD	Oct 2011

Project Director: Michael Garrick

Drawing Status:

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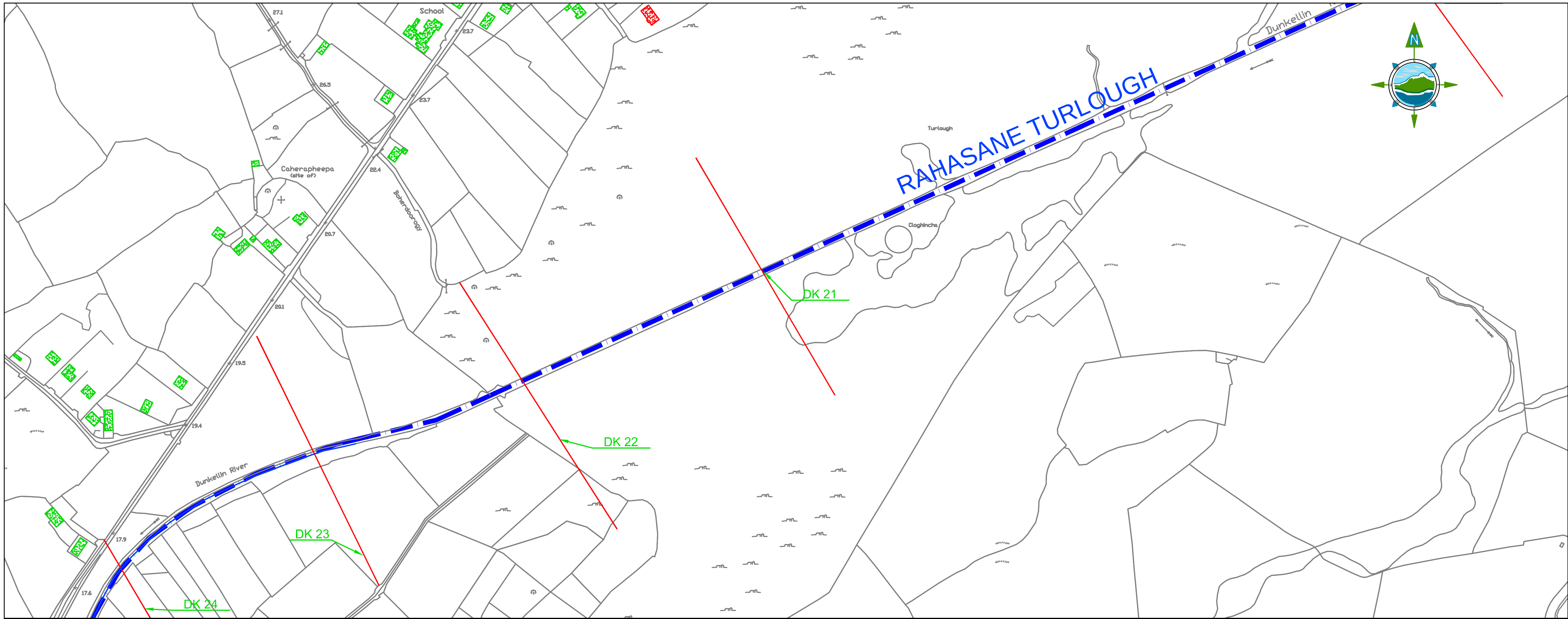
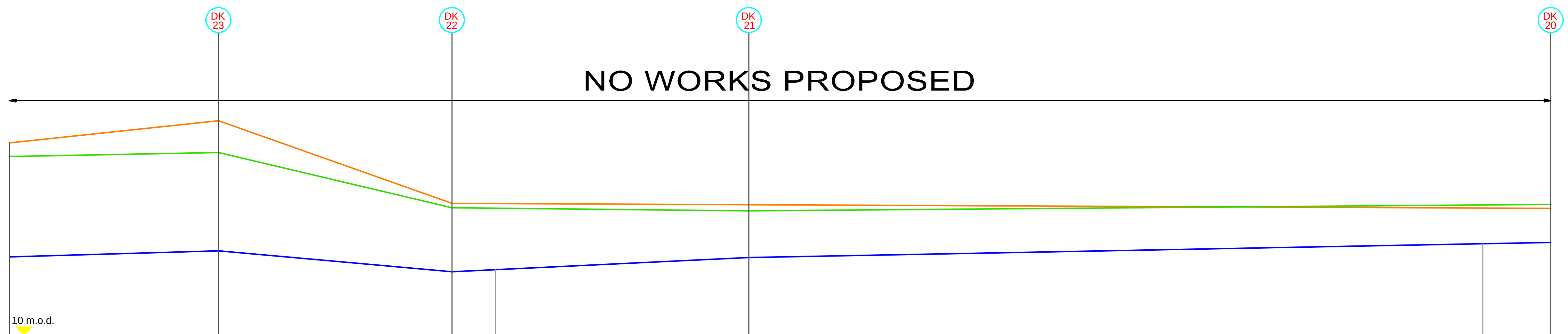
Drawing No.: 6408-2204 Revision: G





Existing RB Level (m.o.d.)	17.205	17.249	15.136	15.307	15.008	15.125	15.271
Existing LB Level (m.o.d.)	17.760	18.652	15.315	15.307	15.260	15.125	15.112
Existing Bed Level (m.o.d.)	13.146	13.387	12.545	12.629	13.120	13.677	13.729
Chainage (m.)	4.507	4.719	4.956	5.000	5.257	6.000	6.069

LEGEND

- RIVER
- Cross Section Reference (DK 38)
- Proposed Stepped Channel Widening
- Location of Proposed Spoil Heaps
- Location of Proposed Spoil Spreading

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Rev	Date	Description	By	Chkd.
D	Sept/13	Issue	CK	MMcD

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Layout Plan & Longitudinal Section of Existing channel and Proposed works Sheet 4 of 7

Scale @ A1: H - 1:2500 V - 1:100
Scale @ A3: H - 1:5000 V - 1:200

Prepared by: PMF | Checked: MMcD | Date: Oct 2011

Project Director: Michael Garrick

Drawing Status:

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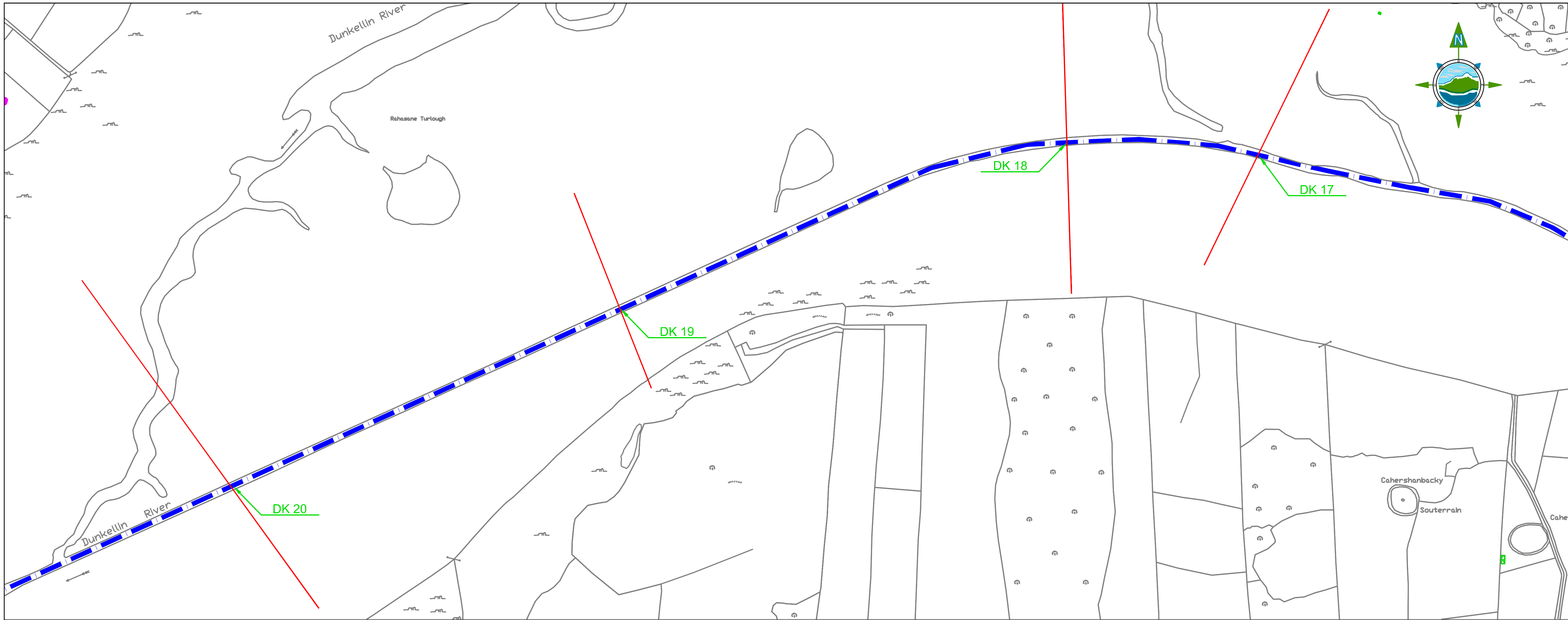
Drawing No.: 6408-2205 Revision: D



LEGEND

RIVER

Cross Section Reference — DK 38

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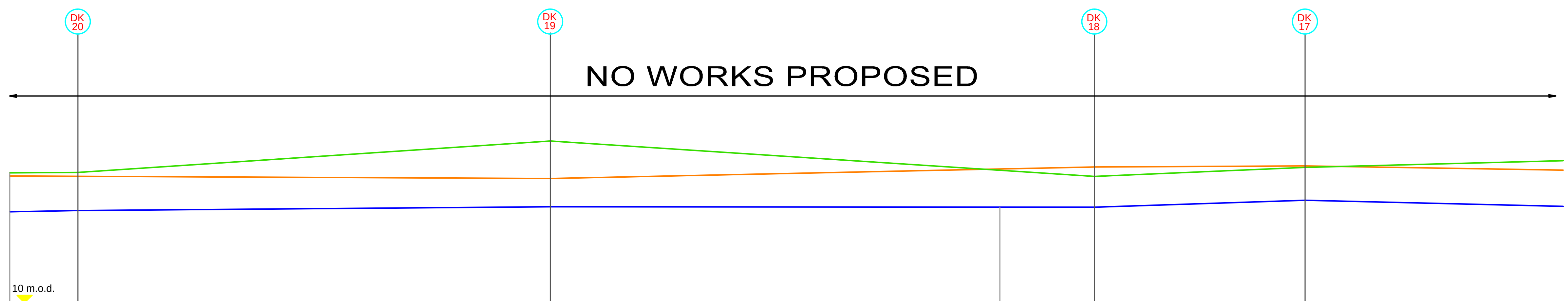
Rev	Date	Description	By	Chkd.
C	Sept/13	Issue	CK	MMcD



Existing RB Level (m.o.d.)	15.125	15.271	16.534	15.410	15.103	15.474
Existing LB Level (m.o.d.)	15.125	15.112	17.249	15.410	15.491	15.526
Existing Bed Level (m.o.d.)	13.677	13.729	13.878	13.865	13.862	14.146
Chainage (m.)	6.000	6.069	6.546	7.000	7.095	7.308

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Layout Plan & Longitudinal Section of Existing channel and Proposed works Sheet 5 of 7

	H	V
Scale @ A1:	H - 1:2500	V - 1:100
Scale @ A3:	H - 1:5000	V - 1:200

Prepared by: PMF | Checked: MMcD | Date: Oct 2011

Project Director: Michael Garrick

Drawing Status:

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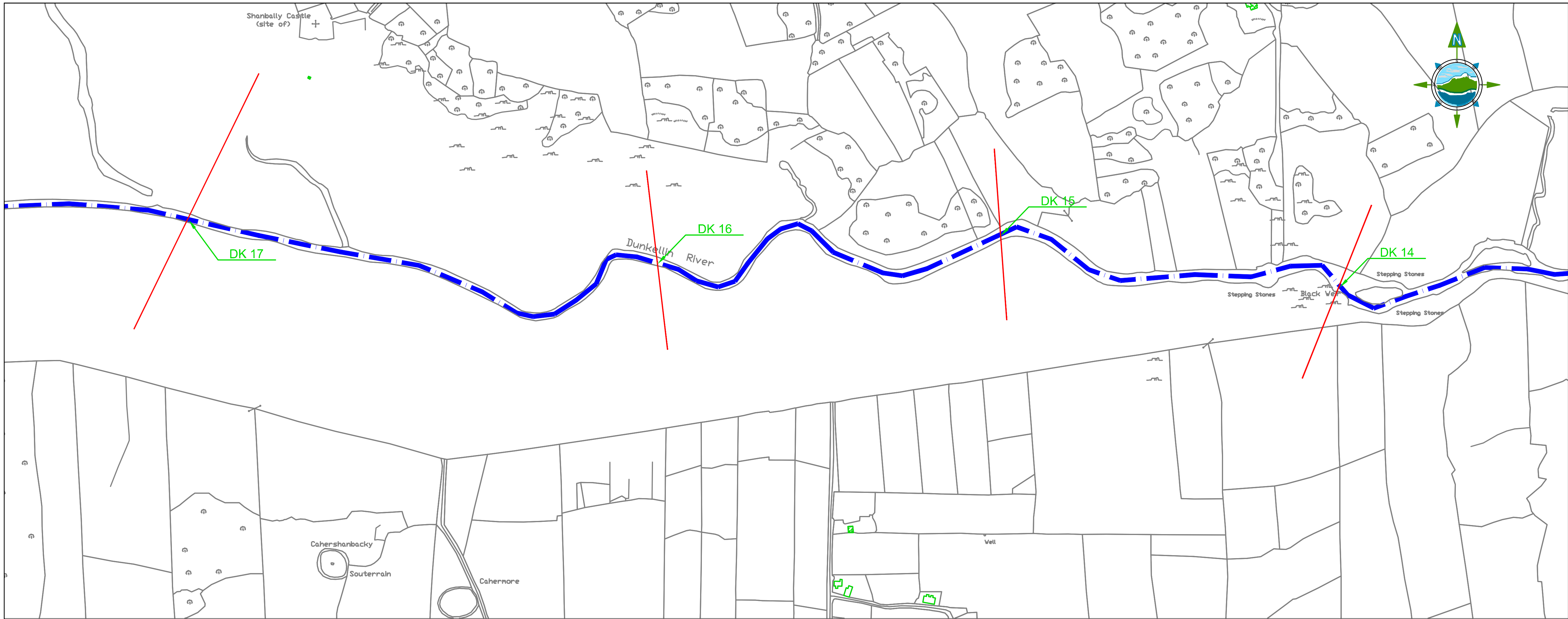
Drawing No.: 6408-2206 | Revision: C



LEGEND

RIVER

Cross Section Reference — DK 38

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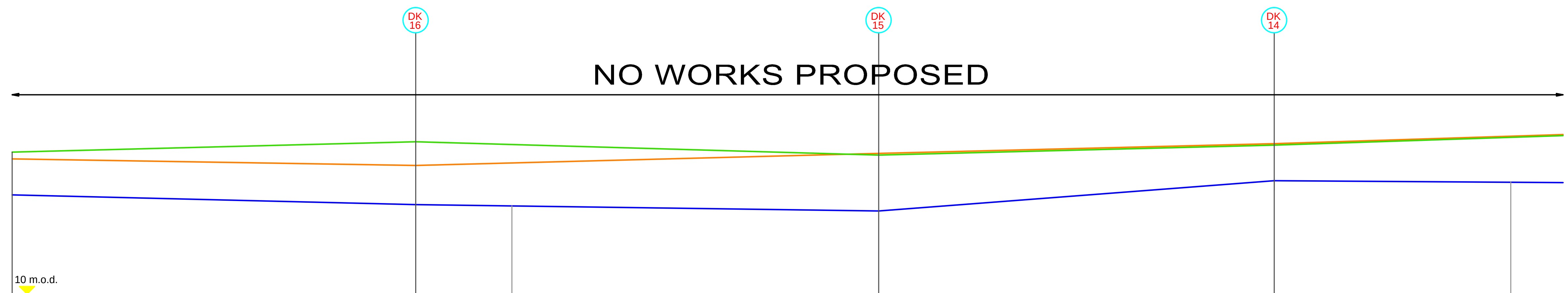
Rev	Date	Description	By	Chkd.
C	Sept/13	Issue	CK	MMcD



Existing RB Level (m.o.d.)	15.670	16.085	15.243	15.552	15.956	16.311
Existing LB Level (m.o.d.)	15.401	15.142	15.243	15.626	16.013	16.311
Existing Bed Level (m.o.d.)	13.961	13.577	13.523	13.317	14.532	14.467
Chainage (m.)	7.501	7.904	8.000	8.367	8.763	9.000

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Layout Plan & Longitudinal Section of Existing channel and Proposed works Sheet 6 of 7

Scale @ A1: H - 1:2500 V - 1:100
Scale @ A3: H - 1:5000 V - 1:200

Prepared by: PMF | Checked: MMcD | Date: Oct 2011

Project Director: Michael Garrick

Drawing Status:

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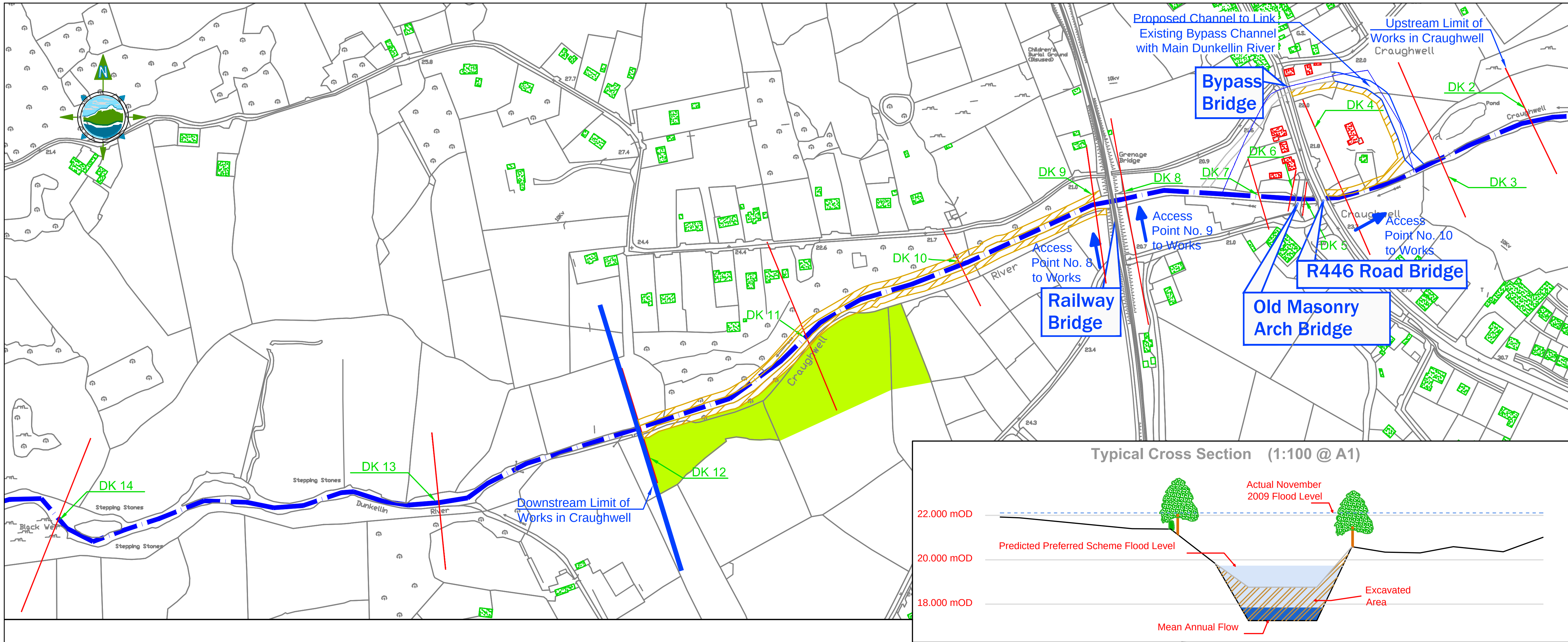
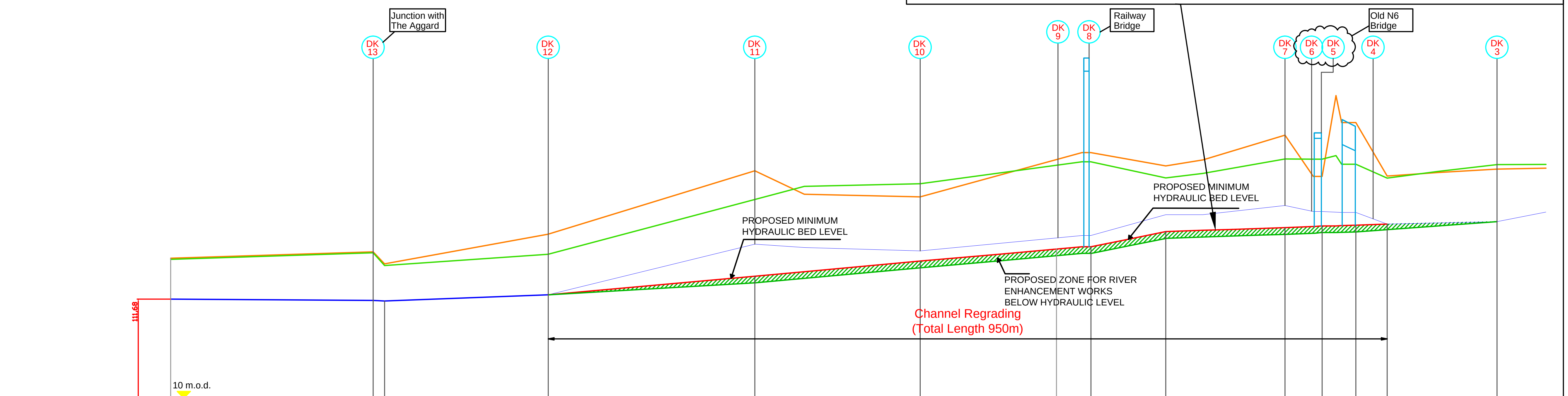
Drawing No.: 6408-2207 | Revision: C





Existing RB Level (m.o.d.)	16.311	16.560	15.978	16.492	19.551	19.669	20.509	20.666	19.936	20.792	20.782	20.549	20.030	20.538
Existing LB Level (m.o.d.)	16.311	16.598	16.056	17.398	20.256	19.078	20.759	21.074	20.472	21.863	20.005	22.435	20.020	20.335
Existing Bed Level (m.o.d.)	14.467	14.405	14.383	14.661	16.949	16.638	17.225	17.335	18.271	18.687	18.422	18.378	17.850	17.961
Proposed Level (m.o.d.)				14.661	15.500	16.180	16.726	16.830	17.510	17.690	17.770	17.800	17.850	
Chainage (m.)	9,000	9,228	9,241	9,426	9,659	9,846	10,000	10,039	10,123	10,258	10,300	10,338	10,373	10,497

LEGEND

- RIVER
- Cross Section Reference (DK 38)
- Location of Proposed Spoil Heaps
- Location of Proposed Spoil Spreading

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Rev	Date	Description	By	Chkd.
F	Sept/14	Issue	DC	MMcD

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Layout Plan & Longitudinal Section of Existing channel and Proposed works Sheet 7 of 7

Scale @ A1: H - 1:2500 V - 1:100
Scale @ A3: H - 1:5000 V - 1:200

Prepared by: PMF | Checked: MMcD | Date: Oct 2011

Project Director: Michael Garrick

Drawing Status:

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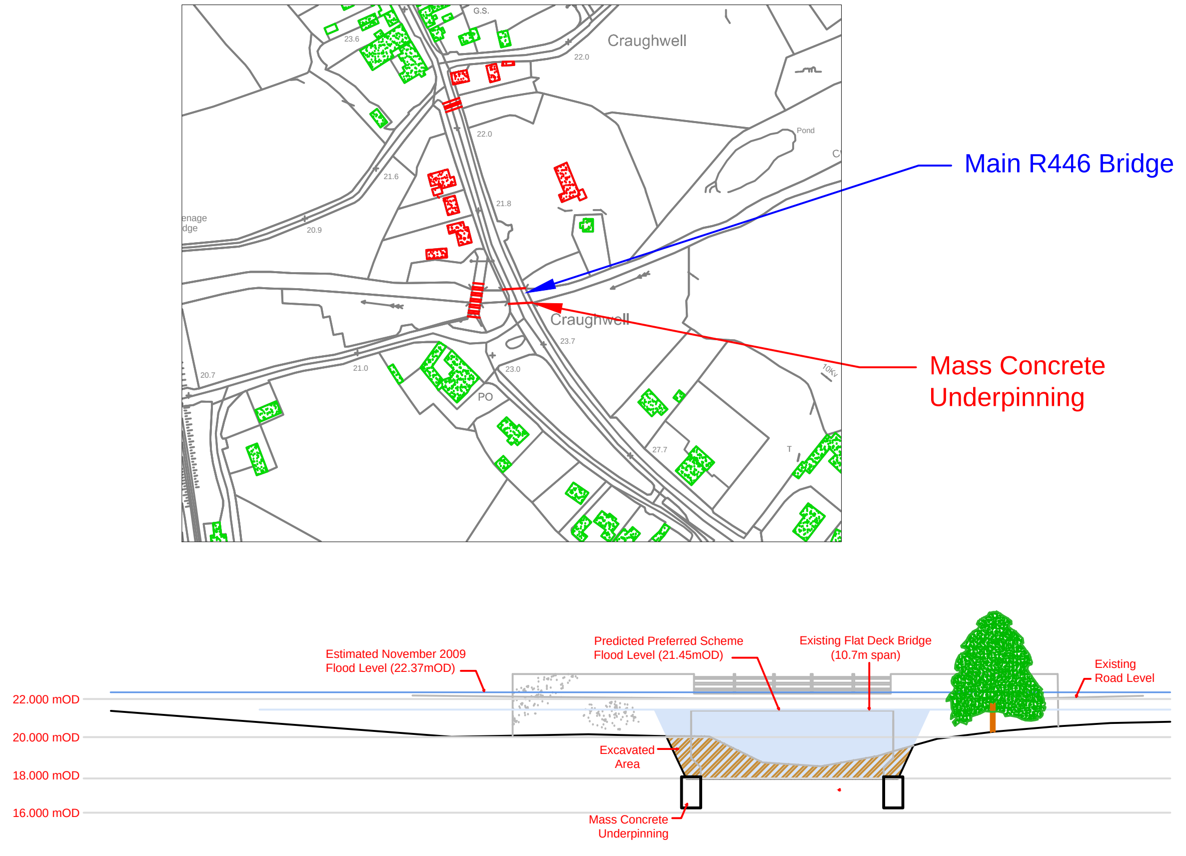
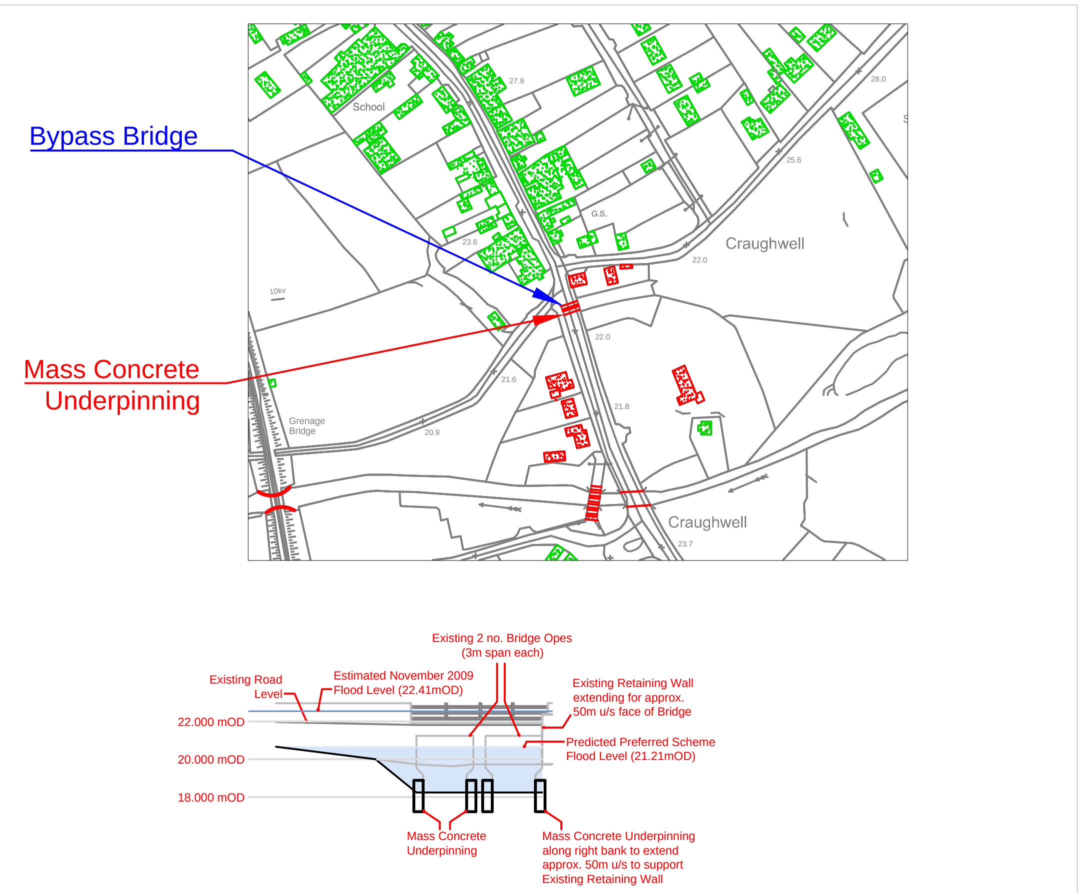
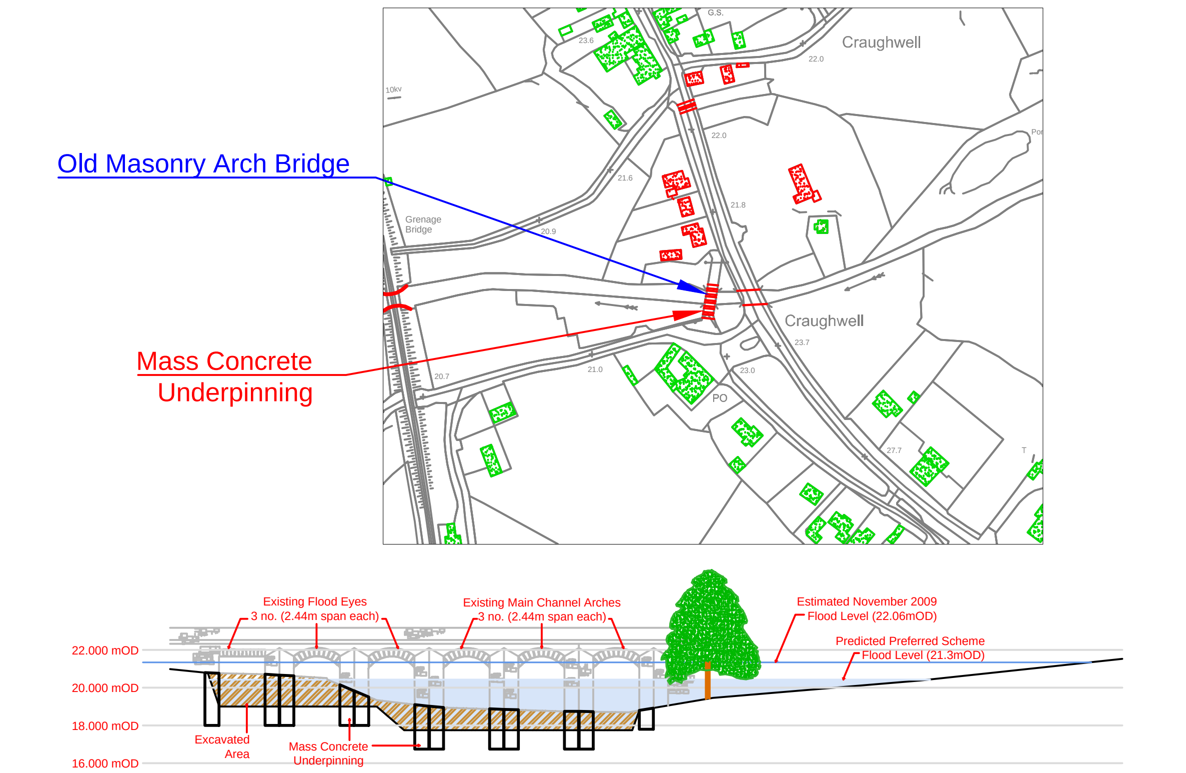
Drawing No.: 6408-2208 Revision: F



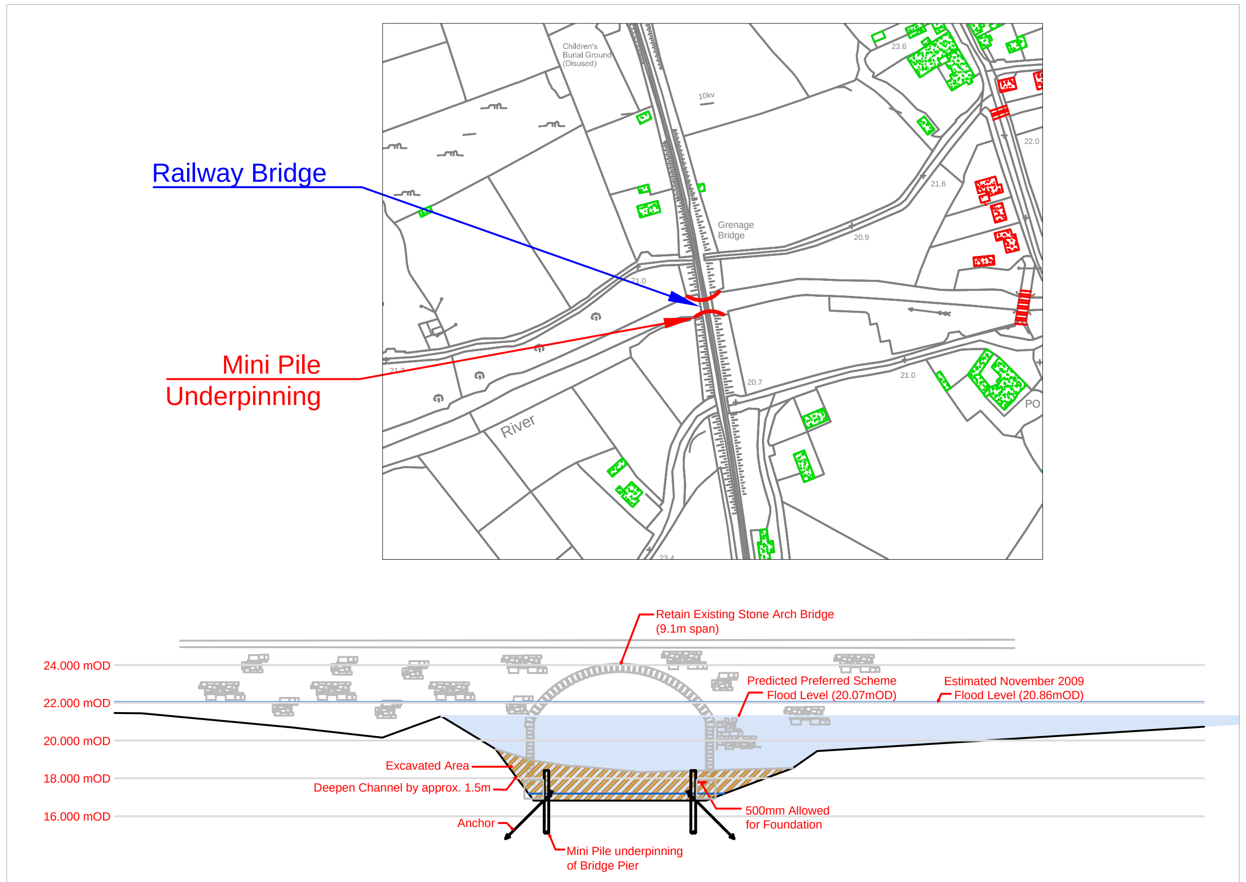
Main R446 Bridge



Bypass Channel Bridge



Old Masonry Arch Pedestrian Bridge



Railway Bridge

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Rev	Date	Description	By	Chkd.
C	Sept/14	Issue	CK	MMcD

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Proposed Works at Bridges on the Dunkellin River Sheet 1 of 2

Scale @ A1:	Elevation 1:200	Plan 1:2500
Scale @ A3:	Elevation 1:400	Plan 1:5000
Prepared by: PMF	Checked: MMcD	Date: Oct 2011

Project Director: Michael Garrick

Drawing Status:

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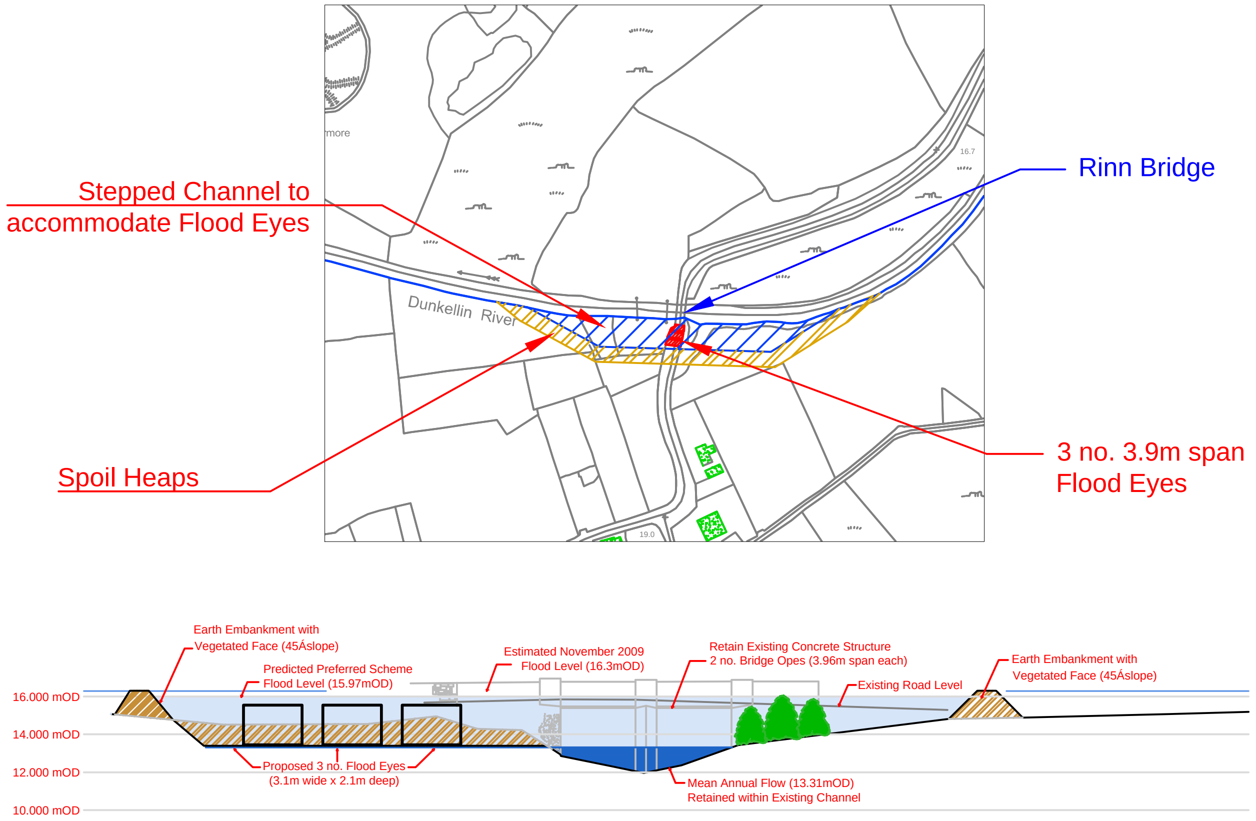
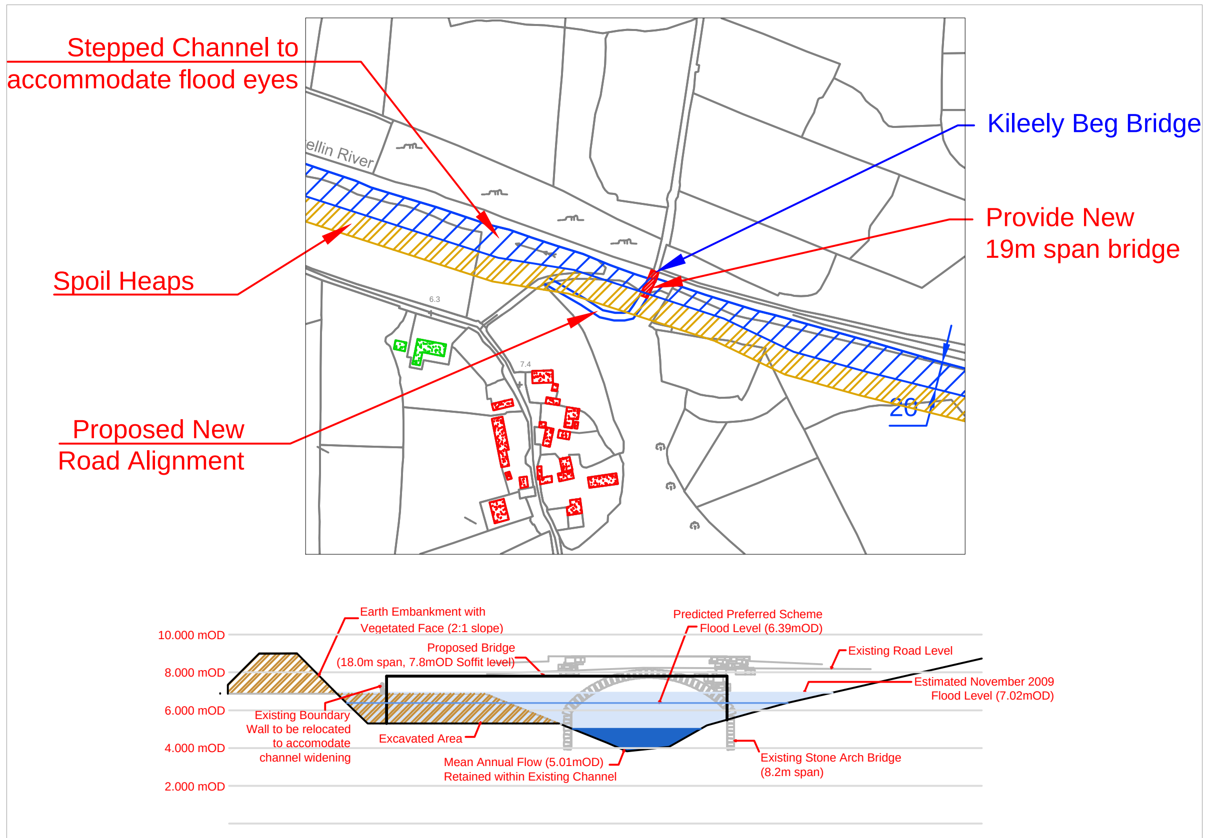
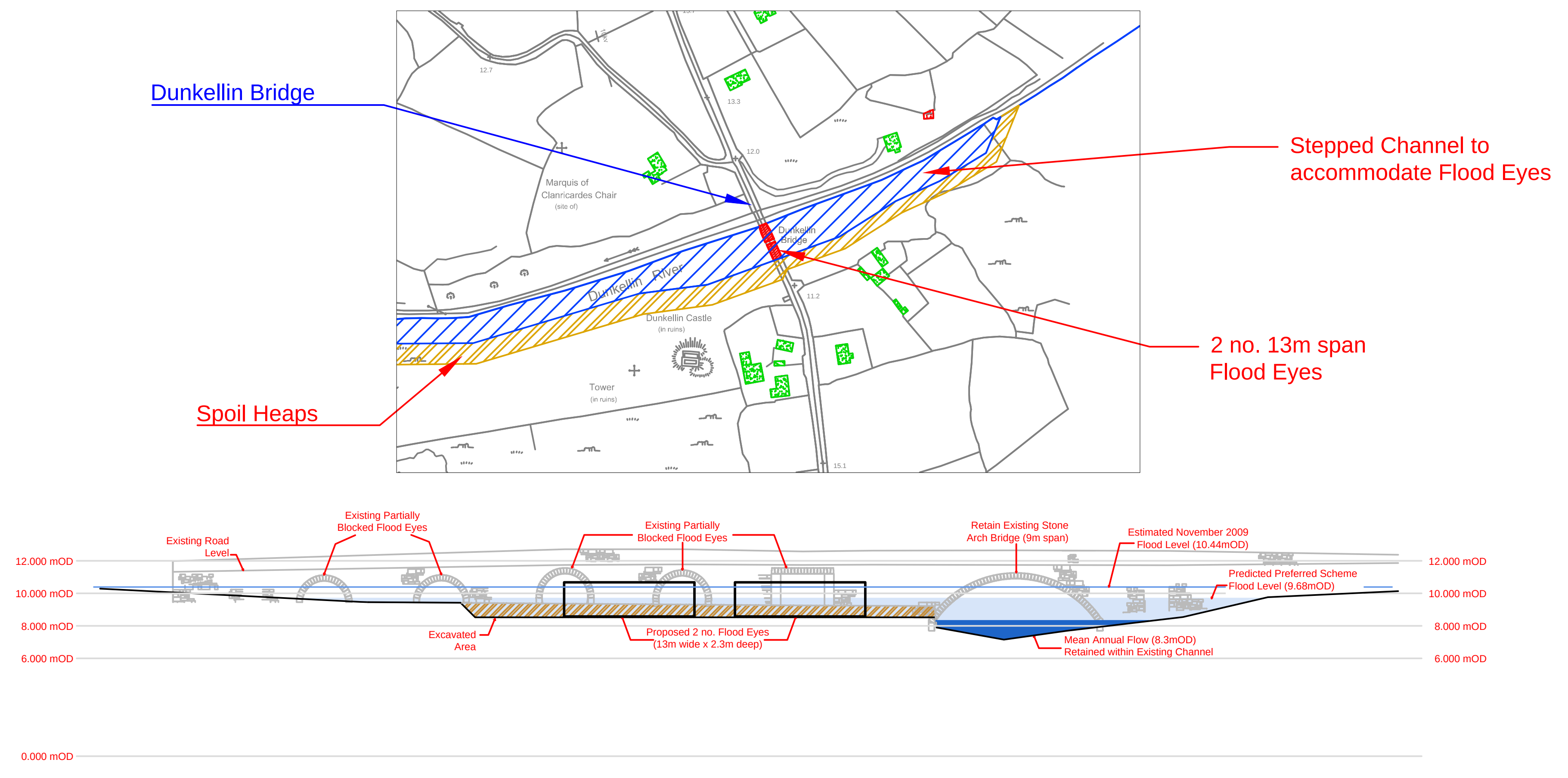
Drawing No.: 6408-2210 Revision: C



Rinn Bridge



Killeely Beg Bridge



Dunkellin Bridge

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Rev	Date	Description	By	Chkd.
C	Sept/14	Issue	CK	MMcD

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Proposed Works at Bridges on the Dunkellin River Sheet 2 of 2

Scale @ A1: Elevation 1:200 Plan 1:2500
Scale @ A3: Elevation 1:400 Plan 1:5000

Prepared by: PMF | Checked: MMcD | Date: Oct 2011

Project Director: Michael Garrick

Drawing Status:

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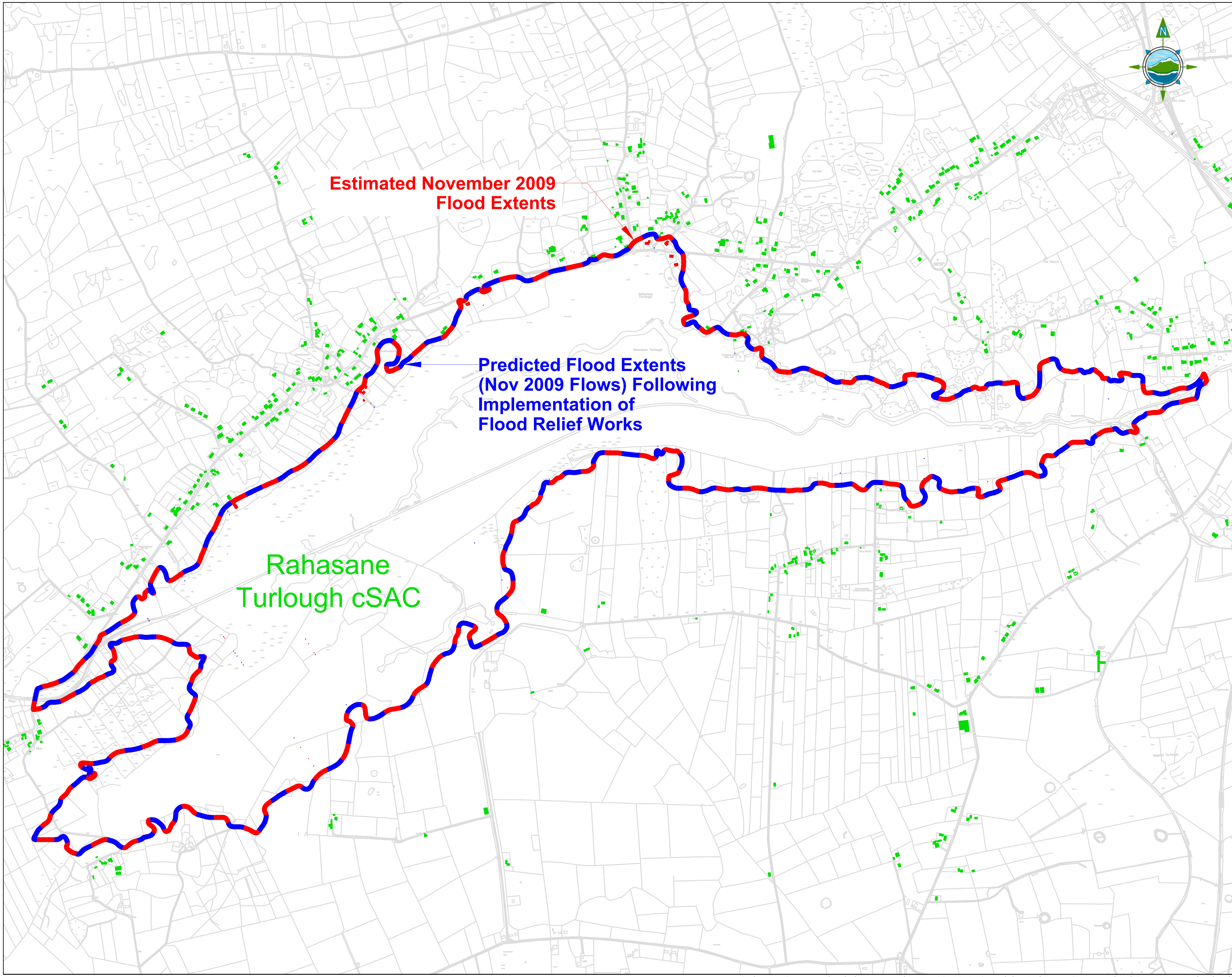
Drawing No.: 6408-2211 Revision: C



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E	July/14	Issue	CK	MMcD
Rev	Date	Description	By	Chkd.

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Predicted Water Levels for November 2009 flood event Pre & Post Flood Alleviation Works

Scale @ A1: 7,500
Scale @ A3: 15,000

Prepared by:	Checked:	Date:
PMF	MMcD	October 2011

Project Director: Michael Garrick

Drawing Status:

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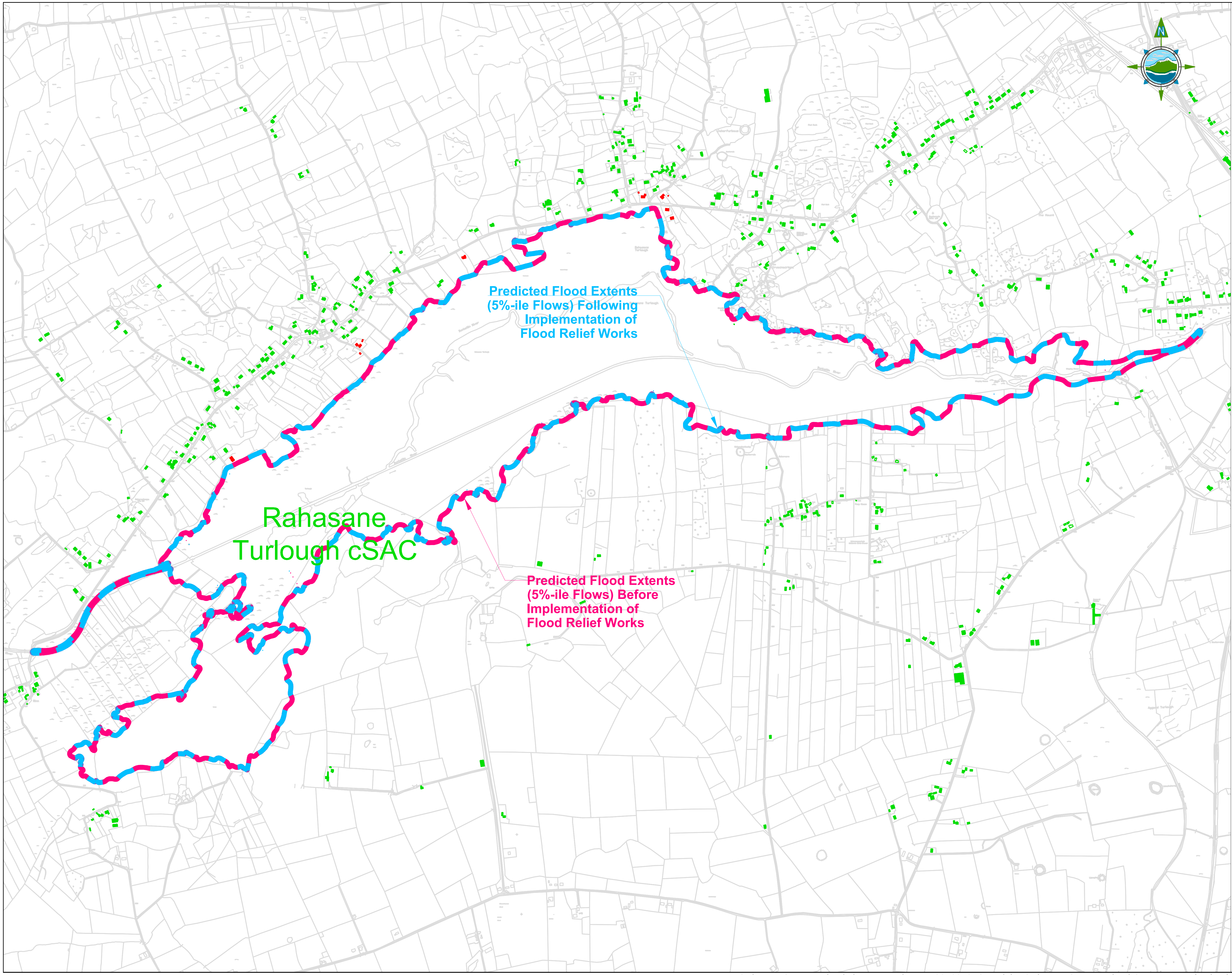
Drawing No.: 6408-2215

Revision: E



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D	July/14	Issue	CK	MMcD
Rev	Date	Description	By	Chkd.

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Predicted Water Levels for 5%-ile Flows Pre & Post Flood Alleviation Works

Scale @ A1: 7,500
Scale @ A3: 15,000

Prepared by: PMF
Checked: MMcD
Date: October 2011

Project Director: Michael Garrick

Drawing Status:

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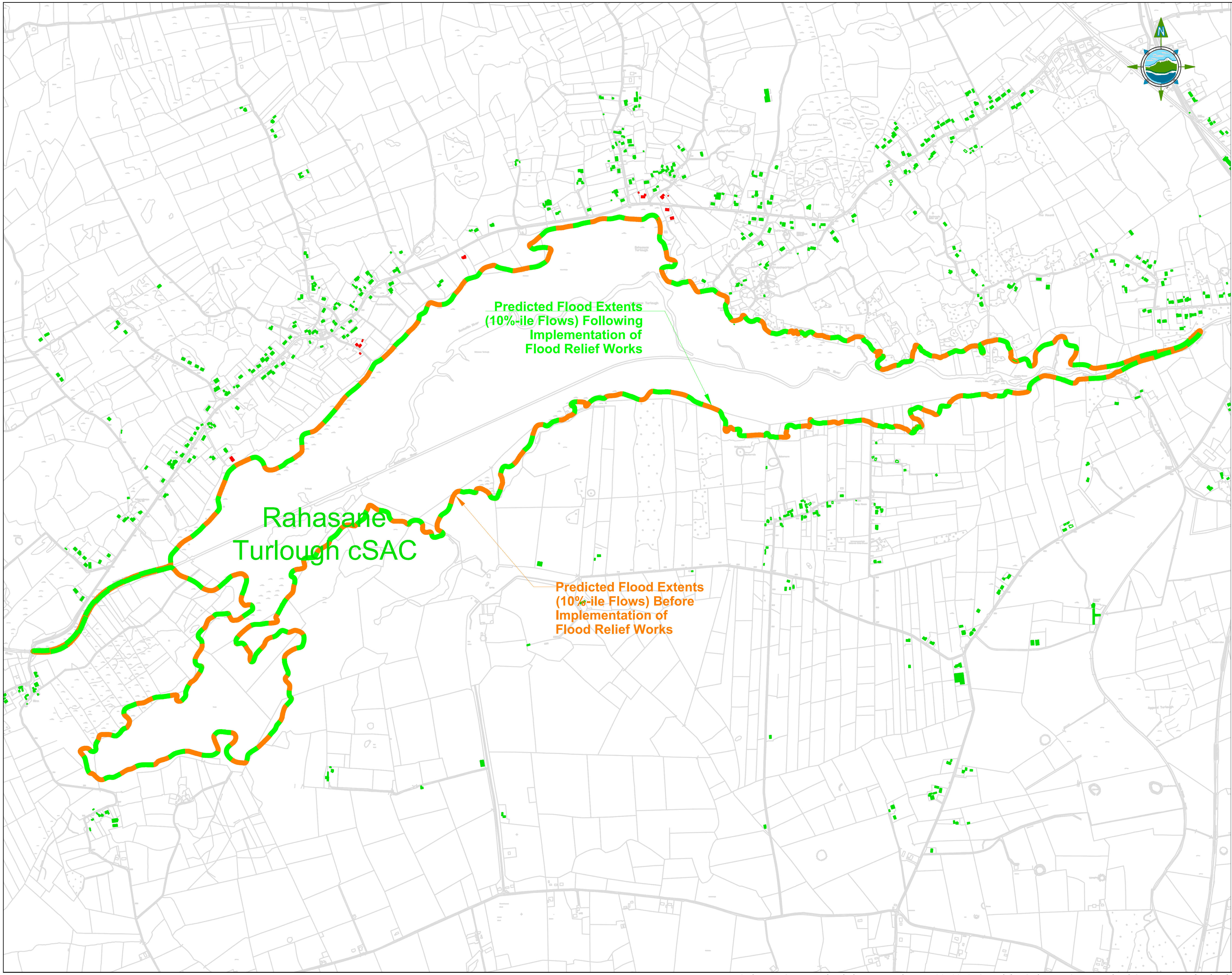
Drawing No.: 6408-2216
Revision: D



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D	July/14	Issue	CK	MMcD
Rev	Date	Description	By	Chkd.

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Predicted Water Levels for 10%-ile Flows Pre & Post Flood Alleviation Works

Scale @ A1: 7,500
Scale @ A3: 15,000

Prepared by:	Checked:	Date:
PMF	MMcD	October 2011

Project Director: Michael Garrick

Drawing Status:

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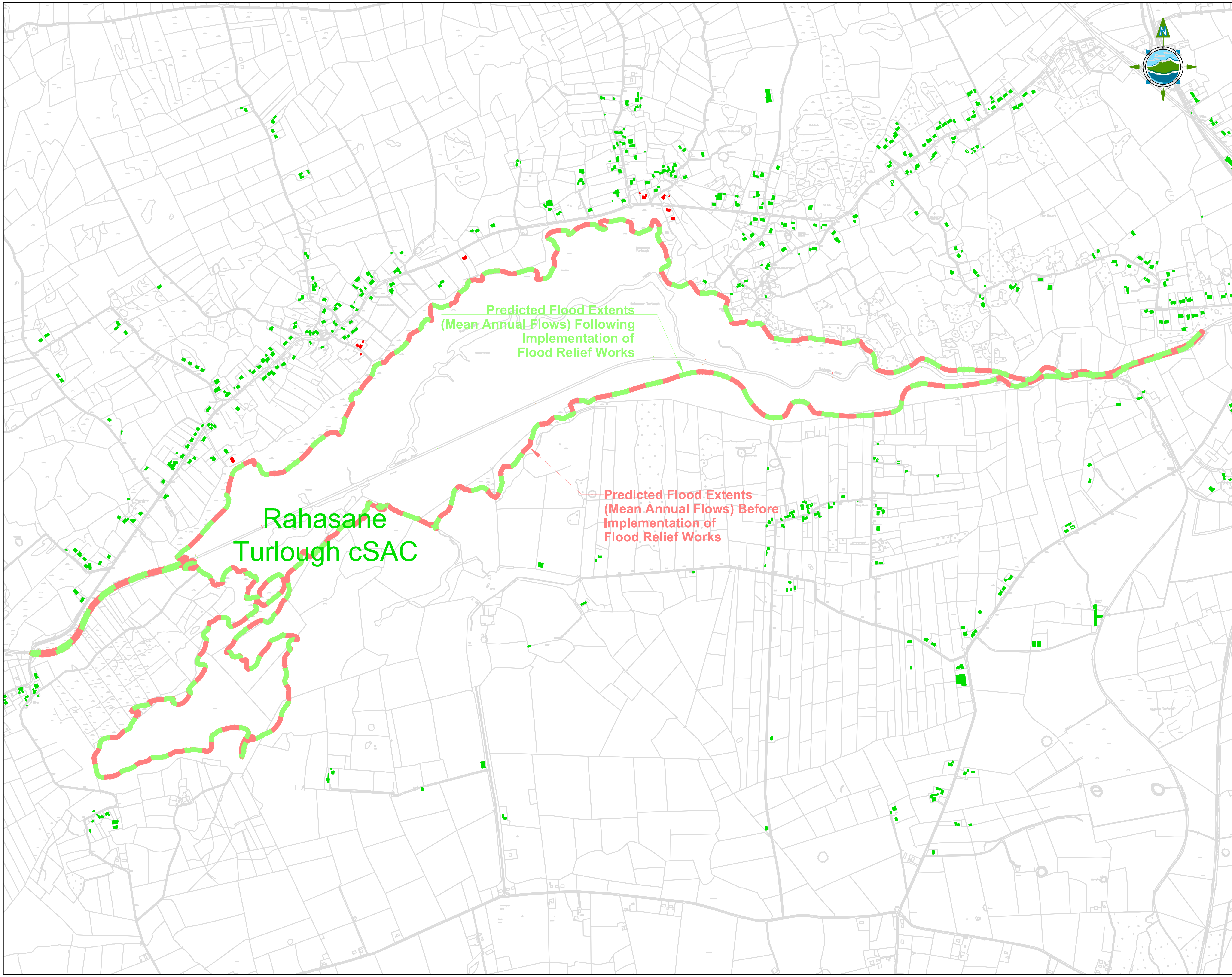
Drawing No.: 6408-2217

Revision: D



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5. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

D	July/14	Issue	CK	MMcD
Rev	Date	Description	By	Chkd.

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Predicted Water Levels for Mean Annual Flow Conditions Pre & Post Flood Alleviation Works

Scale @ A1: 7,500
Scale @ A3: 15,000

Prepared by: PMF | Checked: MMcD | Date: October 2011

Project Director: Michael Garrick

Drawing Status:

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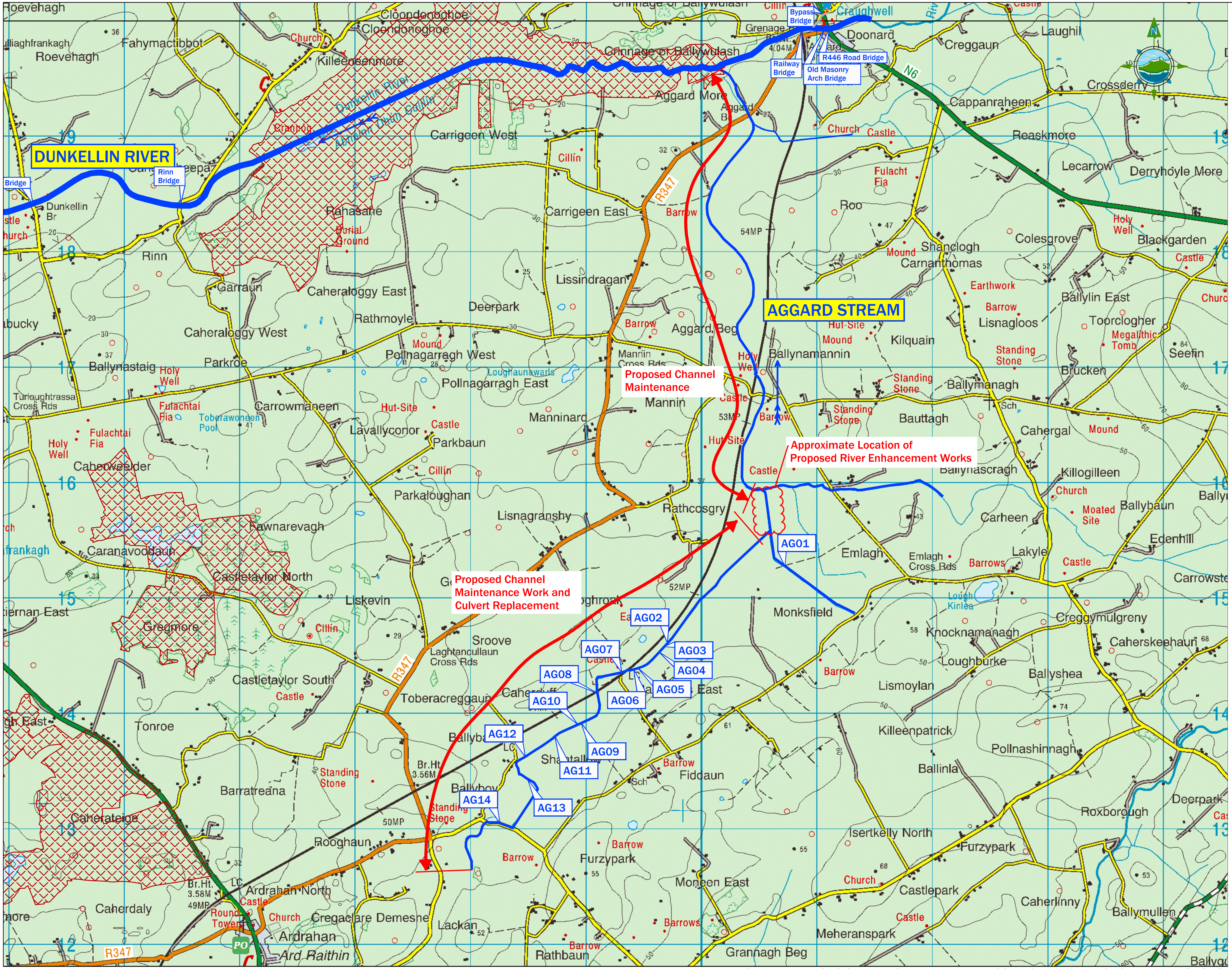

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LEGEND

RIVER	
SAC's, pNHA's, & SPA	

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Rev	Date	Description	By	Chkd.
A	Nov/11	First Issue	PMF	MMcD

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Layout Plan of Proposed Works along Aggard Stream

Scale @ A1: 15,000
Scale @ A3: 30,000

Prepared by:	Checked:	Date:
PMF	MMcD	Nov 2011

Project Director: Michael Garrick

Drawing Status:

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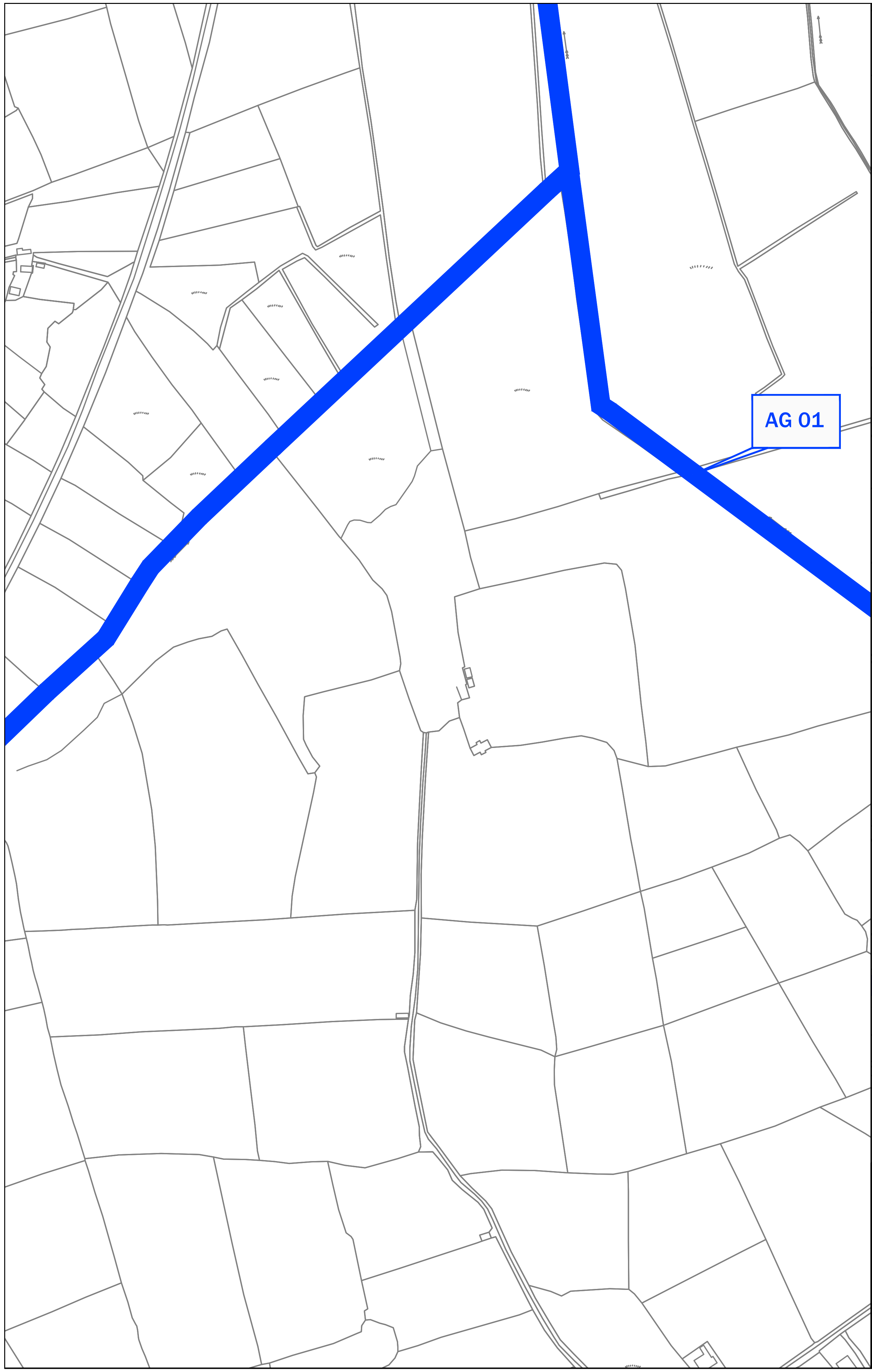
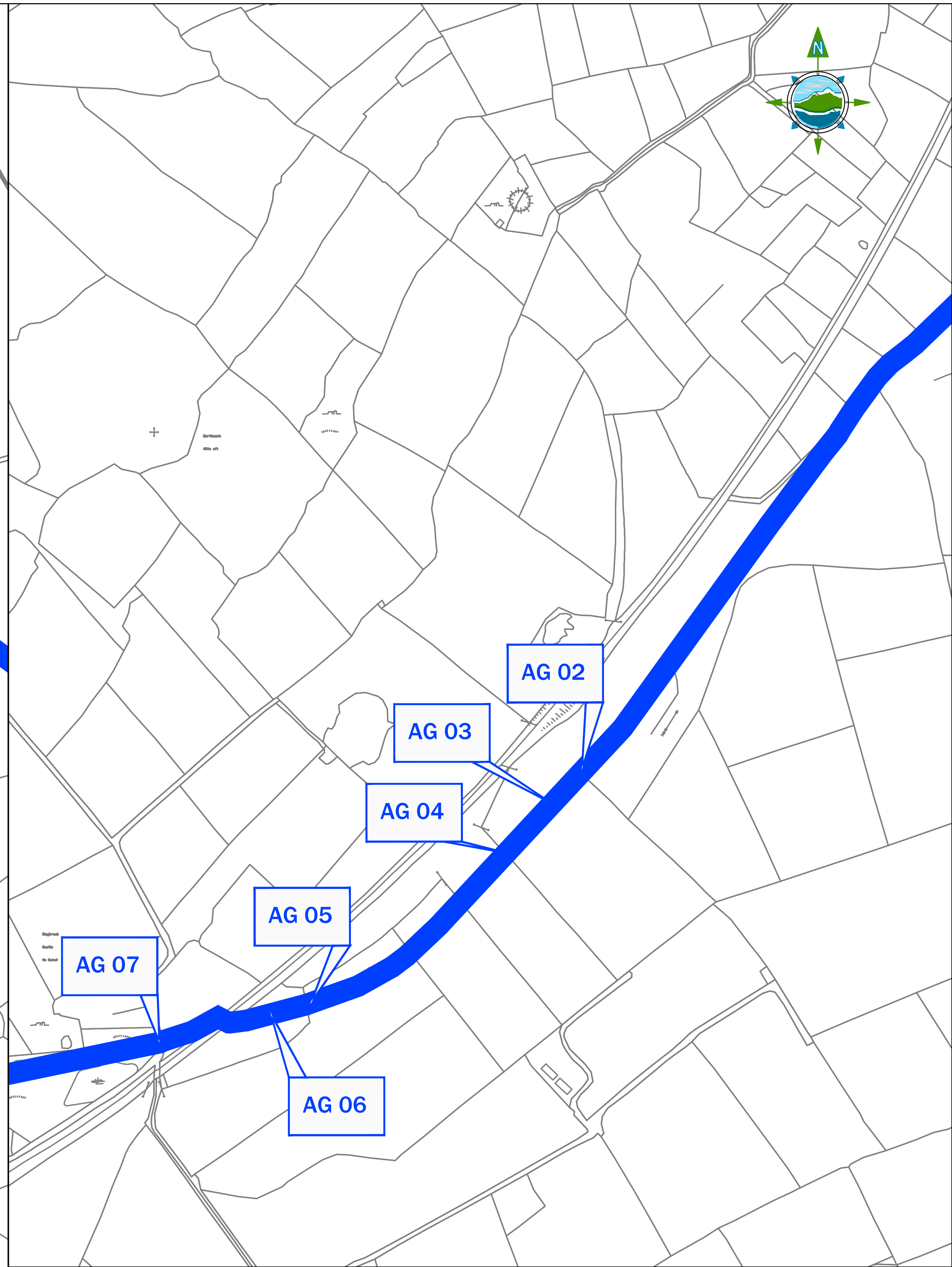
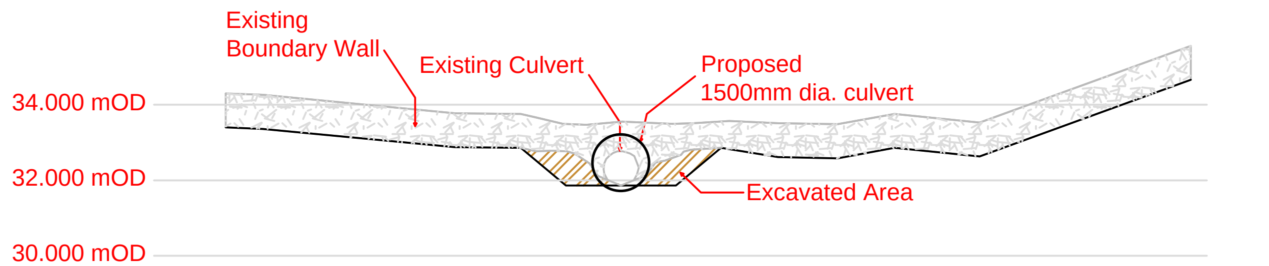
Drawing No.: 6408-2220

Revision: A





Typical Cross Section for Culvert Replacement (Scale 1:100 @ A1)



LEGEND

RIVER

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Rev	Date	Description	By	Chkd.
C	Sept/14	Issue	CK	PC

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Locations of Proposed Culvert Replacement along Aggard Stream Sheet 1 of 2

Scale @ A1: 2500
Scale @ A3: 5000

Prepared by:	Checked:	Date:
PMF	MMcD	Nov 2011

Project Director: Michael Garrick

Drawing Status:

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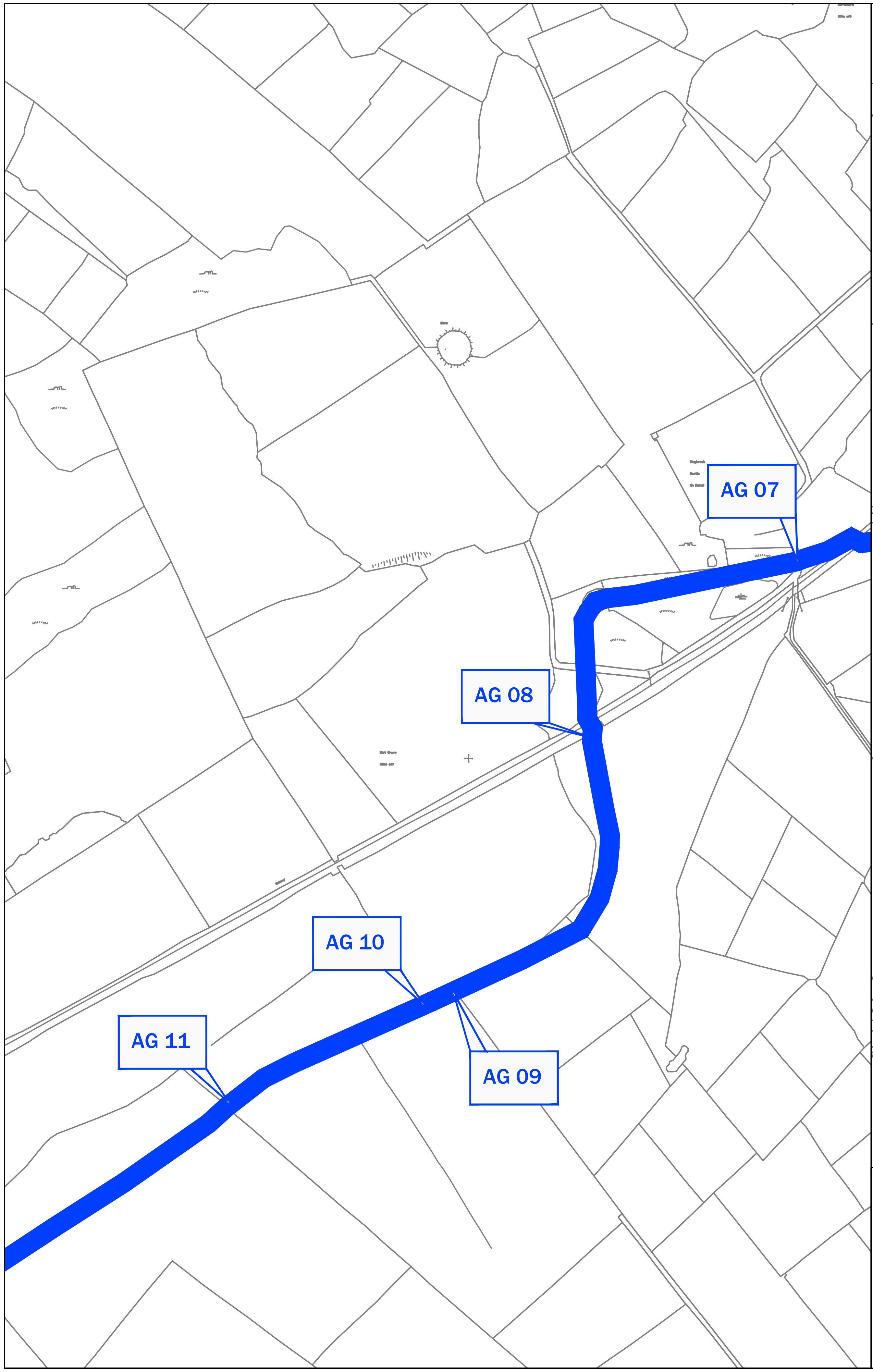
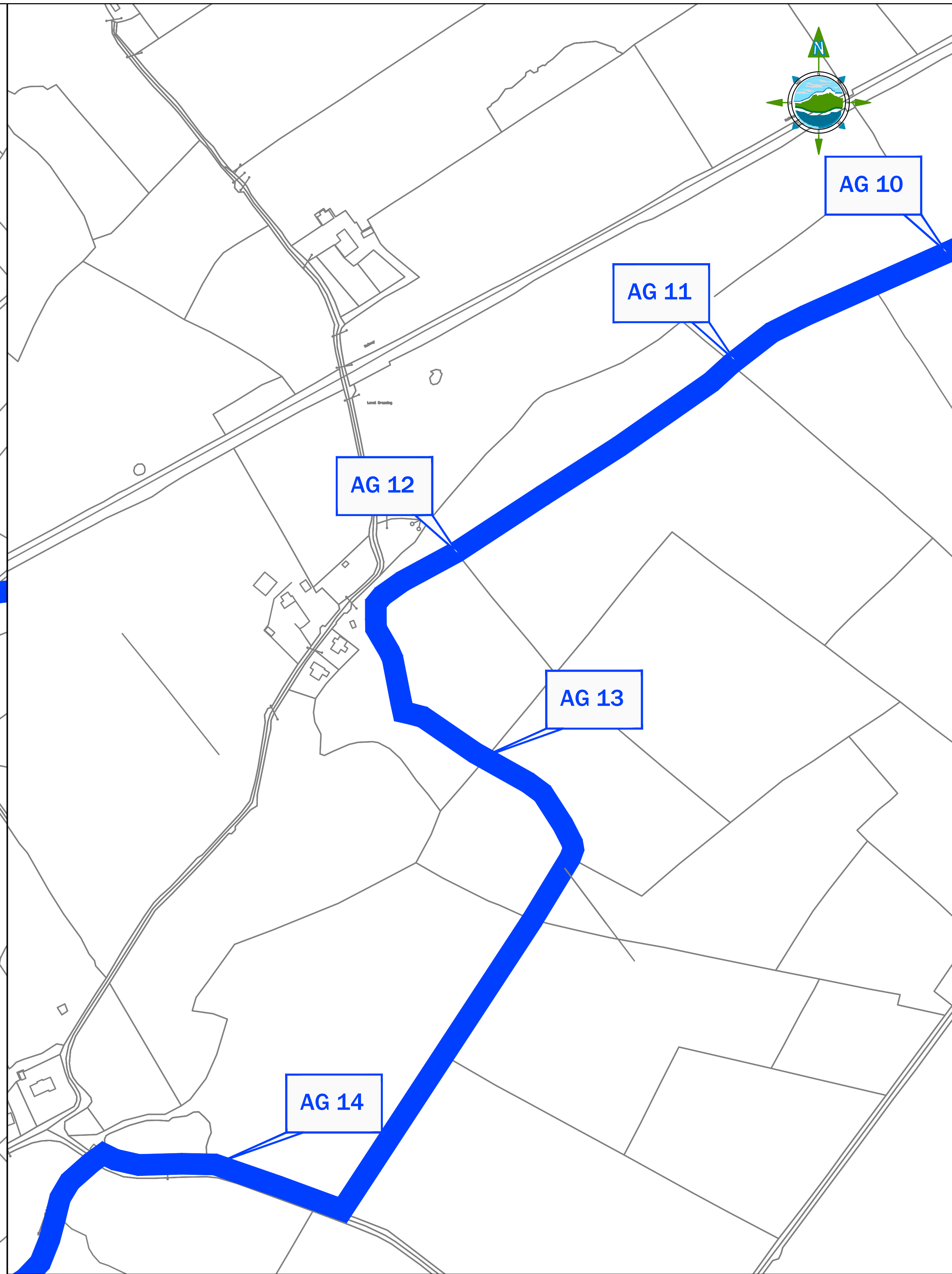
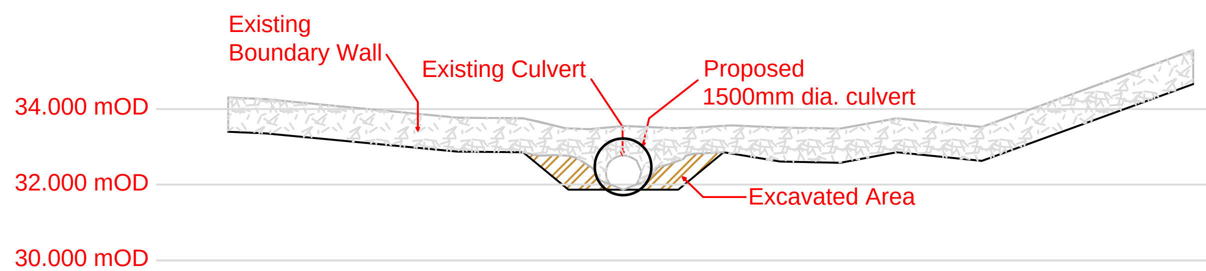
Drawing No.: 6408-2221

Revision: C





Typical Cross Section for Culvert Replacement (Scale 1:100 @ A1)



LEGEND

RIVER

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5. ALL LEVELS SHOWN RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

Rev	Date	Description	By	Chkd.
C	Sept/14	Issue	CK	PC

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Locations of Proposed Culvert Replacement along Aggard Stream Sheet 2 of 2

Scale @ A1: 2500
Scale @ A3: 5000

Prepared by: PMF | Checked: MMcD | Date: Nov 2011

Project Director: Michael Garrick

Drawing Status:

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Rev	Date	Description	By	Chkd.
A	Sept/14	First Issue	CK	PC

Client: Galway County Council

Project: Dunkellin River and Aggard Stream Flood Relief Scheme

Title: Location of Site Notices

Scale @ A1: 1:17,500
Scale @ A3: 1:35,000

Prepared by:	Checked:	Date:
CK	PC	Sept 14

Project Director: Michael Garrick

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Revision: A

APPENDIX B

NPWS Site Synopses

Site Name: Rahasane Turlough SAC

Site Code: 000322

Rahasane Turlough lies in gently undulating land, approximately 2 km west of Craughwell, Co. Galway. It consists of two basins which are connected at times of flood but separated as the waters decline. The larger of these, the northern basin, takes the Dunkellin River westwards.

The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes):

[3180] Turloughs*

Rahasane Turlough was formerly the natural sink of the Dunkellin River, but now an artificial channel takes some of the water further downstream. Water escapes the artificial channel to sweep around the northern basin, and again in the west, where it flows into an active swallow-hole system. The main swallow-holes here are constantly changing, but reach 5 m in diameter and 2-3 m deep. Some minor collapses are found elsewhere in the turlough, as well as a small number of more permanent pools. Mostly, the edges of the turlough rise gradually into the surrounding land, but in places, rocks mark a more sudden transition. The southern basin is an impressive feature, with high rocky sides above an undulating base, strewn with boulders. There is a low hill on the south side of the main basin, and another on the north-east, near Shanbally Castle, where smooth limestone pavement is evident. The major part of the turlough is open, flat and grassy, with occasional depressions and dry channels. The substrate consists largely of silty clay with shell fragments, reaching over 3 m in thickness. Locally in the main basin there are signs of marl, but peat is absent everywhere. Like the southern basin, the eastern end of the main (northern) basin is distinguished by the presence of large rocks scattered over the floor.

The vegetation of Rahasane is divided between dry and wet communities. Because of its large catchment, the turlough is naturally eutrophic and this, together with a lack of peat, limits the sedges (*Carex* spp.) which are usually abundant in turlough vegetation. In places with outcropping limestone, the vegetation is predominantly dry grassland with Red Fescue (*Festuca rubra*) and Crested Dog's-tail (*Cynosurus cristatus*), among a generally calcicole community. Large areas in the drier parts of the turlough are covered by a community characterised by an abundance of Creeping Cinquefoil (*Potentilla reptans*), with Common Sedge (*Carex nigra*), Silverweed (*Potentilla anserina*) and Creeping Bent (*Agrostis stolonifera*). Where the soil is less well-drained, Creeping Cinquefoil disappears from this community and the rare species, Fen Violet (*Viola persicifolia*), which is listed in the Irish Red Data Book, occurs. In these areas, the presence of Common Spike-rush (*Eleocharis palustris*) suggests that water is close to the surface.

Wet communities are associated with the river channels and pools. Fully aquatic communities include such species as Fan-leaved Water Crowfoot (*Ranunculus circinatus*), Fennel Pondweed (*Potamogeton pectinatus*), Lesser Pondweed (*P. pusillus*), Fat Duckweed (*Lemna gibba*), Whorled Water-milfoil (*Myriophyllum verticillatum*) and Needle Spike-rush (*Eleocharis acicularis*). Semi-aquatic communities fringe the main channel of the river and colonise muddy pools in the basin. Species such as Lesser Water-parsnip (*Berula erecta*), Fool's Water-cress (*Apium nodiflorum*), River Water-dropwort (*Oenanthe fluviatilis*) and Amphibious Bistort (*Polygonum amphibium*) occur, along with the rare species, Northern Yellow-cress (*Rorippa islandica*), which is listed in the Irish Red Data Book. There are also some narrow fields with Yellow Iris (*Iris pseudacorus*).

There are small areas of scrub on the southern and north-western sides of the turlough, but the area of flooded woodland is small. The scrub is made up of Buckthorn (*Rhamnus cathartica*), Ash (*Fraxinus excelsior*) and Hazel (*Corylus avellana*). The trees support a range of epiphytic mosses such as *Leskea polycarpa, Amblystegium riparium, Isopterygium elegans, Isothecium myosuroides* and *Thuidium tamariscinum*.

Rahasane Turlough is renowned for its wintering wildfowl populations, but it also supports nesting waders in summer, which include Lapwing, Redshank, Snipe and Dunlin. Figures stated in the following account represent mean (and peak) counts obtained during the three seasons, 1984/85 to 1986/87. Internationally important numbers of Whooper Swan 179, Golden Plover 17680, Wigeon 7760 and Shoveler 498 are found. The first two species, together with Bewick's Swan, below, are listed on Annex I of the E.U. Birds Directive. Species recorded in nationally important numbers are Bewick's Swan 132, Mute Swan 125, Teal 3005, Mallard 777, Pintail 102, Pochard 356, Tufted Duck 381, Coot 1289, Lapwing 3995, Dunlin 3569 (5653), Black-tailed Godwit 170 and Curlew 1205. Small numbers of the internationally important Greenland White-fronted Goose regularly overwinter at Rahasane (average count, as above, 59), but numbers have been declining over the years.

There is a small run of Atlantic Salmon (*Salmo salar*) through the Dunkellin River when it is flowing overground. The fish pass through the turlough but do not use it for spawning. This species is listed on Annex II of the E.U. Habitats Directive.

The Fairy Shrimp (*Tanymastix stagnalis*, Class Crustacea) was first recorded in Ireland from the southern basin at Rahasane, though it has since been recorded elsewhere. It requires isolation from predators to grow to reproductive age and so cannot occur in permanent waterbodies.

The turlough is closely grazed by cattle, sheep and horses. Grazing is a critical factor in maintaining a balance between open swards and woodland development at the edges of the turlough. Drainage is a major threat to turloughs, but the Dunkellin

River has not been arterially drained. The river was straightened many years ago where it crosses the turlough, and the artificial channel was dredged again in 1992, but this does not appear to have affected winter flooding. Some degree of artificial enrichment of the basin is occurring from the farming areas upstream, and local enrichment is associated with grazing practices. Eutrophication is among the major threats to turlough systems in general.

Rahasane Turlough is of major ecological significance as one of only two large turloughs in the country which still function naturally. It is the most important turlough in Ireland for birdlife. In a relatively recent national survey, it was also rated very highly for its vegetation, and supports two rare species listed in the Irish Red Data Book. Turloughs are a rare habitat type and are given priority status under Annex I of the E.U. Habitats Directive.

SITE SYNOPSIS

SITE NAME: RAHASANE TURLOUGH SPA

SITE CODE: 004089

Rahasane Turlough lies in gently undulating land, approximately 2 km west of Craughwell, Co. Galway. It consists of two basins which are connected at times of flood but separated as the waters recede. The larger of these, the northern basin, takes the Dunkellin River westwards. Rahasane was formerly the natural sink of the Dunkellin River, but now an artificial channel takes some of the water further downstream. Water escapes the artificial channel to sweep around the northern basin, and again in the west, where it flows into an active swallowhole system. Some minor collapses are found elsewhere in the turlough, as well as a small number of more permanent pools. Mostly, the edges of the turlough rise gradually into the surrounding land, but in places rocks mark a more sudden transition. The southern basin has high rocky sides above an undulating base that is strewn with boulders. There is a low hill on the south side of the main basin, and another on the north-east, near Shanbally Castle. The major part of the turlough is open, flat and grassy, with occasional depressions and dry channels. The substrate consists largely of silty clay. Locally in the main basin there are signs of marl, but peat is absent everywhere.

The vegetation of Rahasane is divided between dry and wet communities. Because of its large catchment, the turlough is naturally eutrophic and this, together with a lack of peat, limits the sedges (*Carex* spp.) which are usually abundant in turlough vegetation. In places with outcropping limestone, the vegetation is predominantly dry grassland among a generally calcicole community. Large areas in the drier parts of the turlough are covered by a community characterised by an abundance of Creeping Cinquefoil (*Potentilla reptans*), with Common Sedge (*Carex nigra*), Silverweed (*Potentilla anserina*) and Creeping Bent (*Agrostis stolonifera*). Where the soil is less well-drained, Creeping Cinquefoil disappears from this community and the rare, Red Data Book species, Fen Violet (*Viola persicifolia*), occurs. The wet communities are all associated with the river channels and pools. Fully aquatic communities include such species as Fan-leaved Water-crowfoot (*Ranunculus circinatus*) and pondweeds (*Potamogeton* spp.). Semi-aquatic communities fringe the main channel of the river and colonise muddy pools in the basin. Species such as Lesser Water-parsnip (*Berula erecta*), Fool's Water-cress (*Apium nodiflorum*) and Amphibious Bistort (*Polygonum amphibium*) occur, as well as the rare, Red Data Book species, Northern Yellow-cress (*Rorippa islandica*). There are also some narrow fields with Yellow Iris (*Iris pseudacorus*). There are small areas of scrub on the southern and north-western sides of the turlough, but the area of flooded woodland is small.

Rahasane is considered to be the most important turlough in the country for wintering waterfowl. It is a traditional site for Greenland White-fronted Goose, and supports a population of national importance (218 individuals) - all figures are average peaks for the period 1995/96-1999/00. It also has nationally important populations of Whooper Swan (141), Wigeon (3,630), Pintail (21), Golden Plover (6,626), Lapwing (2,220) and Black-tailed Godwit (435). The Shoveler population (29) is very close to the threshold for national importance. The site has the largest inland population of Dunlin (864) in the country, and also supports Mute Swan (76), Teal (367), Tufted Duck (32), Curlew (197), Redshank (149), Mallard (124), Black-headed Gull (280) and Grey Heron (31). As at all turlough sites, numbers of birds present can vary considerably owing to fluctuations in water levels. The site has long been known as an important waterfowl site and has been monitored annually in recent years.

The Crustacean, Fairy Shrimp (*Tanymastix stagnalis*) was first recorded in Ireland from the southern basin at Rahasane, though it has since been noted elsewhere. It requires isolation from predators to grow to reproductive age and so does not occur in permanent waterbodies.

Arterial drainage, whilst probably now unlikely to occur, would cause serious damage to the flooding pattern of this turlough and would be expected to affect the bird populations. The Greenland White-fronted Goose population is particularly vulnerable to habitat degradation as the flock has only one alternative feeding site (at Cregganna). Some degree of artificial enrichment of the basin is occurring from the farming areas upstream, and local enrichment is associated with grazing practices at the site; however, the bird populations are unlikely to be affected by such activities. The turlough is closely grazed by cattle, sheep and horses, and grazing is a critical factor in maintaining a balance between open swards and woodland development at the edges of the turlough.

Rahasane Turlough SPA is of high ornithological importance and supports seven species of national importance. The Wigeon and Golden Plover populations are of particular note as they each represent approximately 4% of the national totals of these species. The occurrence of Greenland White-fronted Goose, Whooper Swan and Golden Plover is of importance as these species are listed on Annex I of the E.U. Birds Directive.

1.12.2004

Site Name: Galway Bay Complex SAC

Site Code: 000268

Situated on the west coast of Ireland, this site comprises the inner, shallow part of a large bay which is partially sheltered by the Aran Islands. The Burren karstic limestone fringes the southern sides and extends into the sublittoral. West of Galway city the bedrock geology is granite. There are numerous shallow and intertidal inlets on the eastern and southern sides, notably Muckinish, Aughinish and Kinvarra Bays. A number of small islands composed of glacial deposits are located along the eastern side. These include Eddy Island, Deer Island and Tawin Island. A diverse range of marine, coastal and terrestrial habitats, including several listed on Annex I of the E.U. Habitats Directive, occur within the site, making the area of high scientific importance.

The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes):

[1140] Tidal Mudflats and Sandflats
[1150] Coastal Lagoons*
[1160] Large Shallow Inlets and Bays
[1170] Reefs
[1220] Perennial Vegetation of Stony Banks
[1310] *Salicornia* Mud
[1330] Atlantic Salt Meadows
[1410] Mediterranean Salt Meadows
[3180] Turloughs*
[5130] Juniper Scrub
[6210] Orchid-rich Calcareous Grassland*
[7210] *Cladium* Fens*
[7230] Alkaline Fens
[1355] Otter (*Lutra lutra*)
[1365] Common (Harbour) Seal (*Phoca vitulina*)

Galway Bay South holds a very high number of littoral communities (12). They range from rocky terraces, to sandy beaches with rock or sand dunes behind. The intertidal sediments of Galway Bay support good examples of communities that are moderately exposed to wave action. A well-defined talitrid amphipod zone in the upper shore gives way to an intertidal, mid shore zone with sparse epifauna or infauna. On the lower, flat part of the shore, the tubes of the deposit-feeding terebellid worm, *Lanice conchilega*, are common on the surface. Nereid and cirratulid polychaete worms (*Hediste diversicolor*, *Arenicola marina*), small crustaceans and bivalves (*Angulus tenuis*, *Cerastoderma edule* and *Macoma balthica*) are present. The area has the country's only recorded example of the littoral community characterized by *Fucus serratus* with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata. This community has very high species richness (85 species), as do the sublittoral fringe communities on the Finavarra reef (88 species). The rare Purple Sea Urchin *Paracentrotus lividus* and the foliose red alga *Phyllophora sicula* are present at Finavarra, whereas the red alga *Rhodymenia delicatula* and the rare brown alga, *Ascophyllum nodosum* var. *mackii,* occur in Kinvarra and Muckinish Bays. Sublittorally, the area has a number of distinctive and important communities. Of particular note is that Ireland's only reported piddock (bivalve mollusc) bed thrives in the shallows of Aughinish Bay. The rare sponge, *Mycale contarenii,* is also found here. There is further interest in an extensive maerl bed of *Phymatolithon calcareum* which occurs in the strong tidal currents of Muckinish Bay. There is also maerl off Finavarra Point and in Kinvarra Bay (*Lithothamnion corallioides*, *Lithophyllum dentatum* and *Lithophyllum fasciculatum*). An oyster bed in Kinvarra Bay and seagrass (*Zostera* spp.) beds off Finavarra Point are also important features. Other significant habitats which occur include secondary maerl beds and communities strongly influenced by tidal streams.

Saltmarshes are frequent within this extensive coastal site, with both E.U. Habitats Directive types, 'Atlantic Salt Meadow' and 'Mediterranean Salt Meadow' well represented. Most of the saltmarshes are classified as the bay type, with the substrate being mud or mud/sand. There is one lagoon type and one estuary type. Lagoon saltmarshes are the rarest type found in Ireland. The best examples of saltmarsh are located in inner Galway bay, east of a line running between Galway city and Kinvarra. In this area the coastline is highly indented, thus providing the sheltered conditions necessary for extensive saltmarsh development. Common saltmarsh species include Thrift (*Armeria maritima*), Red Fescue (*Festuca rubra*), Common Scurvygrass (*Cochlearia officinalis*), Lax-flowered Sea-lavender (*Limonium humile*), Common Saltmarsh-grass (*Puccinellia maritima*), Saltmarsh Rush (*Juncus gerardi*) and Sea Rush (*Juncus maritimus*). On the lower levels of the saltmarshes and within pans there occurs Glasswort (*Salicornia europaea* agg.). A noteworthy feature of the saltmarsh habitat within this site is the presence of dwarfed brown seaweeds in the vegetation. These are also known as "turf fucoids" and typical species include *Fucus* spp., *Ascophyllum nodosum* and *Pelvetia canaliculata*. A number of locally rare vascular plant species also grow in saltmarsh areas within the site. These include Reflexed Saltmarsh-grass (*Puccinellia distans*) and Sea-purslane (*Halimione portulacoides*), which are both relatively rare in the western half of the country.

Shingle and stony beaches can be found throughout the site, with the best examples along the more exposed shores to the south and west of Galway city and to the north and east of Finavarra, Co. Clare. In general, these shingle shorelines are sparsely vegetated and frequently occur interspersed with areas of sandy beach and/or bedrock shore. The associated flora is dominated by plant species of frequently disturbed maritime habitats. To the south and west of Galway city, typical plants include Curled Dock (*Rumex crispus*), Common Couch (*Elymus repens*), Sea Sandwort (*Honkenya peploides*), Sea Beet (*Beta vulgaris* subsp. *maritima*), Sea Mayweed (*Matricaria maritima*), Silverweed (*Potentilla anserina*) and Oraches (*Atriplex* spp.). Two rare plant species are associated with the habitat: Henbane (*Hyoscyamus niger*), a threatened species listed in the Irish Red Data Book, grows on shingle beach to the south of Lough Atalia; there are also old records for the threatened plant species Sea-kale (*Crambe maritima*).

An excellent range of lagoons of different types, sizes and salinities occurs within the site. This habitat is given priority status on Annex I of the E.U. Habitats Directive. One unusual type of lagoon, karstic rock lagoon, is particularly well represented. This type of lagoon is common on the Aran Islands, but on mainland Ireland, all but one are confined to this site. Additionally, the best example of all karstic lagoons in the country, Lough Murree, is found at this site. The flora of the habitat is rich and diverse, reflecting the range of salinities in the different lagoons. It is typically brackish, with two species of Tasselweed (*Ruppia* spp.), two Red Data charophytes *Chara canescens* and *Lamprothamnion papulosum*, and *Chaetomorpha linum*, an alga (all lagoonal specialists). The fauna of the lagoon is also rich, diverse and lagoonal. At least 10 lagoonal specialist species were recorded in 1996 and 1998 from the combined habitat of all the lagoons, which is one of the highest number for any lagoonal habitat in the country. Many of the species appear to be rare. The lagoons within this site are excellent examples of the habitat type and of high conservation importance.

Other terrestrial habitats within this site which are of conservation importance include Great Fen-sedge (*Cladium mariscus*)-dominated fen and Black Bog-rush (*Schoenus nigricans*)-dominated alkaline fen at Oranmore, a turlough of moderate size at Ballinacourty, limestone pavement mainly along the southern shore, dry calcareous grassland with orchids (best examples occurring west of Salthill), Juniper (*Juniperus communis*) scrub formations at Oranmore, wet grassland and an area of deciduous woodland at Barna. The orchid-rich grassland occurs on a serious of small drumlin hills found to the west of Galway City, and is largely confined to the sides of the hills. Calcicole pecies such as Kidney Vetch (*Anthyllis vulneraria*), Harebell (*Campanula rotundifolia*), Spring Gentian (*Gentiana verna*), Common Spotted-orchid (*Dactylorhiza fuchsii*), Lesser Twayblade (*Listera ovata*), Pyramidal Orchid (*Anacamptis pyramidalis*), Yellow-wort (*Blackstonia perfoliata*) and Greater Knapweed (*Centaurea scabiosa*) are found here, among others. Juniper is also found in this area.

Areas of alkaline and *Cladium* fen as best represented near Oranmore, and species such as Great Fen-sedge, Common Reed (*Phragmites australis*), Purple Moor-grass (*Molinia caerulea*), Bogbean (*Menyanthes trifoliata*) and Long-stalked Yellow-sedge (*Carex lepidocarpa*) are found along with the usually dominant, Black Bog-rush. The turlough at Ballinacourty floods to about 25 ha in winter, and has vegetation with a typical zonation. Wetland species such as Amphibious Bistort (*Polygonum amphibium*), Common Marsh-bedstraw (*Galium palustre*) and Marsh Cinquefoil (*Potentilla palustris*) are found near the swallow-hole, with species of wet grassland close to the flood limit (e.g. Silverweed, *Potentilla anserina,* Water Mint, *Mentha* *aquatica* and Creeping Bent, *Agrostis stolonifera*). Sedges (*Carex* spp.) dominate in between.

Inner Galway Bay provides extensive good quality habitat for Common Seal (maximum count of 317 in the all-Ireland survey of 2003). This species is listed on Annex II of the E.U. Habitats Directive. The seals use a range of haul-out sites distributed through the bay - these include inner Oranmore Bay, Rabbit Island, St. Brendan's Island, Tawin Island, Kinvarra Bay, Aughinish Bay and Ballyvaughan. The site provides optimum habitat for Otter, also an Annex II-listed species.

Galway Bay is a very important ornithological site. The shallow waters provide excellent habitat for Great Northern Divers (35), Black-throated Divers (28), Scaup (39), Long-tailed Duck (27) and Red-breasted Merganser (232). (Figures given are peak average maxima over the 3 winters 1994/95 to 1996/97). All of these populations are of national importance. The intertidal areas and shoreline provides feeding and roosting habitat for wintering waterfowl, with Brent Goose (517) having a population of international importance and a further 11 species having populations of national importance. Four of the regular wintering species are listed on Annex I of the E.U. Birds Directive - Golden Plover, Bar-tailed Godwit and the two diver species. Breeding birds are also of importance, with significant populations of Sandwich Terns (81 pairs in 1995) and Common Terns (99 pairs in 1995), both also being listed on Annex I of the E.U. Birds Directive. A large Cormorant colony (approx. 300 pairs in 1989) occurs on Deer Island.

Fishing and aquaculture are the main commercial activities within the site. A concern is that sewage effluent and detritus of the aquaculture industry could be deleterious to benthic communities. Reef and sediment communities are vulnerable to disturbance or compaction from tractors accessing oyster trestles. The *Paracentrotus lividus* populations have been shown to be vulnerable to over-fishing. Extraction of maerl in Galway Bay is a threat. Owing to the proximity of Galway city, shoreline and terrestrial habitats are under pressure from urban expansion and recreational activities. Eutrophication is probably affecting some of the lagoons and is a continued threat. Drainage is a general threat to the turlough and fen habitats. Bird populations may be disturbed by aquaculture activities.

This large coastal site is of immense conservation importance, with many habitats listed on Annex I of the E.U. Habitats Directive, four of which have priority status (lagoon, *Cladium* fen, turlough and orchid-rich calcareous grassland). The examples of shallow bays, reefs, lagoons and saltmarshes found within this site are amongst the best in the country. The site supports an important Common Seal colony and a breeding Otter population (Annex II species), and six regular Annex I E.U. Birds Directive species. The site also has four Red Data Book plant species, plus a host of rare or scarce marine and lagoonal animal and plant species.

SITE SYNOPSIS

SITE NAME: INNER GALWAY BAY SPA

SITE CODE: 004031

Galway Bay SPA is a very large, marine-dominated, site situated on the west coast of Ireland. The inner bay is protected from exposure to Atlantic swells by the Aran Islands and Black Head. Subsidiary bays and inlets (e.g. Poulnaclough, Aughinish and Kinvarra Bays) add texture to the patterns of water movement and sediment deposition, which lends variety to the marine habitats and communities. The terraced Carboniferous (Viséan) limestone platform of the Burren sweeps down to the shore and into the sublittoral. The long shoreline is noted for its diversity, with complex mixtures of bedrock shore, shingle beach, sandy beach and fringing salt marshes. Intertidal sand and mud flats occur around much of the shoreline, with the largest areas being found on the sheltered eastern coast between Oranmore Bay and Kinvarra Bay. A number of small islands composed of glacial deposits are included, such as Deer Island, along with some rocky islets.

The southern part of Galway Bay holds a very high number of littoral communities. They range from rocky terraces to sandy beaches with rock or sand dunes behind. The intertidal sediments of Galway Bay support good examples of communities that are moderately exposed to wave action. A well-defined talitrid zone in the upper shore gives way to an intertidal, mid-shore zone with sparse epifauna or infauna. On the lower, flat part of the shore, the tubes of the deposit-feeding terebellid worm, *Lanice conchilega*, are common on the surface. Nereid and cirratulid polychaete worms (*Hediste diversicolor*, *Arenicola marina*), small crustaceans and bivalves (*Angulus tenuis*, *Cerastoderma edule* and *Macoma balthica*) are present. Sublittorally, the area has a number of distinctive and important communities. Of particular note is that Ireland's only reported piddock bed thrives in the shallows of Aughinish Bay. The rare sponge, *Mycale contarenii*, is also found here. Of additional interest is the presence of an extensive maerl bed of *Phymatolithon calcareum* which occurs in the strong tidal currents of Muckinish Bay. There is also maerl off Finavarra Point and in Kinvarra Bay (*Lithothamnion corallioides*, *Lithophyllum dentatum* and *Lithophyllum fasciculatum*). An oyster bed in Kinvarra Bay and seagrass (*Zostera* spp.) beds off Finavarra Point are also important features.

Salt marshes are frequent within this extensive coastal site, with the best examples located east of a line running between Galway City and Kinvarra. In this area the coastline is highly indented, thus providing the sheltered conditions necessary for extensive salt marsh development. Common salt marsh species present include Thrift (*Armeria maritima*), Red Fescue (*Festuca rubra*), Common Scurvygrass (*Cochlearia officinalis*), Lax-flowered Sea-lavender (*Limonium humile*), Common Saltmarsh-grass (*Puccinellia maritima*), Saltmarsh Rush (*Juncus gerardi*) and Sea Rush (*Juncus maritimus*). On the lower levels of the salt marshes and within pans is found Glasswort (*Salicornia europaea* agg.). Shingle and stony beaches occur throughout the site, with the best examples found along the more exposed shores to the south and west of Galway City and to the north and east of Finnavara. In general, these shingle shorelines are sparsely vegetated, with such species as Curled Dock (*Rumex crispus*), Common Couch (*Elymus repens*), Sea Sandwort (*Honkenya peploides*) and Sea Beet (*Beta vulgaris*).

Galway Bay is one of the most important ornithological sites in the western region. It supports an excellent diversity of wintering wetland birds, with divers, grebes, cormorants, dabbling duck, sea duck and waders all well represented. There are internationally important wintering populations of Great Northern Diver (83) and Brent Goose (676), and nationally important populations of an additional sixteen species, i.e. Black-throated Diver (25), Cormorant (266), Mute Swan (150), Wigeon (1,157), Teal (690), Shoveler (88), Red-breasted Merganser (249), Ringed Plover (335), Golden Plover (2,030), Lapwing (3,969), Dunlin (2,149), Bar-tailed Godwit (447), Curlew (697), Redshank (505), Greenshank (20) and Turnstone (182) – all figures are average peaks for the 5 seasons 1995/96-1999/00. Of note is that the populations of Red-breasted Merganser and Ringed Plover represent 6.7% and 3.3% of the respective national totals. Black-throated Diver is a scarce species in Ireland and the Galway Bay population is the most regular in the country. Other species which occur in notable numbers include Little Grebe (35), Grey Heron (102), Long-tailed Duck (19) and Scaup (40). The bay is an important wintering site for gulls, especially Black-headed Gull (1,815), Common Gull (1,011) and Herring Gull (216). In addition, the following species also use the site: Red-throated Diver (13), Great Crested Grebe (16), Mallard (200), Shelduck (139), Common Scoter (79), Oystercatcher (575), Grey Plover (60), Black-tailed Godwit (45) and Great Black-backed Gull (124). The site provides both feeding and roost sites for most of the species, though some birds also commute to areas outside of the site. The wintering birds of Galway Bay have been monitored annually since 1980/81.

The site has several important populations of breeding birds, most notably colonies of Sandwich Tern (81 pairs in 1995) and Common Tern (99 pairs in 1995). A large Cormorant colony occurs on Deer Island – this had 205 pairs in 1985 and 300 pairs in 1989.

Inner Galway Bay provides good quality habitat for Common Seal, a species that is listed on Annex II of the E.U. Habitats Directive. In 1984, this seal colony was one of the top three sites in the country, with over 140 animals recorded. The seals use a range of haul-out sites distributed through the bay. The site provides optimum habitat for Otter.

While there are no imminent threats to the birds, a concern is that sewage effluent and detritus of the aquaculture industry could be deleterious to benthic communities and could affect food stocks of divers, seaduck and other birds. Bird populations may also be disturbed by aquaculture activities. Owing to the proximity of Galway City, shoreline habitats are under pressure from urban expansion and recreational activities.

This large coastal site is of immense ornithological importance, with two wintering species having populations of international importance and a further sixteen species having populations of national importance. The breeding colonies of Sandwich Tern, Common Tern and Cormorant are also of national importance. Also of note is that seven of the regularly occurring species are listed on Annex I of the E.U. Birds Directive, i.e. Red-throated Diver, Black-throated Diver, Great Northern Diver, Golden Plover, Bar-tailed Godwit, Sandwich Tern and Common Tern.

APPENDIX C

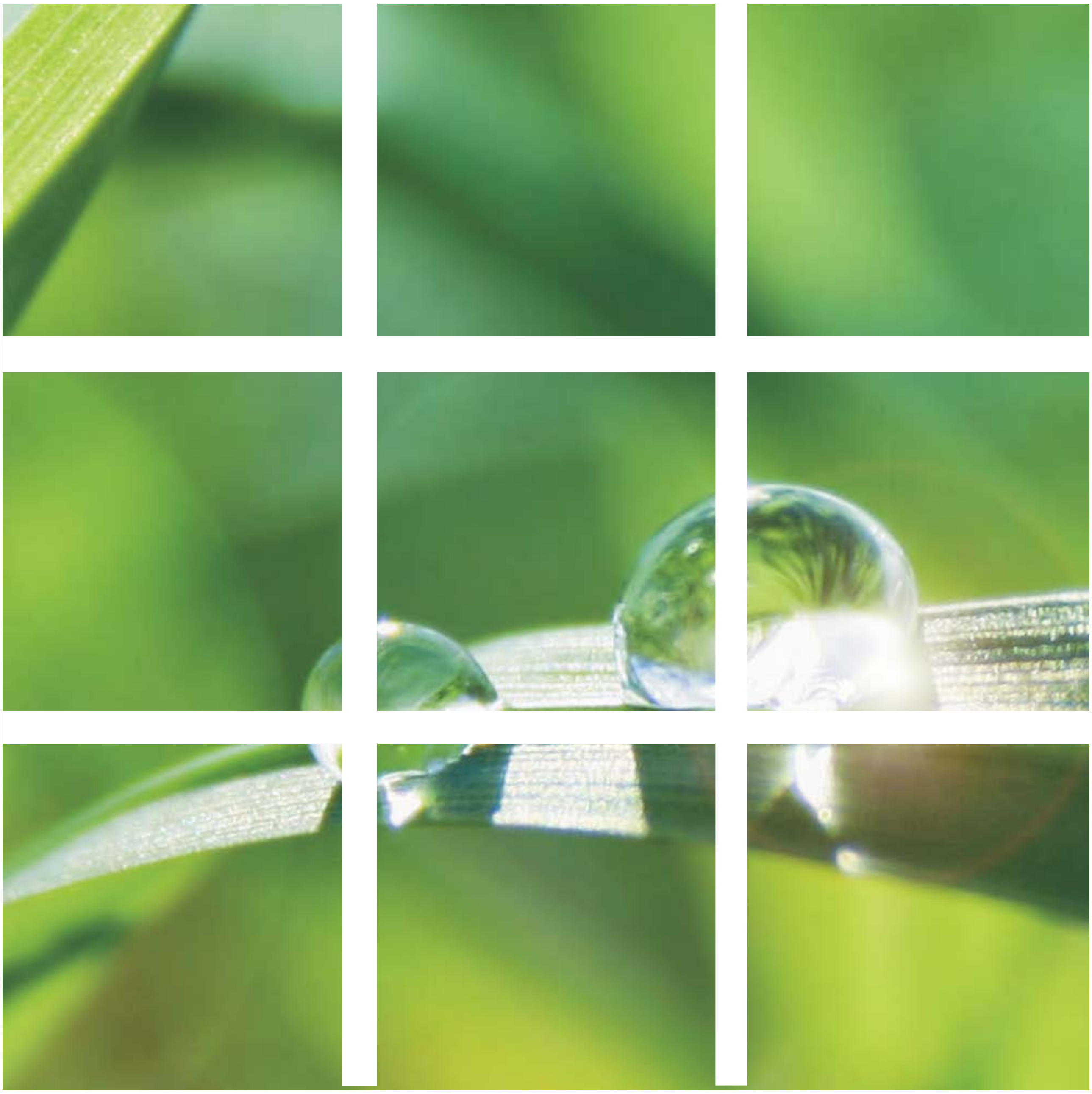
Appropriate Assessment Screening Report

RPS

The Dunkellin River and Aggard Stream Flood Relief Scheme

Stage 1 - Screening for Appropriate Assessment

August 2011



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RPS

Dunkellin River and Aggard Stream Flood Relief Scheme

Stage 1 – Screening for Appropriate Assessment

DOCUMENT CONTROL SHEET

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Project Title	Dunkellin River and Aggard Stream Flood Relief Scheme					
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		M. Walsh.	P. Kearney	W Madden		

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1 INTRODUCTION

In March 2011 Galway County Council appointed RPS as environmental consultants for the Dunkellin River and Aggard Stream Flood Relief Scheme. The environmental outputs associated with the Scheme are set out in three distinct stages.

Having consulted with relevant stakeholders as part of Stage 1 it was decided to move Screening for Appropriate Assessment (AA) to Stage 2 and Appropriate Assessment (if required) to Stage 3. As a result the environmental outputs for each stage are as follows:

Stage 1

- Environmental Constraints Study
- Public Consultation

Stage 2

- Environmental Assessment of Viable Options
- Screening for Appropriate Assessment
-

Stage 3

- Environmental Impact Statement (EIS)
- Appropriate Assessment (if deemed necessary as a result of the Appropriate Assessment Screening)
- Public Consultation

Stage 1 Environmental Constraints Study and Public Consultation was completed in April and early May 2011. This report fulfils one required element of Stage 2 – to complete screening for Appropriate Assessment (AA) of the Viable Options for the proposed Flood Relief Scheme.

The design of the Flood Relief Scheme has been progressed to a "*Viable Options Report on Measures to Address Flooding on the Dunkellin River and Aggard Stream*" which was completed in June 2011. The proposed flood alleviation measures set out in this report form the scope of this AA Screening exercise.

The AA process is being conducted for the proposed Flood Relief Scheme in order to comply with the requirements of the Habitats Directive 92/43/EEC, Article 6(3) and (4), Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites. Such assessments are required where it is identified that a proposed plan or project could have significant impact on a Natura 2000 site (i.e. SAC or SPA). Articles 6(3) and (4) of the Directive, state the following;

6.3 'Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to Appropriate Assessment of its implications for the site in view of the site's conservation objectives... the competent national authorities shall *agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned….'*

6.4 'If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest… the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected...'

This Stage 1 – Screening for AA has been completed in order to determine whether a Stage 2 Full AA is required.

Figure 1.1 shows the extent of the study area for the purposes of the proposed Flood Relief Scheme and **Figure 1.2** and **Figure 1.3** shows the location of all Natura 2000 Sites within a 15km distance of the study area.

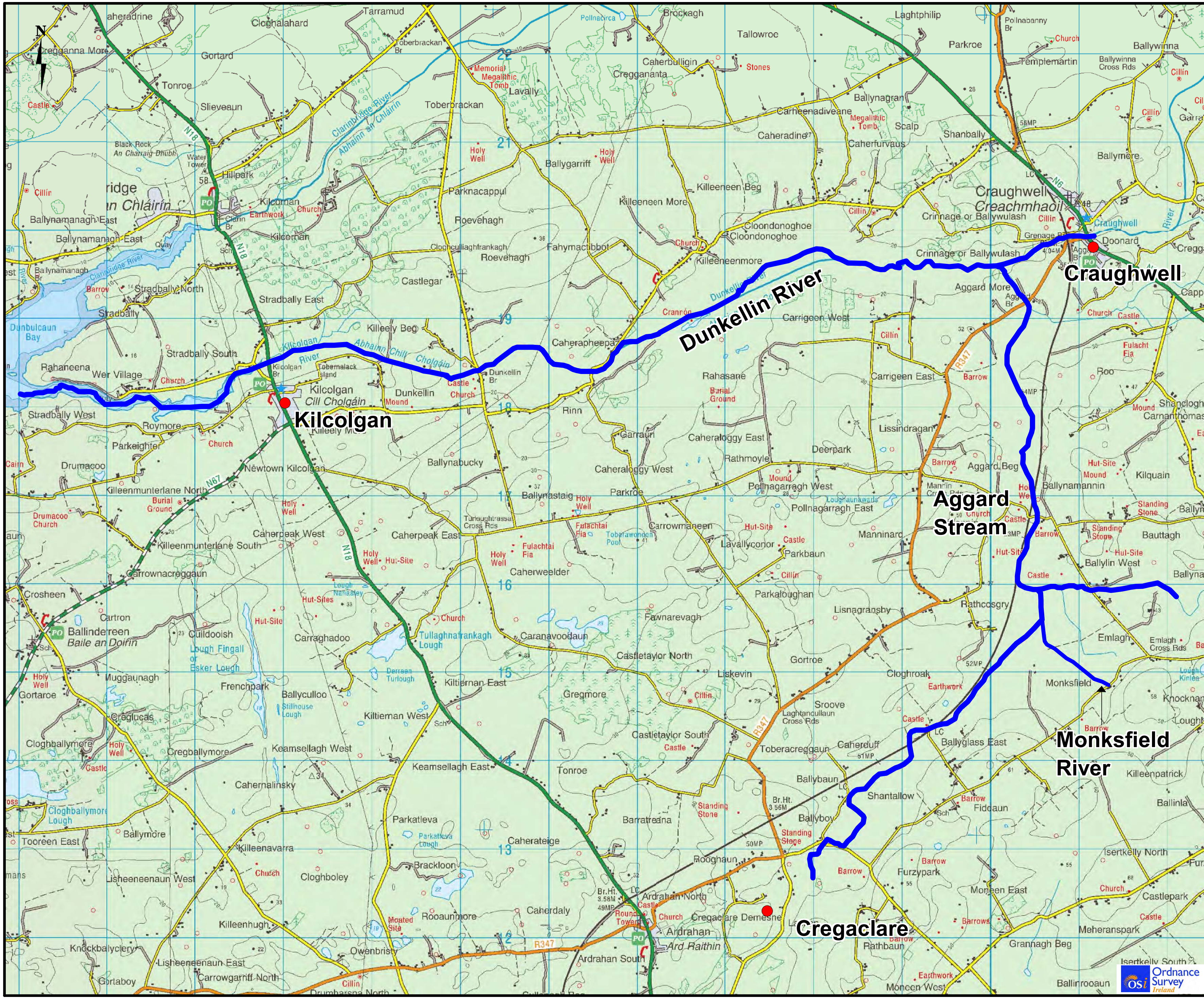
In total 23 Natura 2000 Sites (Special Areas of Conservation (SAC's) and Special Protected Areas (SPA's)) lie within a 15km radius of the proposed works. These are listed below:

1. Cregganna Marsh **SPA**/ (Site Code: 004142)
2. Monivea Bog **cSAC**/pNHA (Site Code: 002352),
3. Lough Corrib **cSAC** (Site Code: 000297),
4. Slieve Aughty Mountains **SPA** (Site Code: 004168),
5. Sonnagh Bog **cSAC** (Site Code: 001913),
6. Peterswell Turlough **cSAC** (Site Code: 000318),
7. Lough Coy **cSAC** (Site Code: 002117),
8. Cahermore Turlough **cSAC** (Site Code: 002294),
9. Ballinduff Turlough **cSAC** (Site Code: 002295),
10. Coole Garryland Turlough **cSAC/SPA** (Site Code:002294/002294)/**SPA**
11. Kiltartan Cave **cSAC** (Site Code: 000286),
12. East Burren Complex **cSAC** (Site Code: 001926),
13. Lough Cutra **SAC** (Site Code: 000299)
14. Caherglassaun Turlough **cSAC** (Site Code: 000238)
15. Drummin Wood **cSAC** (Site Code: 002181)
16. Lough Fingall Complex **cSAC** (Site Code: 000606),
17. Kiltiernan Turlough **cSAC**(Site Code: 001285),
18. Castletaylor Complex **cSAC**(Site Code: 000242),
19. Lough Rea **cSAC/SPA**(Site Code: 000304/004134),
20. Ardrahan Grassland **cSAC** (Site Code: 002244),
21. Rahasane Turlough **cSAC/SPA** Site Code: 000322/004089)
22. Galway Bay Complex **cSAC** (Site Code: 000268), and
23. Inner Galway Bay **SPA** (Site Code: 004031).

Given that sites 1-15 do not lie within the Dunkellin/Kilcolgan River Surface Water catchment, a reasonable assumption may be made that the proposed works will not have any direct, indirect or cumulative impact on these sites, either alone or in combination with other plans or projects.

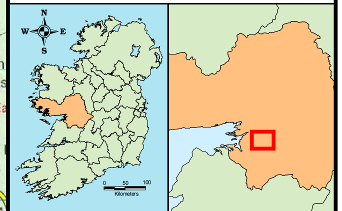
Therefore, the sites considered further in this Stage 1 – Screening for AA will be confined to the following Natura 2000 Sites:

- Rahasane Turlough cSAC/SPA,
- Lough Rea cSAC/SPA,
- Castletaylor Complex cSAC,
- The Ardrahan Grassland cSAC,
- Galway Bay Complex cSAC,
- Lough Fingall Complex cSAC,
- Kilternan Turlough cSAC, and
- Inner Galway Bay SPA.



Legend

Dunkellin River, Aggard Stream & Monksfield River Study Section



Client

Galway County Council

Project

Dunkellin River and Aggard Stream Flood Relief Scheme; Environmental Consultancy Services

Title

Proposed Flood Relief Scheme - Study Area

Figure 1.1

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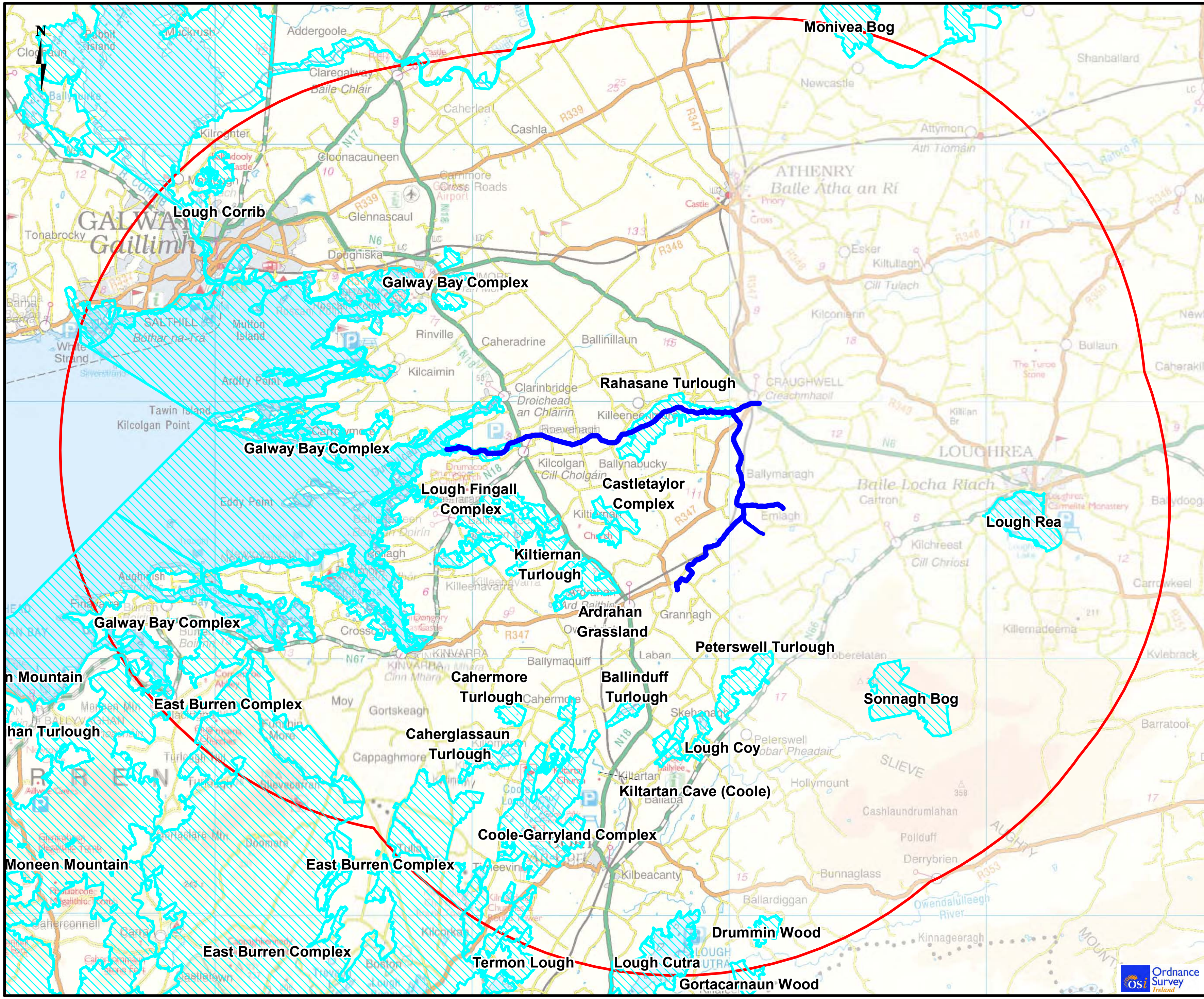

Legend

- Dunkellin River, Aggard Stream & Monksfield River Study Section
- Special Area of Conservation (SAC)
- 15km radius

Client

Galway County Council

Project

Dunkellin River and Aggard Stream Flood Relief Scheme; Environmental Consultancy Services

Title

Special Area of Conservation (SAC) within 15km radius of Dunkellin River & Aggard Stream

Figure 1.2

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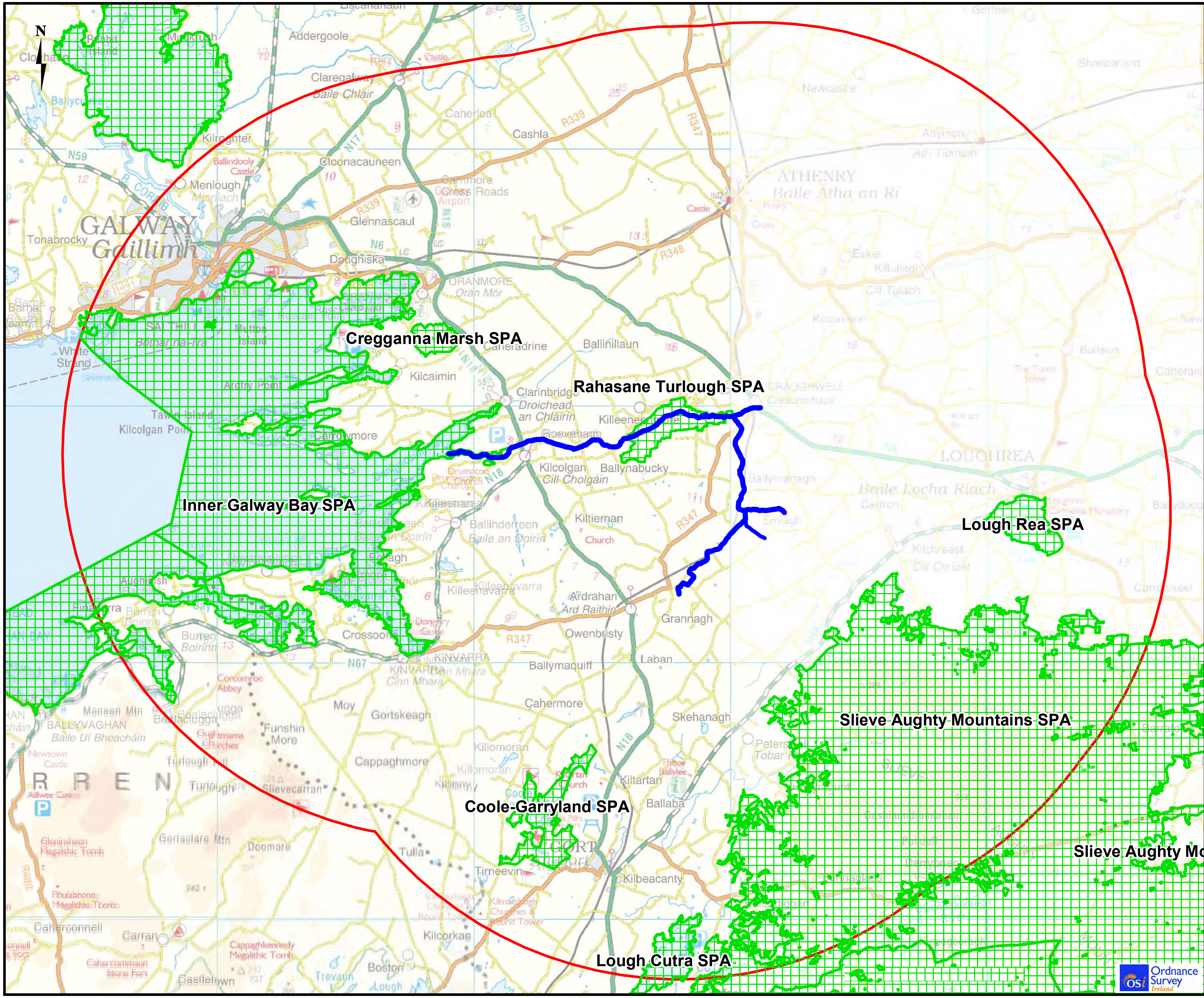

Legend

Dunkellin River, Aggard Stream & Monksfield River Study Section

Special Protection Area (SPA)

15km radius

Client

Galway County Council

Project

Dunkellin River and Aggard Stream Flood Relief Scheme; Environmental Consultancy Services

Title

Special Protection Area (SPA) within 15km radius of Dunkellin River & Aggard Stream

Figure 1.3

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2 METHODOLOGY

The Department of the Environment Heritage and Local Government guidelines (DELHG, 2009) outlines the European Commission's methodological guidance (EC, 2002) promoting a four-stage process to complete the Appropriate Assessment (AA), and outlines the issues and tests at each stage. An important aspect of the process is that the outcome at each successive stage determines whether a further stage in the process is required.

The four stages are summarised diagrammatically in **Figure 2.1**. Stages 1-2 deal with the main requirements for assessment under Article 6(3). Stage 3 may be part of the Article 6(3) Assessment or may be a necessary precursor to Stage 4. Stage 4 is the main derogation step of Article 6(4).

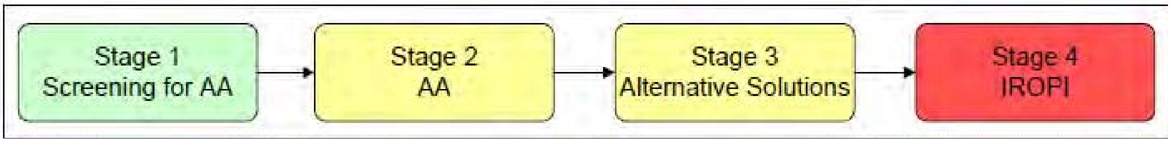

Figure 2.1 Four Stages of Appropriate Assessment

Stage 1 - Screening is the process that addresses and records the reasoning and conclusions in relation to the first two tests of Article 6(3):

(i) whether a plan or project (in this instance the proposed flood alleviation measures) is directly connected to or necessary for the management of the Natura 2000 Sites, and
(ii) whether a plan or project, alone or in combination with other plans and projects, is likely to have significant effects on the Natura 2000 Sites in view of their conservation objectives.

If the effects are deemed to be significant, potentially significant, or uncertain, or if the screening process becomes overly complicated, then the process must proceed to Stage 2 (AA). This report fulfils the information necessary to enable the appropriate authority to screen the proposed flood alleviation measures development for the requirement to prepare an Appropriate Assessment.

This report forms Stage 1 of the AA process and sets out the following information:

- Management of the Natura 2000 Sites listed in Section 1,
- Description of the proposed flood alleviation measures,
- Characteristics of the Natura 2000 Sites, and
- Assessment of Significance of the proposed flood alleviation measures on the Natura 2000 Sites in question.

This report has been prepared having regard to the following;

- Schedule 6(3) of the Habitats Directive 92/43/EEC (Assessment of Plans and projects Significantly Affecting Natura 2000 Sites),

- Guidance from the EU Commission and DEHLG (2009, Rev Feb. 2010) Appropriate Assessment of Plans & Projects, Guidance for Planning Authorities. [1]
- Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities (DOEHLG 2009, rev 2010),
- Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg (EC, 2000),
- Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg (EC, 2002),
- Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the commission; (EC, 2007),
- Interpretation Manual of European Union Habitats. Version EUR 27. European Commission 2007, and
- Screening of Natura 2000 Sites for Impacts of Arterial Drainage Maintenance Operations, Series of Ecological Assessments of Arterial Drainage Maintenance - No.1,OPW, 2007.

[1] (a) European Communities, 2000. Managing Natura 2000 sites: The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC
(b) European Communities, 2002. Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance in the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC.
(c) European Communities, 2007. Guidance document on Article 6(4) of the 'Habitat Directive' 92/43/EEC.
(d) DEHLG 2009 (Feb 2010). Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities.

3 STAGE 1 – SCREENING FOR APPROPRIATE ASSESSMENT

3.1 MANAGEMENT OF THE NATURA 2000 SITES

The proposed flood alleviation measures proposed for the Dunkellin River and Aggard Stream Flood Relief Scheme are not considered necessary to the successful management of the following Natura 2000 Sites:

- Rahasane Turlough cSAC/SPA,
- Lough Rea cSAC/SPA,
- Castletaylor Complex cSAC
- The Ardrahan Grassland cSAC,
- Galway Bay Complex cSAC,
- Lough Fingall Complex cSAC,
- Kilternan Turlough cSAC, and
- Inner Galway Bay SPA.

3.2 DESCRIPTION OF THE PROJECT OR PLAN

The characteristics of the proposed flood alleviation measures are outlined here.

Location of Proposed Flood Alleviation Measures	The principal study area for the proposed Flood Relief Scheme will be the channel, floodplain, and immediate surrounding areas of: - The Dunkellin/Craughwell River extending along the main channel from approximately 200m upstream of Craughwell Village, through the Rahasane Turlough cSAC, to the sea at Kilcolgan. - The Aggard Stream and Monks field River from the townland of Cregaclare (near Ardrahan) to its outfall at the confluence of the Dunkellin and Craughwell Rivers. - **Figure 3.1** shows the extent of the study area.

Figure 3.1 Extent of the Area Proposed for Flood Alleviation Measures

Description of the Proposed Works

Description of the key components of the project

It is proposed to complete the following works (**Table 3.1**) as part of the flood Relief Scheme:

Table 3.1 Proposed Flood Alleviation Measures

Location No.	Description of Location	Proposed Viable Scheme
1	Works at Kilcolgan & N18 Bridges	No Works Proposed
2	Channel Works from the N18 Bridge to Killeely Beg Bridge	Increase top of bank width from average of 31m to 50m
3	Salmon Counter	Remove Salmon Counter
4	Works at Killeely Beg Bridge	Provide new bridge with 19m span
5	Channel Works from Killeely Beg Bridge to Dunkellin Bridge	Increase top of bank width from average of 19m to 37m
6	Works at Dunkellin Bridge	Provide 15m flood eye on left bank and 10m flood eye on right bank
7	Channel Works from Dunkellin Bridge to Rinn Bridge	Increase top of bank width from average of 20m to 38m
8	Works at Rinn Bridge	Provide 5.5m flood eyes on left and right bank
9	Channel Works from Rinn Bridge to the Rahasane Turlough	Increase top of bank width from average of 21m to 41m
	Works at Rahasane Turlough	*It is Not Proposed to Complete any Works within the Rahasane Turlough cSAC*
10	Channel Works from Aggard Stream to upstream of the R446 Bridge	Regrade to match proposed bed levels at Craughwell Bridges
11	Railway Bridge in Craughwell	Deepen bridge by 1.5m by underpinning
12	Masonry Arch Pedestrian Bridge	Deepen bridge by 1.5m by underpinning to match R446 bridge levels and provide stepped channel along left bank at 19mOD
13	R446 Bridge	Deepen bridge by 1.2m by underpinning
14	Bypass Channel	Regrade from a level of 19.0mOD u/s of Craughwell to 18.74mOD d/s of Craughwell

3.3 CHARACTERISTICS OF THE NATURA 2000 SITES

Ten Natura 2000 Sites have been considered within the scope of this Stage 1 – Screening for AA. Details for these sites are set out here.

Site Name and Code	Rahasane Turlough cSAC (Site Code: 000322)
Site Description	Rahasane Turlough is of major ecological significance as one of only two large turloughs which still function naturally. It is the most important turlough for birdlife in the country. It consists of two basins which are connected at times of flood but separated as the waters decline. The larger of these, the northern basin, takes the Dunkellin River westwards. Rahasane was formerly the natural sink of the Dunkellin River, but now an artificial channel takes some of the water further downstream. The NPWS site synopsis for this designated site is included in full as **Appendix A** to this report.
Qualifying Features of the Site	The qualifying habitats and species found within Rahasane Turlough cSAC are set out below:

Habitat Type (Annex I of the Habitats Directive)	Habitat Code	Main Threats and Impacts
Turloughs	3180	Grazing, hunting, drainage, fertilisation

Site Name and Code	Lough Rea cSAC (Site Code:000304)
Site Description	Lough Rea is a hard water lake, a habitat listed on Annex I of the E.U. Habitats Directive. Lough Rea is also important for birds and holds internationally important numbers of Shoveler and nationally important numbers of Tufted Duck and Coot. Ten further bird species are present at levels of regional/local importance. It supports a population of Brown Trout. The NPWS site synopses for this designated site is included in full as **Appendix A** to this report.
Qualifying Features of the Site	The qualifying habitats and species found within Lough Rea cSAC are set out below.

Habitat Type (Annex I of the Habitats Directive)	Habitat Code	Main Threats and Impacts
Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.	3140	General forestry management, leisure fishing, hunting, grazing, cultivation, fertilisation, urbanised areas, human habitation, dispersed habitation.

Site Name and Code	**Castletaylor Complex cSAC (Site Code: 000242)**
Site Description	This site is situated approximately 4 km south-east of Kilcolgan and lies in a gently undulating limestone topography. Although relatively small in area, the site contains a diverse range of habitats, including five EU Habitats Directive Annex I habitats, turloughs, limestone pavement, orchid-rich calcareous grassland, alpine heath and juniper scrub. The first three of these are listed as priority habitats under the Directive. The NPWS site synopses for this designated site is included in full as **Appendix A** to this report.
Qualifying Features of the Site	The qualifying habitats and species found within Rahasane Turlough cSAC are set out below:

Habitat Type (Annex I of the Habitats Directive)	Habitat Code	Main Threats and Impacts
Turloughs	3180	Grazing, removal of hedges and copses, dispersed habitation
Limestone pavements	8240	
Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia)(*important orchid sites)*	6210	
Juniperus communis formations on heaths or calcareous grasslands	5130	
Alpine and Boreal heaths	4060	

Site Name and Code	**Ardrahan Graslands cSAC (Site Code: 002244)**
Site Description	Ardrahan Grassland contains a mosaic of calcareous habitats including good examples of three habitats listed on Annex I of the EU Habitats Directive - limestone pavement, alpine heath and Juniper scrub. The presence of a relatively unpolluted marl lake adds further diversity and interest to the site. The NPWS site synopsis for this designated site is included in full as **Appendix A** to this report.
Qualifying Features of the Site	The qualifying habitats and species found within Ardrahan Graslands cSAC are set out below.

Habitat Type (Annex I of the Habitats Directive)	Habitat Code	Main Threats and Impacts
Juniperus communis formations on heaths or calcareous grasslands	5130	Grazing, paths, tracks, cycling tracks, water pollution, fertilisation, routes, autoroutes, restructuring agricultural land holding.
Alpine and Boreal heaths	4060	
Limestone pavements*	8240	

<table>
<tr><th>Site Name and Code</th><th>Galway Bay Complex cSAC (Site Code: 000268)</th></tr>
<tr><td>Site Description</td><td>This large coastal site is of immense conservation importance, with many habitats listed on Annex I of the EU Habitats Directive, four of which have priority status (lagoon, Cladium fen, turlough and orchid-rich calcareous grassland). The examples of shallow bays, reefs, lagoons and salt marshes are amongst the best in the country. The site supports an important Common Seal colony and a breeding Otter population, both species that are listed on Annex II of the EU Habitats Directive, and six regular Annex I EU Birds Directive species.

The NPWS site synopsis for this designated site is included in full as Appendix A to this report.</td></tr>
<tr><td>Qualifying Features of the Site</td><td>The qualifying habitats and species found within the Galway Bay Complex cSAC are set out below:
<table>
<tr><th>Habitat Type (Annex I of the Habitats Directive)</th><th>Habitat Code</th><th>Main Threats and Impacts</th></tr>
<tr><td>Large Shallow Inlets and Bays</td><td>1160</td><td rowspan="15">Grazing, fish and shellfish aquaculture, fertilisation, professional fishing, mowing /cutting, leisure fishing, walking, horseriding and non-motorised vehicles, taking / removal of fauna, nautical sports, discharges, fixed location fishing, sand and gravel extraction, reclamation of land from sea, estuary or marsh, urbanised areas, human habitation, industrial or commercial areas, drainage.

Use of pesticides, fertilisation, removal of hedges and copses, removal of scrub, felling of native or mixed woodland, professional fishing (including lobster pots and fyke nets), hunting, trapping, poisoning, poaching, sand and gravel extraction, mechanical removal of peat, urbanised areas, human habitation, continuous urbanisation, industrial or commercial areas, discharges, disposal of household waste, disposal of industrial waste, disposal of inert materials, other discharges, routes, autoroutes, bridge, viaduct, water pollution, other forms or mixed forms of pollution, infilling of ditches, dykes, ponds, pools, marshes or pits, drainage, management of aquatic and bank vegetation for drainage purposes, removal of sediments (mud ...), canalisation, modifying structures of inland water course</td></tr>
<tr><td>Mudflats and sandflats not covered by seawater at low tide</td><td>1140</td></tr>
<tr><td>Reefs</td><td>1170</td></tr>
<tr><td>Juniperus communis formations on heaths or calcareous grasslands</td><td>5130</td></tr>
<tr><td>Alkaline fens</td><td>7230</td></tr>
<tr><td>Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia)(*important orchid sites)*</td><td>6210</td></tr>
<tr><td>Turloughs*</td><td>3180</td></tr>
<tr><td>Calcareous fens with Cladium mariscus and species of the Caricion davallianae*</td><td>7210</td></tr>
<tr><td>Salicornia and other annuals colonizing mud and sand</td><td>1310</td></tr>
<tr><td>Mediterranean salt meadows (Juncetalia ncarnat)</td><td>1410</td></tr>
<tr><td>Atlantic salt meadows (Glauco-Puccinellietalia maritimae)</td><td>1330</td></tr>
<tr><td>Perennial vegetation of stony banks</td><td>1220</td></tr>
<tr><td>Coastal lagoons*</td><td>1150</td></tr>
<tr><td>Common Seal (Phoca vitulina)</td><td>1365</td></tr>
<tr><td>Otter (Lutra lutra)</td><td>1355</td></tr>
</table></td></tr>
</table>

Site Name and Code	**Lough Fingall cSAC (Site Code: 000606)**

Site Description

This site is of great conservation importance for the presence of six EU Habitats Directive habitats, including four priority habitats. The transitions and gradations between habitats, for example between turloughs, lakes and limestone pavement, gives rise to a range of physical conditions that favour many uncommon species. In addition, the site supports an internationally important population of Lesser Horseshoe bats.

The NPWS site synopsis for this designated site is included in full as **Appendix A** to this report.

Qualifying Features of the Site

The qualifying habitats and species found within Lough Fingall cSAC are set out below:

Habitat/Species Type (Annex I of the Habitats Directive)	Habitat /Species Code	Main Threats and Impacts
Limestone pavements	8240	Grazing, removal of hedges and copses, burning, dispersed habitation, drainage, fertilisation.
Turloughs	3180	
Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*	7210	
Juniperus communis formations on heaths or calcareous grasslands	5130	
Alpine and Boreal heaths	4060	
Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia)(* important orchid sites)	6210	
Lesser Horseshoe Bat *(Rhinolophus hipposideros)*	1303	

Site Name and Code	**Kilternan Turlough cSAC (Site Code: 001285)**

Site Description

Kiltiernan Turlough is an example of a partly modified, relatively dry turlough, without any accumulation of peat. It includes a variety of typical dry Turlough vegetation types and is notable for the presence of the rare plant species, Alder Buckthorn and Fen Violet.

The NPWS site synopsis for this designated site is included in full as **Appendix A** to this report.

Qualifying Features of the Site

The qualifying habitats and species found within Kilternan Turlough cSAC are set out below:

Habitat Type (Annex I of the Habitats Directive)	Habitat Code	Main Threats and Impacts
Turloughs	3180	Cultivation, mowing/cutting, fertilisation, grazing, hunting, management of water levels.

Site Name and Code	**Lough Rea SPA (Site Code: 004134)**
Site Description	Lough Rea is an important ornithological site for the nationally important populations of Shoveler and Coot, and regionally/locally important populations of a further ten species that it holds. It is also of significance as an excellent example of a hard water lake, a habitat that is listed on Annex I of the E.U. Habitats Directive. The NPWS site synopsis for this designated site is included in full as **Appendix A** to this report.
Qualifying Features of the Site	The qualifying habitats and species found within Lough Rea SPA are set out below:

Habitat Type (Annex I of the Birds Directive)/ Special Conservation Interests	Habitat Code	Main Threats and Impacts
Shoveler (*Anas clypeata*)	A056	Leisure fishing, hunting, nautical sports, water pollution, fertilisation, general forestry management, urbanised areas, human habitation.
Coot (*Fulica atra*)	A125	

<table>
<tr><th>Site Name and Code</th><th>Rahasane Turlough SPA (Site Code: 004089)</th></tr>
<tr><td>Site Description</td><td>Rahasane Turlough SPA is of high ornithological importance and supports seven species of national importance. The Wigeon and Golden Plover populations are of particular note as they each represent approximately 4% of the national totals of these species. The occurrence of Greenland White-fronted Goose, Whooper Swan and Golden Plover is of importance as these species are listed on Annex I of the E.U. Birds Directive.

The NPWS site synopsis for this designated site is included in full as Appendix A to this report.</td></tr>
<tr><td>Qualifying Features of the Site</td><td>The qualifying habitats and species found within Rahasane Turlough SPA are set out below:

<table>
<tr><th>Habitat Type (Annex I of the Birds Directive)/ Special Conservation Interests</th><th>Species Code</th><th>Main Threats and Impacts</th></tr>
<tr><td>Whooper Swan (Cygnus Cygnus)</td><td>A038</td><td rowspan="5">Grazing, hunting, drainage, fertilisation.</td></tr>
<tr><td>Greenland White-fronted Goose(Anser albifrons flavirostris)</td><td>A395</td></tr>
<tr><td>Golden Plover (Pluvialis apricaria)</td><td>A140</td></tr>
<tr><td>Black-tailed Godwit (Limosa limosa)</td><td>A156</td></tr>
<tr><td>Wigeon (Anas Penelope)</td><td>A050</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Site Name and Code</th><th>Inner Galway Bay SPA (Site Code: 004031)</th></tr>
<tr><td>Site Description</td><td>Galway Bay SPA is a very large, marine-dominated, site situated on the west coast of Ireland. This large coastal site is of immense ornithological importance, with two wintering species having populations of international importance and a further sixteen species having populations of national importance. The breeding colonies of Sandwich Tern, Common Tern and Cormorant are also of national importance. Also of note is that seven of the regularly occurring species are listed on Annex I of the E.U. Birds Directive, i.e. Red-throated Diver, Black-throated Diver, Great Northern Diver, Golden Plover, Bar-tailed Godwit, Sandwich Tern and Common Tern.

The NPWS site synopsis for this designated site is included in full as Appendix A to this report.</td></tr>
<tr><td>Qualifying Features of the Site</td><td>The qualifying habitats and species found within Inner Galway Bay SPA are set out below:
<table>
<tr><th>Habitat Type (Annex I of the Birds Directive)/ Special Conservation Interests</th><th>Habitat Code</th><th>Main Threats and Impacts</th></tr>
<tr><td>Red-throated Diver (Gavia stellata)</td><td>A001</td><td rowspan="23">Grazing, leisure fishing, discharges, nautical sports, walking, horseriding and non-motorised vehicles, water pollution, reclamation of land from sea, estuary or marsh, dykes, embankments, artificial beaches, fish and shellfish aquaculture, professional fishing, hunting, fertilisation, urbanised areas, human habitation, industrial or commercial areas, routes, autoroutes.</td></tr>
<tr><td>Black-throated Diver (Gavia arctica)</td><td>A002</td></tr>
<tr><td>Great Northern Diver (Gavia immer)</td><td>A003</td></tr>
<tr><td>Golden Plover (Pluvialis apricaria)</td><td>A140</td></tr>
<tr><td>Bar-tailed Godwit (Limosa lapponica)</td><td>A157</td></tr>
<tr><td>Sandwich Tern (Sterna sandvicensis)</td><td>A191</td></tr>
<tr><td>Common Tern(Sterna hirundo)</td><td>A193</td></tr>
<tr><td>Common Gull (Larus canus)</td><td>A182</td></tr>
<tr><td>Black Headed Gull (Larus ridibundus)</td><td>A179</td></tr>
<tr><td>Turnstone (Arenaria interpres)</td><td>A169</td></tr>
<tr><td>Red Shank (Tringa totanus)</td><td>A162</td></tr>
<tr><td>Curlew (Numenius arquata)</td><td>A160</td></tr>
<tr><td>Dunlin (Calidris alpina)</td><td>A149</td></tr>
<tr><td>Lapwing (Vanellus vanellus)</td><td>A142</td></tr>
<tr><td>Ringed Plover (Charadrius hiaticula)</td><td>A137</td></tr>
<tr><td>Red Breasted Merganser (Mergus serrator)</td><td>A069</td></tr>
<tr><td>Northern Shoveler (Anas clypeata)</td><td>A056</td></tr>
<tr><td>Teal (Anas crecca)</td><td>A052</td></tr>
<tr><td>Eurasian Wigeon (Anas Penelope)</td><td>A050</td></tr>
<tr><td>Shelducks (Tadorna tadorna)</td><td>A048</td></tr>
<tr><td>Light Bellied Brent Goose (Branta bernicla hrota)</td><td>A046</td></tr>
<tr><td>Grey Heron (Ardea cinerea)</td><td>A028</td></tr>
<tr><td>Cormorant (Phalacrocorax carbo)</td><td>A017</td></tr>
</table></td></tr>
</table>

Site Conservation Objectives and Strategy/Management Plans	The integrity of a Natura 2000 sites (referred to in Article 6.3 of the EU Habitats Directive) is determined based on the conservation status of the qualifying features of the sites as set out above. According to the EU Habitats Directive, favourable conservation status of a habitat is achieved when: • its natural range, and area it covers within that range, is stable or increasing, and • the ecological factors that 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 as defined below. The favourable conservation status of a species is achieved when: • Population data on the species concerned indicate that it is maintaining itself, and • The natural range of the species is neither being reduced or 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. **Designated Sites Conservation Objectives** Conservation Management Plans have not yet been prepared for the Natura 2000 listed above. However conservation objectives for each site have been set out by the NPWS. The following draft conservation objectives have been provided by the NPWS for cSAC's and SPA's. **Objective 1:** To maintain and where possible enhance the Annex I habitats and Annex II species for which the cSAC's have been designated under the Habitats Directive. **Objective 2:** To maintain the Annex I species for which the SPA's have been designated under the Birds Directive. **Objective 4:** To maintain the extent, species richness and biodiversity of the entire sites. **Objective 5:** To establish effective liaison and co-operation with landowners, legal users and relevant authorities. **Strategies to Achieve Objectives** • Maintain and monitor a favourable water quality status, • Regulate and monitor where possible the activities (threats and pressures) as set out above, and • Initiate and maintain communication and consultation between all relevant stakeholders of the designated sites.

3.4 EXISTING ENVIRONMENT

Habitats and Species in the Study Area	A site walkover was carried out in order to identify the habitats present within the study area. The habitats found within the study area are listed in **Table 3.2** and **Table 3.3** below and shown in **Figure 3.2 to Figure 3.4**.

Table 3.2 Terrestrial Habitats Recorded within the Study Area

Habitat Type and Reference Code	Located within Study Area
Improved Agricultural Grassland (GA1)	Widespread throughout the study area
Dry Calcareous & Neutral Grassland (GS1)	Widespread throughout the study area.
Wet Grassland (GS4)	Widespread throughout the study area.
Marsh (GM1)	Small pockets throughout the study area.
Oak-ash-hazel woodland (WN2)	Crinnage (Ballywulash), Carrigeen West
Wet pedunculate oak-ash woodland (WN4)	Crinnage (Ballywulash)
Scrub (WS1)	Scattered throughout study area
Hedgerows (WL1)	Throughout the study area
Treelines (WL2)	Occasional, scattered distribution.
Recolonising Bare Ground (ED3)	Craughwell, Caherapheepa.
Exposed Calcareous Rock (ER2)	Small areas of Exposed Calcareous Rock ER2 were found between Dunkellin Bridge and Rinn Bridge, and in the townland of Carrigeen West.
Stone Walls and Other Stone Work (BL1)	Scattered throughout study area

Species-rich Calcareous Grassland in the townland of Crinnage (Ballywulash)

Wet Grassland

Ash/Hazel Woodland in the townland of Carrigeen West

Field layer of Ash/Hazel woodland

Wet Pendunculate Oak-Ash Woodland

Treeline beside the Dunkellin River

Limestone Pavement on the southern side of the turlough

Stone wall on the south eastern side of the turlough. *Cinclidotus fontinaloides* moss and calcareous deposits indicate that this wall is inundated during the winter months

Table 3.3 Aquatic Habitats Recorded in the Existing Environment

Habitat Type and Reference Code	Located within Study Area
Turlough (FL6)	Rahasane Turlough, Dunkellin Turlough, Castlegar Turlough
Eroding Upland Rivers (FW1)	Upstream of Rahasane Turlough, at the railway bridge at Craughwell
Depositing Lowland Rivers (FW2)	In the townland of Aggard More
Canals (FW3)	The artificial channel within Rahasane Turlough
Drainage Ditches (FW4)	Occur throughout study area.

<table>
<tr>
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View of Rahasane Turlough from the north eastern side

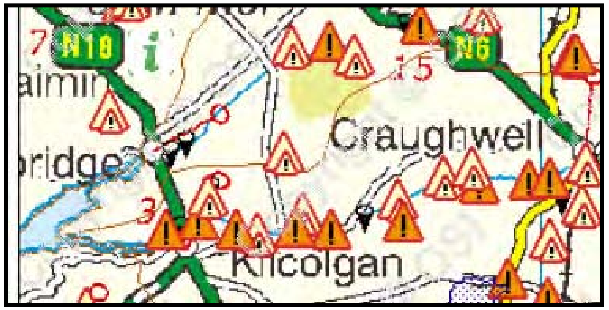

The Dunkellin River at the railway bridge in Craughwell, upstream of Rahasane Turlough – Eroding Upland River

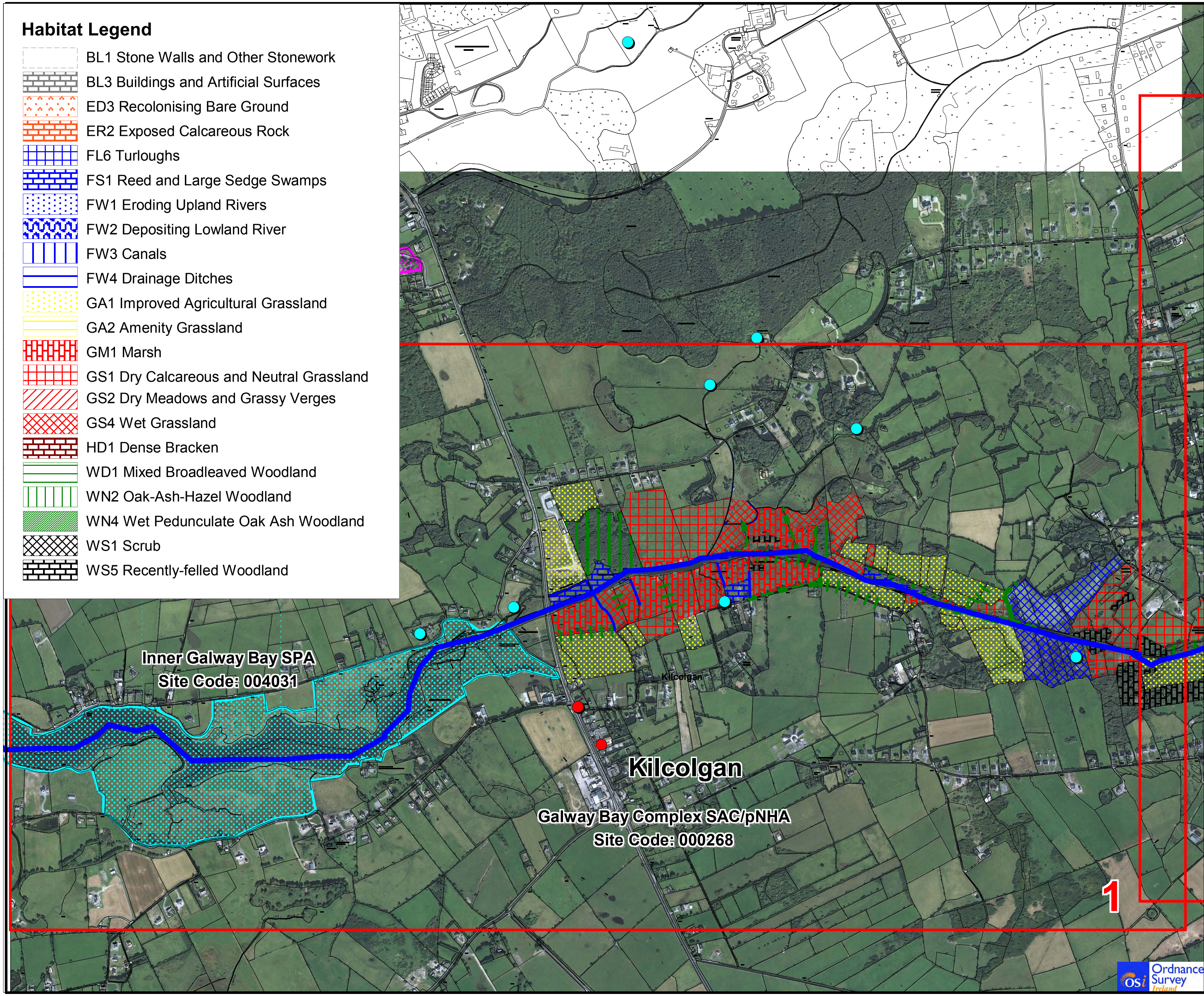

The Dunkellin River in the townland of Aggard More - Depositing Lowland River


The artificial channel within Rahasane Turlough – classified as a Canal FW3
</td>
</tr>
<tr>
<td>**Water Quality in the Study Area**</td>
<td>

- Water quality of the Dunkellin River at Craughwell has been classified good from Craughwell down to Rinn Bridge and Moderate from Rinn Bridge to Kilcolgan under the Water Framework Directive River Water Body Status.
- There are two EPA water quality monitoring stations located on the Dunkellin River from Craughwell to Kilcolgan that have been surveyed in 2009. Old Road Bridge monitoring point (29K010400) had a Q4 rating (good) in 2009 and Dunkellin Bridge (29K010600) had a Q3-4 rating (moderate) in 2009.
</td>
</tr>
<tr>
<td>**Geology and Hydrogeology in the Study Area**</td>
<td>

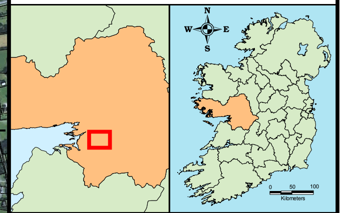
- **Soils:** Subsoils within the study area comprise predominantly of till derived chiefly from limestone. Stream section of the study area there are deposits of lake sediments and alluvium. Outcrops of karst rock are scattered throughout the study area.
- **Bedrock Geology:** The bedrock geology of the area is predominately limestone. Visean Limestone (undifferentiated) lies to the north of the Dunkellin River. The bedrock geology of the area to the south of the Dunkellin River is comprised of the Castlequarter Member of the Tubber Formation, the Burren Formation and the Lucan Formation.
- **Karst Feature**: There are 20 no. karst features located within the 1km buffer zone including turloughs, swallow holes and springs.
- **Hydrogeology:** The rock underlying the majority of the study area is classified by the Geological Survey of Ireland as a ‘Regionally Important Aquifer – Karstified”. A segment of rock underlying the Aggard Stream is classified by the Geological Survey of Ireland as a ‘Locally Important Aquifer’. The majority of the aquifer around the Dunkellin River is classified by the Geological Survey of Ireland as “Extreme Vulnerability” and “Extreme (rock near the surface or karst”). The majority of the aquifer surrounding the Aggard Stream is classified by the Geological Survey of Ireland as “High Vulnerability” with small intermittent areas of “Extreme Vulnerability” and “Extreme (rock near the surface or karst)”.
</td>
</tr>
</table>

Flooding in the Study Area	There is a history of flooding in the Dunkellin River catchment including the most notable flood events of recent times in November 2009 and January 2005. **Figure 3.5** shows the numerous flooding events that have been recorded by the OPW in the study area.  **Figure 3.5 Flooding Events on the Dunkellin River (www.opw.ie)**



Legend

- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Natural Heritage Area (NHA)
- Karst Feature
- Drainage ditch
- Hedgerow
- Treeline



Client

Galway County Council

Project

Dunkellin River and Aggard Stream Flood Relief Scheme; Environmental Consultancy Services

Title

Habitat Map

Figure 3.2

RPS

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Issue Details

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Checked by: MW		File Ref.	
Approved by: PK		MGE0260MI0012D02	
Scale: N.T.S.		Drawing No.	Rev.
Date: July '11		MI0012	D02

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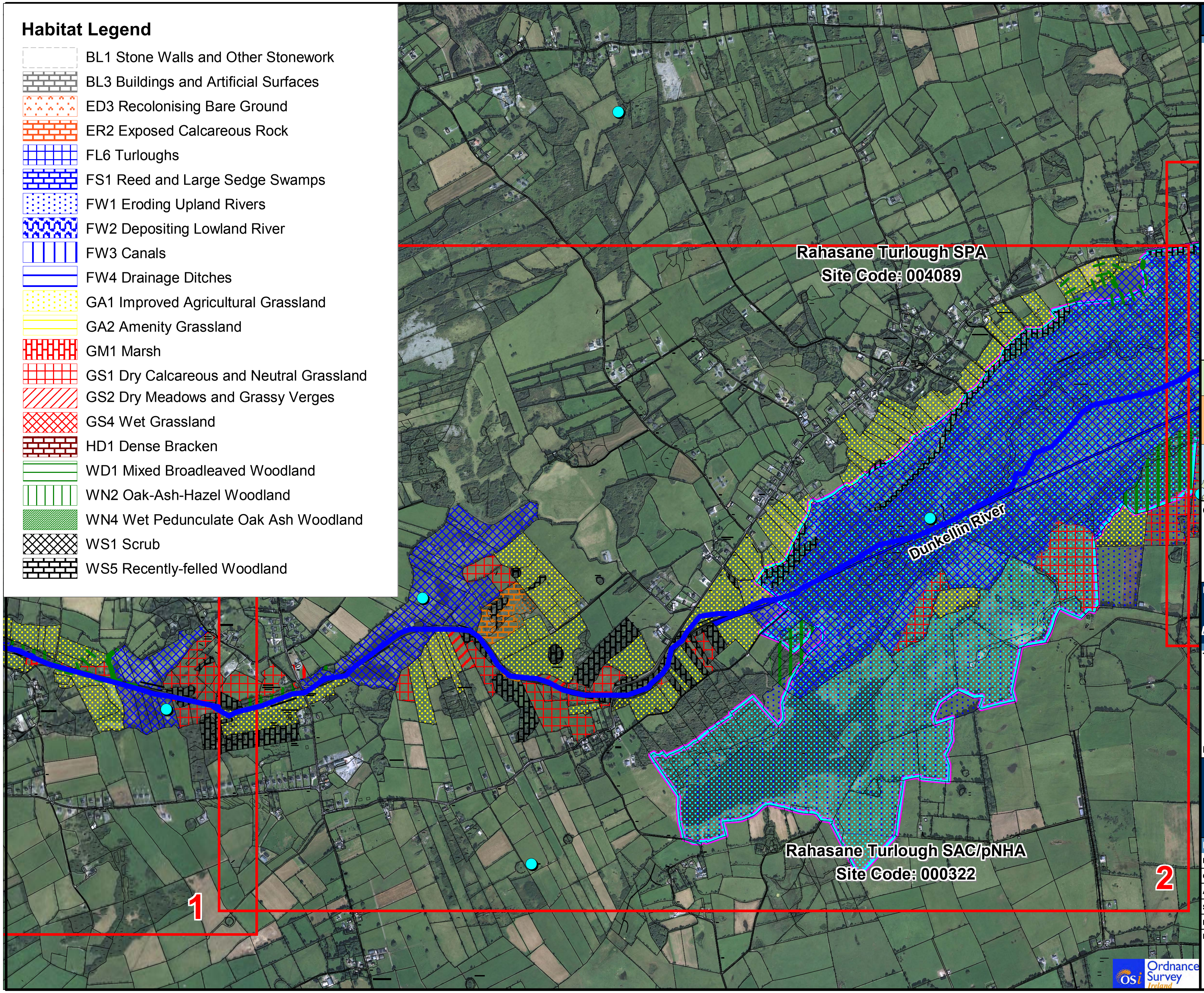

Client
Galway County Council

Project
Dunkellin River and Aggard Stream Flood Relief Scheme; Environmental Consultancy Services

Title
Habitat Map

Figure 3.3

RPS
Lyrr Building,
IDA Business & Technology Park,
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Issue Details

Drawn by: JH		Project No. MGE0260	
Checked by: MW		File Ref. MGE0260MI0012D02	
Approved by: PK			
Scale: N.T.S.		Drawing No.	Rev.
Date: July '11		MI0012	D02

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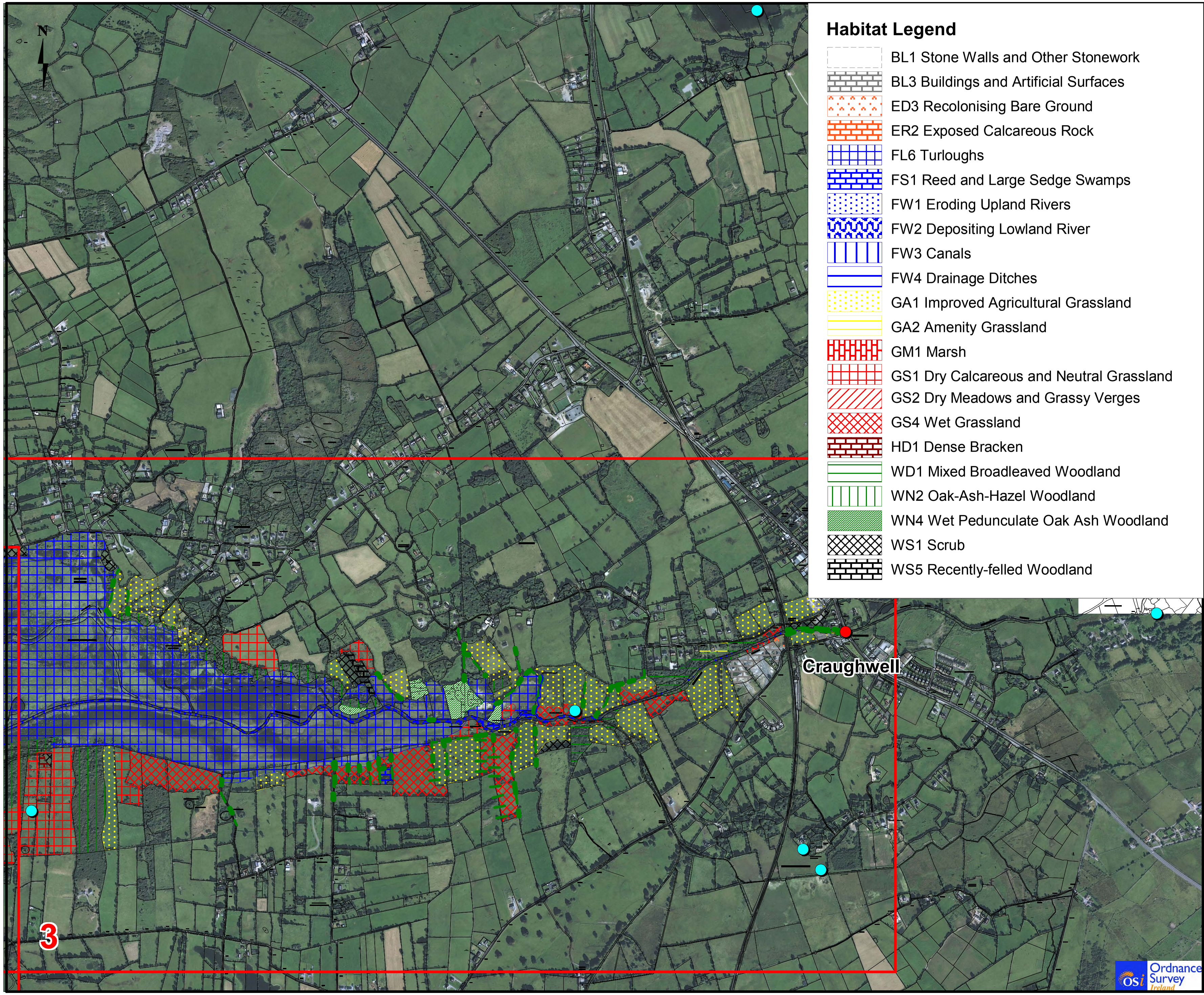

Legend

- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Natural Heritage Area (NHA)
- Karst Feature
- Drainage ditch
- Hedgerow
- Treeline

Client

Galway County Council

Project

Dunkellin River and Aggard Stream Flood Relief Scheme; Environmental Consultancy Services

Title

Habitat Map

Figure 3.4

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3.5 ASSESSMENT OF SIGNIFICANCE

ASSESSMENT CRITERIA – SCREENING MATRIX	
Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the Natura 2000 Sites	• Interference with the hydrological regime of Rahasane Turlough cSAC; flood alleviation works may lead to some drainage of the turlough which would have a significant negative impact. • Potential for contamination of the water quality of Rahasane Turlough and Galway Bay Complex cSAC/pNHA/Inner Galway Bay SPA during the construction stage of the proposed flood alleviation works. • Interference with the hydrological regime of the Galway Bay Complex cSAC/pNHA/Inner Galway Bay SPA, due to a possible increase in discharge flow to these waters from the Dunkellin Catchment. • Disturbance of faunal species in Rahasane Turlough, Galway Bay Complex cSAC/pNHA/Inner Galway Bay SPA during the construction phase of the proposed works.
Describe any likely direct, indirect or secondary impacts of the project on the Natura 2000 Sites	• **Size and Scale** Rahasane Turlough cSAC/SPA covers an approximate area of 350ha. There will be no works carried out within the Rahasane Turlough; therefore there will be no significant direct impact on Rahasane Turlough cSAC/SPA in this regard. However, the proposed flood alleviation measures may have significant indirect impact on the hydrological regime of the turlough, thus on the size and scale of the turlough. Castletaylor Complex cSAC, Ardrahan Grassland cSAC and Lough Rea cSAC/SPA cover approximate areas of 145ha, 200ha and 364ha, respectively, though as none of these sites are located on the Dunkellin River or are downstream of the proposed works they are less likely to be affected in this regard. The Galway Bay Complex cSAC covers an area of 11,600ha and the Inner Galway Bay SPA covers an area of 12,911ha, and so the proposed flood alleviation works are much less likely to have a significant impact on these Natura 2000 sites in terms of size and scale. • **Land-Take** No works are to be carried out within the Natura 2000 sites, and so there will be no impacts in this regard. • **Distance from Natura 2000 site or key features of the site** Rahasane Turlough cSAC, Galway Bay Complex cSAC and the Inner Galway Bay SPA are all located on the Dunkellin River and are downstream of the proposed works, and so there may be some impact in this regard. Works will not be carried out within these Natura 2000 sites, but some works will be carried out directly adjacent to the Rahasane Turlough cSAC.

	The other Natura 2000 sites, Castletaylor Complex cSAC, Ardrahan Grassland cSAC and Lough Rea cSAC/SPA all lie within the Dunkellin River Catchment, but are located approximately 2.5km, 4.3km and 10.7km, respectively, from the proposed works. As Lough Rea cSAC/SPA and Castletaylor Complex are both located upstream of the proposed works, they are unlikely to be affected. The Ardrahan Grassland cSAC does not contain any water-dependent habitats, and so is also unlikely to be affected by the proposed works. • **Resource Requirements** Abstraction for water supply purposes or other natural resources exploration are not part of this proposed development and so there will be no impacts in this regard. • **Emissions** During construction, emissions of suspended solids, fuels, lubricants and waste concrete to surface waters are possible. A range of stringent measures will be put in place in order to prevent emissions generated during construction from entering the Natura 2000 sites. If suitable measures are put in place during construction, emissions from these activities will not have an impact on the quality of the water of the Rahasane Turlough cSAC or in turn on the Galway Bay Complex cSAC and Inner Galway Bay SPA downstream of the proposed works. • **Excavation Requirements** The proposed works involve some excavation within the Dunkellin River, but no works are proposed within Rahasane Turlough itself. • **Transportation Requirements** There will be a slight increase in traffic within the area during the construction phase of the proposed flood alleviation works, but this is not expected to have a significant impact on the Natura 2000 sites in the area. • **Duration of construction, operation, decommissioning** The construction phase of the proposed flood alleviation works is expected to last approximately 9-12 months. During this time, there may be an increase in sedimentation or release of pollution to watercourses caused by stream widening works and operation of machinery. Once the flood alleviation works have been completed, they are expected to remain in place indefinitely, and therefore no decommissioning works are to take place. • **Cumulative Impacts with Other Plans and Projects in the Area** As part of the screening for an AA, in addition to the proposed works, other relevant projects and plans in the region must also

be considered at this stage. These plans and projects are considered further in this respect in **Table 3.4.**

Table 3.4 Potential In-Combination Effects of Other Plans and Projects

Name of Plan or Project	Key policies/issues/objectives directly related to the relevant Natura 2000 sites	Potential cumulative or in-combination effects on the relevant Natura 2000 sites
Galway County Development Plan 2009-2015	Designated Sites, Habitats and Species Policies and Objectives Natural Heritage and Biodiversity Polices and Objectives Natural Water Systems Polices	Positive Impact
Craughwell Local Area Plan 2009 – 2015	**Policy EH4.1:** The Local Authority shall seek to comply with the Habitats Directive and Natura 2000 recommendations, including the protection of fisheries habitats. **Policy EH4.2:** No projects giving rise to significant adverse direct, indirect or secondary impacts on Natura 2000 sites arising from their size or scale, land take, proximity, resource requirements, emissions of construction, operation, decommissioning or from any other effects shall be permitted on the basis of this Plan (either individually or in combination with other plans or projects). **Policy EH4.3:** It shall be the policy of GCC to ensure that development within the Plan Area and the provision of services take into account the relevant Management Plans (if any) for SACs and SPAs in the area. **Policy EH4.4:** Consult the Department of the Environment, Heritage and Local Government in relation to proposed developments adjoining designated conservation sites.	Positive Impact
Western RBMP Plan 2009-2015	The Western RBD Management Plan, issued in December 2009, sets out a number of objectives and measures for all water bodies in the Western Region. The following applies to the Dunkellin River **Objectives**: Ensure that the status of waters supporting protected areas is protected and (where necessary) improved by 2015. **Measures**: Implement 11 EU Directives, 9 other basic requirements.	Positive impact
Forest Management Plan –	Sets outs management objectives for the forestry located in the	Possible impacts upstream of

	Kilcornan (GY15) 2011-2015	Clarinbridge, Kilcolgan and Craughwell areas in terms of nature conservation, species diversity, security, adjoining lands, thinning, clear felling, replanting and social and environmental impact assessment.	Craughwell during clear felling.
	NPWS Conservation Management Plans	Conservation Management Plans have not been published by the NPWS for any of the Natura 2000 Sites to date. However the general conservation objectives have been established.	Positive impacts
	Draft Regional Flood Risk Appraisal for the Draft Regional Planning Guidelines for the West Region 2010 – 2022 (22 January 2010)	The Draft Regional Flood Risk Appraisal prepared for the Draft Regional Planning Guidelines for the West Region 2010-2022 outlines the Regional Flood Risk Appraisal for the West Region Authority's functional area. It examines the relationship between the Draft Regional Planning Guidelines, flood risk in the West Region and the management of flood risk. This document lists all the OPW Arterial Drainage and Flood Relief Schemes in the Western River Basin District. Apart from the Dunkellin River Flood Relief Scheme, there are no other flood relief schemes in the area which would affect the Rahasane Turlough.	Possible Cumulative Impacts
	Proposed Wastewater Treatment Plant, Craughwell – Appropriate Assessment Screening Report	An Appropriate Assessment Screening Report carried out on behalf of GCC by Tobins Engineers concluded that the construction and operation of the proposed WWTP would not have a significant negative impact on the Rahasane Turlough cSAC/SPA, and that the plant would in fact have a moderate positive impact on the cSAC during the operational phase as it will replace diffuse sources of pollution such as septic tanks with a modern water treatment plant with tertiary level treatment (Phosphorus removal).	Potentially positive impact.
	National Primary Route from Galway to Ennis N18.	The proposed M18 route corridor crosses the Dunkellin River between the Rinn Bridge and the Dunkellin Bridge. As the works will be carried out downstream of Rahasane Turlough, no impacts in the form of water pollution are expected on the cSAC/SPA. At a distance of approximately 1.2km, it is highly unlikely that these works will have a cumulative impact on Rahasane Turlough cSAC in terms of visual impact or disturbance to birds. It is possible that the works will have a cumulative impact on the Galway Bay cSAC and Inner Galway Bay SPA in the form of release of contaminants to the aquatic environment, but due to the temporary nature of the works and the large absorption capacity of these sites this impact is not considered to be significant.	Potentially Negative Impact on Galway Bay Complex cSAC /Inner Galway Bay SPA. No impact on Rahasane Turlough SPA.

	M6 Galway to Ballinasloe Road Scheme	The newly-constructed M6 between Galway and Ballinasloe crosses the Dooyertha River, a tributary of the Dunkellin River, 8km upstream of Craughwell. Due to the distance of the new road from Rahasane Turlough (over 6km), it is not expected that this will have a cumulative impact on the cSAC/SPA.	No Impact.
	Local Planning Applications	A search of the planning applications on Galway County Council's planning website was completed. The area considered included sites within or near lands within the extents of the November 2009 flood event. The planning applications that have been successful in the past year and those that are currently under consideration were analysed. **Planning Applications in Craughwell:** **Pl. Ref. 11364:** HR Property Developments Ltd have applied for extension of duration for the construction of 36 no. dwelling houses consisting of 12 no. dwellings in 3 no. terraces, 18 no. semi-detached and 6 no. detached dwellings including a proprietary effluent treatment plant and percolation area along with associated site development works (4233sqm)(previous pl. ref. 05/2217). This development is located approximately 300m from the extent of the November 2009 Dunkellin River flood event. **Pending decision.** **Aggard More Townland:** **Pl. Ref. 11237:** For retention of modifications to elevations and layout of existing dwelling as constructed, granted under pl. ref. 08/3629. Permission to also include retention of garage as constructed and to include all associated site works and repositioning of dwelling along with the rectification of any discrepancy from previously granted dwelling (gross floor space house 302.62sqm garage 43.75sqm). Site located 500m south of the extents of the November 2009 flood event. **Conditional Permission granted.** **South of Rahasane Turlough:** **Pl. Ref. 1191:** Application for Extension of Duration for the construction of a dwelling house, garage at rear, septic tank and associated services (previously granted under outline permission no. 02/1009) (gross floor space 218.8sqm) (previous pl. ref. 05/4623) in the townland of Rinn (approximately 200m from the extent of flooding area). **Granted (unconditional).**	Potentially Negative Impact

<table>
<tr>
<td></td>
<td></td>
<td>Kilcolgan:

Pl Ref. 101243: Extension of duration for retention of garden centre and associated retail unit and permission sought for new car park (gross floor space 98sqm) (previous pl. ref. 04/4444) (ext of duration 10/15). Site located 200m south of November 2009 flooding extents. Granted (unconditional).

Stradbally East:

Pl Ref. 11448: Permission for development on site comprising of dwelling, stables and septic tank. Previous planning relating to dwelling was planning ref 32387. Directly adjacent to lands flooded during the November 2009 flood event. Pending Decision.

Killeely Beg:

Pl. Ref. 11461: Extension of duration for change of house plans on site previously approved under planning ref. no. 05/4512 and permission to construct domestic garage and all associated services (gross floor space house 202.5sqm garage 72sqm)(previous pl. ref. 10/444) in the townland of Killeely Beg (200m from extent of November 2009 flooding). Pending decision.

Crinnage or Ballywulash:

Pl. Ref. 10636: Permission for reclamation of lands. Site located approximately 360m north of extent of November 2009 flooding. Conditional permission granted.

Pl. Ref. 101385: Permission to construct a carbon neutral two storey dwelling house and sewage treatment plant system (gross floor space 260sqm) (230m from extent of November 2009 flooding). Conditional permission granted.</td>
<td></td>
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<tr>
<td>Describe any likely changes to the site arising as a result of the following:</td>
<td colspan="3">- Reduction of Habitat
No works will be carried out within the Natura 2000 sites and so there will be no direct impacts in this regard. However, alteration of the flooding pattern within the wider area may decrease the floodplain of Rahasane Turlough, and thus reduce habitat area within this cSAC/SPA.

- Disturbance to Key Species
There is potential for disturbance to some of the key species of Rahasane Turlough cSAC/SPA during the construction phase of</td>
</tr>
</table>

	the proposed flood alleviation works, especially if works are inappropriately timed (Rahasane Turlough is host to large numbers of overwintering birds, including the EU Birds Directive Annex I species Greenland White-fronted Goose, Whooper Swan, Bewick's Swan and Golden Plover, the reason for its designation as an SPA). Disturbance to any of the key species of the other Natura 2000 sites is not expected. - **Habitat or Species Fragmentation** There will be no direct impacts in this regard, as no works are to be carried out within the Natura 2000 sites. However, there may be indirect impacts in this regard. The proposed works may lead to a reduction of the flood plain area and this may result in the permanent separation of the two turlough basins. No habitat or species fragmentation is expected in the other Natura 2000 sites. - **Reduction in species density** The proposed flood alleviation works may alter of the hydrological regime in the turlough. This may impact the floral species density in Rahasane Turlough cSAC/SPA and the availability of suitable habitat for waterfowl species that use the site, including the EU Birds Directive Annex I species Greenland White-fronted Goose, Whooper Swan, Bewick's Swan and Golden Plover. The proposed flood alleviation works will result in a slight increase in the volume of water being discharged to the Galway Bay cSAC and Inner Galway Bay SPA during times of flood. This may have some localised effects on species in the estuary, due to a change in the salinity levels. It is uncertain to what extent this will affect the species within the estuary. No reduction in species density is expected at the other Natura 2000 sites in the area. - **Changes in key indicators of conservation value** Vegetation composition in the turlough is considered to be the main indicator of the conservation value of the Rahasane Turlough cSAC. It is considered likely that the alteration of the hydrological pattern in the turlough may result in a change to the vegetation composition of the turlough. Due to the ornithological importance of Rahasane Turlough SPA, the numbers of birds of conservation importance using the site is also considered to be a key indicator of conservation value. Reducing the flood plain of the turlough may result in some loss of habitat for these species, and may therefore lead to a decline in the numbers of birds visiting the site. The proposed flood alleviation works will increase the volume of water being discharged to the Galway Bay cSAC and Inner Galway Bay SPA during times of flood. This may have some localised effects on species in the estuary, due to a change in the salinity levels. It is uncertain to what extent this will affect the key indicators of the conservation value of these sites (i.e. the qualifying habitats and species).

	No change in key indicators is expected at the other Natura 2000 sites in the area. - **Climate Change** It is widely predicted that the climate in Ireland will change in future, leading to increases in sea level, storm event magnitude and frequency, and rainfall depths, intensities and patterns. The effects of Climate Change are likely to have a significant impact on the relevant Natura 2000 sites in the future, in particular on the hydrological regime of Rahasane Turlough cSAC.
Describe any likely impacts on the Natura 2000 sites as a whole in terms of: Interference with key relationships that define the structure and function of the site	- **Interference with key relationships that define the structure and function of the sites** One of the key relationships that defines the structure and function of Rahasane Turlough cSAC is that between the balance of inflow and outflow to the turlough, and the vegetation composition of the site. The proposed flood alleviation works will interfere with this relationship. If the proposed flood alleviation works are to be carried out, there will be a reduction in the inflow of water to Rahasane turlough. It is likely that there will be a significant change in the amount of water being held at the turlough site at different times of the year, and that this alteration of the hydrological regime may result in a change to the vegetation composition of the turlough. Another key relationship of the Rahasane Turlough is between the extent, frequency and duration of flooding and the numbers of birds using the site. This key relationship may be affected by an alteration of the hydrological regime of the turlough. One of the key relationships that defines the structure and function of Galway Bay Complex cSAC/Inner Galway Bay SPA is that between water quality and the presence of species within the site. The proposed works may lead to an increase in sedimentation and an alteration of salinity levels within the estuary, which may in turn affect the species within the Natura 2000 site. It is not expected that there will be any interference with the key relationships that define the structure and function of the other Natura 2000 sites in the area.
Provide Indicators of significance as a result of the identification of effects set out above	- **Loss** It is possible that the proposed works will lead to a change in the vegetation composition of the Rahasane Turlough cSAC. Loss of any amount of the Turlough habitat is considered highly significant. Loss of any of the bird species using the site would be significant, but loss of any of the EU Birds Directive Annex I species would be considered highly significant. Loss of the rare species, Northern Yellow-cress (*Rorippa islandica*) and Fen Violet (*Viola persicifolia*) would also be considered significant.

in terms of:	An indicator of significance within the Galway Bay Complex cSAC/Inner Galway Bay SPA would be the loss of the qualifying species of these sites. No fragmentation is expected in the other Natura 2000 sites in the area. - **Fragmentation** Permanent separation of the two turlough basins within Rahasane Turlough cSAC would be considered significant. No fragmentation is expected in the other Natura 2000 sites in the area. - **Disruption** There is potential for disruption of some of the key species of Rahasane cSAC/SPA during the construction phase of the proposed flood alleviation works. A reduction of bird numbers at the site would be an indicator of significance in this regard. There is potential for disruption of some of the key species of Galway Bay Complex cSAC/Inner Galway Bay SPA during the construction phase of the proposed flood alleviation works. A reduction in species density at these sites would be considered an indicator of significance in this regard. No disruption is expected in the other Natura 2000 sites in the area. - **Disturbance** There is potential for disturbance to some of the key species of Rahasane Turlough cSAC/SPA during the construction phase of the proposed flood alleviation works. A reduction in numbers of birds using the site as a result of this disturbance would be an indicator of significance in this regard. There is potential for disturbance to some of the key species of Galway Bay Complex cSAC/Inner Galway Bay SPA during the construction phase of the proposed flood alleviation works. A reduction in species density as a result of this disturbance would be an indicator of significance in this regard. No disturbance is expected in the other Natura 2000 sites in the area. - **Change to key elements of the site** Species composition and plant community ecology in the turlough is considered to be the key element of the Rahasane

	Turlough cSAC. A detailed vegetation survey was carried out at the site by Roger Goodwillie during his survey of turloughs over 10ha in Ireland in 1992. A further survey was carried out by RPS ecologists in spring/summer 2011. No change in turlough vegetation zones was apparent during this re-survey, indicating that the hydrological and management regimes at the turlough have remained much the same during this time. An indicator of significance in this regard is therefore any change to the current vegetation zonation. A reduction in the flood plain area would also be significant. The key element of the Rahasane Turlough SPA is the numbers of waterfowl that use the site. Surveys have been carried out in recent years of the numbers of waterfowl using the site. A reduction in the numbers of waterfowl using the site would be an indicator of significance in this regard. The key element of the Inner Galway Bay SPA is the numbers of waterfowl that use the site. A reduction in the numbers of waterfowl using the site would be an indicator of significance in this regard. The key element of the Galway Bay Complex cSAC is the habitats and species in the site. A reduction in species density or habitat areas would be an indicator of significance in this regard. No change to key elements of the other Natura 2000 sites in the area is expected.
Describe from the above those elements of the project or plan, or combination of elements, where the above impacts are likely to be significant or where the scale or magnitude of impacts is not known.	The most likely significant impact of the proposed flood alleviation works on the Natura 2000 sites in question is interference with the hydrological regime of Rahasane Turlough cSAC/SPA due to alteration of the inflow and outflow of the turlough. One of the key relationships that defines the structure and function of the Rahasane Turlough is that between the balance of inflow and outflow to the turlough, and the vegetation composition of the site. The proposed flood alleviation works will interfere with this relationship. It is likely that there will be a significant change in the amount of water being held at the turlough site at different times of the year, and that this alteration of the hydrological regime may result in a change to the vegetation composition of the turlough. This in turn may have a significant impact on the bird populations using the site. The significance of these impacts is uncertain at this stage. The proposed flood alleviation works may result in the reduction in water quality of Rahasane Turlough during the construction stage of the proposed flood alleviation works. The likelihood of this impact can be reduced through the implementation of appropriate mitigation measures, however. The proposed flood alleviation works will result in an increase in the volume of water being discharged to the Galway Bay cSAC and Inner Galway Bay SPA during times of flood. This may have some localised effects on species in the estuary, due to a change in the salinity levels. It is uncertain to what extent this will affect the key indicators of the conservation value of these sites (i.e. the qualifying habitats and species). As Lough Rea cSAC/SPA, Lough Fingall Complex cSAC, Kiltiernan Turlough cSAC and Castletaylor Complex cSAC are all located

	upstream of the proposed works, they are unlikely to be affected by the proposed works. The Ardrahan Grassland cSAC does not contain any water-dependent habitats, and so is also unlikely to be affected by the proposed works. **The scale and magnitude of impacts on Rahasane Turlough cSAC/SPA, Galway Bay Complex cSAC and Inner Galway Bay SPA is uncertain. It is considered likely that the proposed flood alleviation works will result in an alteration of the hydrological regime in the Rahasane Turlough, and that this will bring about changes to key elements of the site. It is also considered possible that the construction phase of the proposed works will result in the release of contaminants to the cSAC. As the scale and magnitude of impacts is not known for certain but is considered likely, it is recommended that a Stage 2 Appropriate Assessment is required in order to determine the impacts of the proposed flood alleviation works on Rahasane Turlough cSAC/SPA, the Galway Bay Complex cSAC and the Inner Galway Bay SPA. A Natura Impact Statement should therefore be prepared, in order to assist the Development Applications Unit (DAU) in carrying out the Stage 2 Appropriate Assessment.** **No significant impact is expected on the other Natura 2000 sites in the area - Castletaylor Complex cSAC, Lough Rea cSAC/SPA, Ardrahan Grassland cSAC, Lough Fingall Complex cSAC, and Kilternan Turlough cSAC.** **Therefore, a Stage 2 Appropriate Assessment is not required for these Natura 2000 sites in relation to the Dunkellin River and Aggard Stream Flood Relief Scheme.**

APPENDIX A

NPWS Site Synopses for:

Rahasane Turlough cSAC,

Rahasane Turlough SPA,

Lough Rea cSAC,

Lough Rea SPA,

Castletaylor Complex cSAC,

Ardrahan Grassland cSAC,

Galway Bay Complex cSAC,

Lough Fingall Complex cSAC,

Kilternan Turlough cSAC, and

Inner Galway Bay SPA,

SITE NAME: RAHASANE TURLOUGH cSAC

SITE CODE: 000322

Rahasane Turlough lies in gently undulating land, approximately 2km west of Craughwell, County Galway. It consists of two basins which are connected at times of flood but separated as the waters decline. The larger of these, the northern basin, takes the Dunkellin River westwards. Rahasane was formerly the natural sink of the Dunkellin River, but now an artificial channel takes some of the water further downstream. Water escapes the artificial channel to sweep around the northern basin, and again in the west, where it flows into an active swallowhole system. The main swallowholes here are constantly changing, but reach 5m in diameter and 2-3m deep. Some minor collapses are found elsewhere in the turlough, as well as a small number of more permanent pools. Mostly, the edges of the turlough rise gradually into the surrounding land, but in places, rocks mark a more sudden transition. The southern basin is an impressive feature, with high rocky sides above an undulating base, strewn with boulders. There is a low hill on the south side of the main basin, and another on the north-east, near Shanbally Castle, where smooth limestone pavement is evident. The major part of the turlough is open, flat and grassy, with occasional depressions and dry channels. The substrate consists largely of silty clay with shell fragments, reaching over 3m in thickness. Locally in the main basin, there are signs of marl, but peat is absent everywhere. Like the southern basin, the eastern end of the main (northern) basin is distinguished by the presence of large rocks scattered over the floor.

The vegetation of Rahasane is divided between dry and wet communities. Because of its large catchment, the turlough is naturally eutrophic and this, together with a lack of peat, limits the Sedges (*Carex* spp.) which are usually abundant in turlough vegetation. In places with outcropping limestone, the vegetation is predominantly dry grassland with Red Fescue (*Festuca rubra*) and Crested Dog's-tail (*Cynosurus cristatus*) among a generally calcicole community. Large areas in the drier parts of the turlough are covered by a community characterised by an abundance of Creeping Cinquefoil (*Potentilla reptans*), with Common Sedge (*Carex nigra*), Silverweed (*Potentilla anserina*) and Creeping Bent (*Agrostis stolonifera*). Where the soil is less well drained, Creeping Cinquefoil disappears from this community and the rare species, Fen Violet (*Viola persicifolia*), which is listed in The Irish Red Data Book, occurs. In these areas, the presence of Common Spike-rush (*Eleocharis palustris*) suggests that water is close to the surface.

The wet communities are all associated with the river channels and pools. Fully aquatic communities include such species as Fan-leaved Water Crowfoot (*Ranunculus circinatus*), Fennel Pondweed (*Potamogeton pectinatus*), Lesser Pondweed (*P. pusillus*), Fat Duckweed (*Lemna gibba*), Whorled Water-milfoil (*Myriophyllum verticillatum*) and Needle Spike-rush (*Eleocharis acicularis*). Semi-aquatic communities fringe the main channel of the river and colonise muddy pools in the basin. Species such as Lesser Water-parsnip (*Berula erecta*), Fool's Water-cress (*Apium nodiflorum*), River Water-dropwort (*Oenanthe fluviatilis*) and Amphibious Bistort (*Polygonum amphibium*) occur, also the rare species, Northern Yellow-cress (*Rorippa islandica*), which is listed in The Irish Red Data Book. There are also some narrow fields with Yellow Iris (*Iris pseudacorus*).

There are small areas of scrub on the southern and north-western sides of the turlough, but the area of flooded woodland is small. The scrub is made up of Buckthorn (*Rhamnus cathartica*), Ash (*Fraxinus excelsior*) and Hazel (*Corylus avellana*). The trees support a range of epiphytic mosses such as *Leskea polycarpa, Amblystegium riparium, Isopterygium elegans, Isothecium myosuroides* and *Thuidium tamariscinum*.

Rahasane Turlough is renowned for its wintering wildfowl populations, but it also supports nesting waders in summer, which include Lapwing, Redshank, Snipe and Dunlin. Figures stated in the following account represent mean (and peak) counts obtained during the three seasons, 1984/85 to 1986/87. Internationally important numbers of Whooper Swan 179, Golden Plover 17680, Wigeon 7760 and Shoveler 498. The first two species, together with Bewick's Swan, below, are listed on Annex I of the European Birds Directive. Species recorded in nationally important numbers are Bewick's Swan 132, Mute Swan 125, Teal 3005, Mallard 777, Pintail 102, Pochard 356, Tufted Duck 381, Coot 1289, Lapwing 3995, Dunlin 3569 (5653), Black-tailed Godwit 170 and Curlew 1205. Small numbers of the internationally important Greenland White-fronted Goose regularly overwinter at Rahasane (average count, as above, 59), but numbers have been declining over the years.

There is a small run of Atlantic Salmon (*Salmo salar*) through the Dunkellin River when it is flowing overground. The fish pass through the turlough but do not use it for spawning. This species is listed on Annex II of the European Habitats Directive.

The Fairy Shrimp (*Tanymastix stagnalis*, Class Crustacea) was first recorded in Ireland from the southern basin at Rahasane, though it has occurred elsewhere. It requires isolation from predators to grow to reproductive age and so cannot occur in permanent waterbodies.

The Turlough is closely grazed by cattle, sheep and horses. Grazing is a critical factor in maintaining a balance between open swards and woodland development at the edges of the turlough. Drainage is a major threat to turloughs, but the Dunkellin River has not been arterially drained. The River was straightened many years ago, where it crosses the turlough, and the artificial channel was dredged again in 1992, but this does not appear to have affected winter flooding. Some degree of artificial enrichment of the basin is occurring from the farming areas upstream, and local enrichment is associated with grazing practices. Eutrophication is among the major threats to turlough systems in general.

Rahasane Turlough is of major ecological significance as one of only two large turloughs which still function naturally. It is the most important turlough for birdlife in the country. In a relatively recent national survey, it was also rated very highly for its vegetation, and supports two rare species listed in The Irish Red Data Book. Turloughs are a rare habitat type and are given priority status under Annex I of the European Habitats Directive.

20.2.1997

SITE NAME: RAHASANE TURLOUGH SPA

SITE CODE: 004089

Rahasane Turlough lies in gently undulating land, approximately 2 km west of Craughwell, Co. Galway. It consists of two basins which are connected at times of flood but separated as the waters recede. The larger of these, the northern basin, takes the Dunkellin River westwards. Rahasane was formerly the natural sink of the Dunkellin River, but now an artificial channel takes some of the water further downstream. Water escapes the artificial channel to sweep around the northern basin, and again in the west, where it flows into an active swallowhole system. Some minor collapses are found elsewhere in the turlough, as well as a small number of more permanent pools. Mostly, the edges of the turlough rise gradually into the surrounding land, but in places rocks mark a more sudden transition. The southern basin has high rocky sides above an undulating base that is strewn with boulders. There is a low hill on the south side of the main basin, and another on the north-east, near Shanbally Castle. The major part of the turlough is open, flat and grassy, with occasional depressions and dry channels. The substrate consists largely of silty clay. Locally in the main basin there are signs of marl, but peat is absent everywhere.

The vegetation of Rahasane is divided between dry and wet communities. Because of its large catchment, the turlough is naturally eutrophic and this, together with a lack of peat, limits the sedges (*Carex* spp.) which are usually abundant in turlough vegetation. In places with outcropping limestone, the vegetation is predominantly dry grassland among a generally calcicole community. Large areas in the drier parts of the turlough are covered by a community characterised by an abundance of Creeping Cinquefoil (*Potentilla reptans*), with Common Sedge (*Carex nigra*), Silverweed (*Potentilla anserina*) and Creeping Bent (*Agrostis stolonifera*). Where the soil is less well-drained, Creeping Cinquefoil disappears from this community and the rare, Red Data Book species, Fen Violet (*Viola persicifolia*), occurs. The wet communities are all associated with the river channels and pools. Fully aquatic communities include such species as Fan-leaved Water-crowfoot (*Ranunculus circinatus*) and pondweeds (*Potamogeton* spp.). Semi-aquatic communities fringe the main channel of the river and colonise muddy pools in the basin. Species such as Lesser Water-parsnip (*Berula erecta*), Fool's Water-cress (*Apium nodiflorum*) and Amphibious Bistort (*Polygonum amphibium*) occur, as well as the rare, Red Data Book species, Northern Yellow-cress (*Rorippa islandica*). There are also some narrow fields with Yellow Iris (*Iris pseudacorus*). There are small areas of scrub on the southern and north-western sides of the turlough, but the area of flooded woodland is small.

Rahasane is considered to be the most important turlough in the country for wintering waterfowl. It is a traditional site for Greenland White-fronted Goose, and supports a population of national importance (218 individuals) - all figures are average peaks for the period 1995/96-1999/00. It also has nationally important populations of Whooper Swan (141), Wigeon (3,630), Pintail (21), Golden Plover (6,626), Lapwing (2,220) and Black-tailed Godwit (435). The Shoveler population (29) is very close to the threshold for national importance. The site has the largest inland population of Dunlin (864) in the country, and also supports Mute Swan (76), Teal (367), Tufted Duck (32), Curlew (197), Redshank (149), Mallard (124), Black-headed Gull (280) and Grey Heron (31). As at all turlough sites, numbers of birds present can vary considerably owing to fluctuations in water levels. The site has long been known as an important waterfowl site and has been monitored annually in recent years.

The Crustacean, Fairy Shrimp (*Tanymastix stagnalis*) was first recorded in Ireland from the southern basin at Rahasane, though it has since been noted elsewhere. It requires isolation from predators to grow to reproductive age and so does not occur in permanent waterbodies.

Arterial drainage, whilst probably now unlikely to occur, would cause serious damage to the flooding pattern of this turlough and would be expected to affect the bird populations. The Greenland White-fronted Goose population is particularly vulnerable to habitat degradation as the flock has only one alternative feeding site (at Cregganna). Some degree of artificial enrichment of the basin is occurring from the farming areas upstream, and local enrichment is associated with grazing practices at the site; however, the bird populations are unlikely to be affected by such activities. The turlough is closely grazed by cattle, sheep and horses, and grazing is a critical factor in maintaining a balance between open swards and woodland development at the edges of the turlough.

Rahasane Turlough SPA is of high ornithological importance and supports seven species of national importance. The Wigeon and Golden Plover populations are of particular note as they each represent approximately 4% of the national totals of these species. The occurrence of Greenland White-fronted Goose, Whooper Swan and Golden Plover is of importance as these species are listed on Annex I of the E.U. Birds Directive.

1.12.2004

SITE NAME: LOUGH REA cSAC

SITE CODE: 000304

Lough Rea is a hard water lake, a habitat listed on Annex I of the EU Habitats Directive. It is situated directly south of the town of Loughrea, Co. Galway. The lake is 2.5 km at its longest axis. The underlying geology of the area is of Carboniferous limestone and water transparency is very high. The lake, which is fed by springs and by a stream, reaches a maximum depth of 15 m.

Some species of stonewort (a type of alga) characteristic of calcareous waters have been recorded in Lough Rea, including *Chara curta* and *C. contraria*. The Red Data Book species *C. tomentosa* has also been found here. Other aquatic plants present include Slender-leaved Pondweed (*Potamogeton filiformis*), Lesser Pondweed (*P. pusillus*), Fennel Pondweed (*P. pectinatus*), Spiked Water-milfoil (*Myriophyllum spicatum*), Least Bur-reed (*Sparganium minimum*), Amphibious Bistort (*Polygonum amphibium*) and the alga *Chaetomorpha incrassaton.* On the sheltered western and south-eastern shores of the lake some areas of reedswamp, wet grassland and wet woodland are included in the site.

Lough Rea is of considerable ornithological interest. Internationally important numbers of Shoveler overwinter at the site (max. 467, 1995/96) and nationally important numbers of Tufted Duck (max. 406, 1995/96) and Coot (max. 1256, 1996/97) have also been reported. A further 10 species of waterfowl reach regionally or locally important numbers. Brown Trout (*Salmo trutta*) are present in the lake.

The site is largely surrounded by intensively farmed pasture and consequently the main threat to the lake comes from agricultural run-off. The lake is also vulnerable to nutrient input from the town of Loughrea. Boating activities may have some impact on the site and may need to be monitored. An area has been planted with conifers to the east of the lake, but this does not appear to be adversely affecting the ecology of the lake.

Lough Rea is a hard water lake, a habitat listed on Annex I of the E.U. Habitats Directive. Lough Rea is also important for birds and holds internationally important numbers of Shoveler and nationally important numbers of Tufted Duck and Coot. Ten further bird species are present at levels of regional/local importance. It supports a population of Brown Trout.

16.2.1999

SITE NAME: LOUGH REA SPA

SITE CODE: 004134

Lough Rea, a hard water lake, is situated directly south of the town of Loughrea, Co. Galway. The lake is 2.5 km at its longest axis. The underlying geology of the area is of Carboniferous limestone and water transparency is very high. The lake, which is fed by springs and by a stream, reaches a maximum depth of 15 m.

Some species of stonewort (a type of alga) characteristic of calcareous waters have been recorded in Lough Rea, including *Chara curta* and *C. contraria*. The Red Data Book species *C. tomentosa* has also been found here. Other aquatic plants present include Slender-leaved Pondweed (*Potamogeton filiformis*), Lesser Pondweed (*P. pusillus*), Fennel Pondweed (*P. pectinatus*), Spiked Water-milfoil (*Myriophyllum spicatum*), Least Bur-reed (*Sparganium minimum*), Amphibious Bistort (*Polygonum amphibium*) and the alga *Chaetomorpha incrassaton*. On the sheltered western and south-eastern shores of the lake some areas of reedswamp, wet grassland and wet woodland are included in the site.

Lough Rea is of considerable ornithological interest. Internationally important numbers of Shoveler overwinter at the site (5 year winter mean of 246 for the years 1994/95 to 1998/99, maximum 467 in 1995/96 and 681 in the 1980s) and nationally important numbers of Tufted Duck (maximum 406 in 1995/96) and Coot (maximum 1,256 in 1996/97, 1,700 in the 1980s) have also been reported. A further 10 species of waterfowl reach regionally or locally important numbers.

The site is largely surrounded by intensively farmed pasture and consequently the main threat to the lake comes from agricultural run-off. The lake is also vulnerable to nutrient input from the town of Loughrea. Boating activities may have some impact on the site and may need to be monitored.

Lough Rea is a hard water lake, a habitat listed on Annex I of the EU Habitats Directive. Lough Rea is also important for birds and holds internationally important numbers of Shoveler and nationally important numbers of Tufted Duck and Coot. Ten further bird species are present at levels of regional/local importance.

27.2.2002

SITE NAME: CASTLETAYLOR COMPLEX cSAC

SITE CODE: 000242

This site is situated approximately 4 km south-east of Kilcolgan and lies in a gently undulating limestone topography. Although relatively small in area, the site contains a diverse range of habitats, including five EU Habitats Directive Annex I habitats - turloughs, limestone pavement, orchid-rich calcareous grassland, alpine heath and juniper scrub. The first three of these are listed as priority habitats under the Directive.

Caranavoodaun turlough dominates the western half of the site. It occupies a shallow basin set among ridges of limestone outcrop and thin glacial drift and is an excellent example of a calcareous and extremely oligotrophic (nutrient-poor) turlough. It has a limited throughput of water, with a considerable precipitation of marl and some accumulation of peat. Some stands of Black Bog-rush (*Schoenus nigricans*), with sparce Variegated Horsetail (*Equisetum variegatum*), occur at the upper levels, surrounded by patches of Buckthorn (*Rhamnus catharticus*) and Hawthorn (*Crataegus monogyna*) scrub. To the south-east the scrub includes Ash (*Fraxinus excelsior*), Yew (*Taxus baccata*), Whitebeam (*Sorbus aria*) and Irish Whitebeam (*Sorbus hibernica*). Below this there is an extensive area of sedge fen vegetation with species such as Tawny Sedge (*Carex hostiana*), Carnation Sedge (*C. panicea*), Purple Moor-grass (*Molinia caerulea*), Meadow Thistle (*Cirsium dissectum*) and Devil's-bit Scabious (*Succisa pratensis*). Along the western and south-western sides the low-lying ground supports a community of Shoreweed (*Littorella uniflora*), Spike-rushes (*Eleocharis palustris, E. multiflora*) and Bulbous Rush (*Juncus bulbosus*) growing in shallow water that persists into June. The deeper pools are colonised by Pondweeds (*Potamogeton gramineus, P. polygonifolius, P. coloratus*).

North of the turlough there is a mosaic of other habitats. The limestone pavement occurs mainly as scattered boulders with no extensive areas of flat pavement. It has a rich flora with species such as Bloody Crane's-bill (*Geranium sanguinium*), Herb Robert (*G. robertianum*), Burnet Rose (*Rosa pimpinellifolia*), Wood Sage (*Teucrium scordonia*), Quaking-grass (*Briza media*) and the rarer Spring Gentian (*Gentiana verna*) and Mountain Avens (*Dryas octopetala*). Limestone pavement breaks through the turlough floor in places, and supports scrub vegetation with Dewberry (*Rubus caesius*), Dog Rose (*Rosa canina*), stunted Ash (*Fraxinus excelsior*) and Blackthorn (*Prunus spinosa*). The Red Data book species Alder Buckthorn (*Frangula alnus*) occurs amongst this community. Limestone outcrops also occur within the wooded area of the site.

The dry calcareous grassland that occurs amongst the limestone pavement and heath is species-rich, particularly with orchids, including Autumn Lady's tresses (*Spiranthes spiralis*), Early Marsh-orchid (*Dactylorhiza incarnata*), Lesser Butterfly-orchid (*Platanthera bifolia*), Fragrant Orchid (*Gymnadenia conopsea*), Broad-leaved Helleborine (*Epipactis helleborine*) and the scarce Dense-flowered Orchid (*Neotinea maculata*).

The heath at this site is characterised by the presence of Juniper (*Juniperus communis*) and Mountain Avens (*Dryas octopetala*). The presence of Bearberry (*Arctostaphylos uva-ursi*) indicates that some of the heath is similar to the Arctostaphylos-Dryas vegetation of the Burren limestone area, a rare lowland alpine type heath.

The entire eastern part of the site is dominated by dry broad-leaved woodland. Species include Birch (*Betula pubescens*), Ash (*Fraxinus excelsior*) and of particular note Yew (*Taxus baccata*). Hazel (*Corylus avellana*), Holly (*Ilex aquifolium*) and Spindle (*Euonymus europaeus*) are also found.

The turlough does not hold any significant wintering populations of birds, owing to the extreme oligotrophic conditions. Three pairs of Lapwing bred at the site in 1996.

The main land use within the open areas of the site is light grazing by cattle. Some clearance of scrub within parts of the woodland has caused some damage and is a further threat. This site is conservation interest for its diversity of habitats within a relatively small area. The transition from the wetland to the surrounding habitats is particularly well shown.

20.8.1999

SITE NAME: ARDRAHAN GRASSLAND cSAC

SITE CODE: 002244

This site is dominated by a large flat limestone area with a mosaic of typical calcareous habitats including limestone pavement, alpine heath, Juniper scrub and species rich dry grasslands. In contrast, the south west of the site consists of a small marl lake and adjoining fens and marshes with Juniper heath frequent on the higher ground. Soils associated with limestone pavement are generally thin rendzina, deeper pockets are more mineral rich and support limestone grassland and scrub in places.

The site is important for a number of reasons. It contains a small though excellent example of the Annex I habitat alpine heath along with the Annex I priority habitats, limestone pavement, Juniper scrub and hard water lake with Stoneworth (*Chara*) formations. Of particular note, is the abundance of Juniper (*Juniperus communis*) and Bearberry (*Arctostaphylos uva-ursi*) in association with a typical Burren flora including such species as Mountain Aven (*Dryas octopetala*), Spring Gentian (*Gentiana verna*), and various orchid species including The fly Orchid (*Ophrys insectifera*). The southern and western part of the area has a vegetation probably referable to the Centaureo-Cynosuretum but is of significant interest due to the low intensity of management in the area.

Juniper (*Juniper communis*) scrub is frequent within the site. In the north it forms a dense mat over limestone pavement along with Bearberry and Mountain Aven. Further south it occurs on higher undulating ground over a species rich calcareous heath with, Wild Thyme (*Thymus praecox*), Carline Thistle (*Carlina vulgaris*), Tormentil (*Potentilla erecta*), Bloody Cranesbill (*Geranium sanguineum*), Black bog rush (*Schoenus nigricans*), Ling heather (*Calluna vulgaris*) and occasional Bearberry.

Brackloon Lough, occurs in the south of the site and is a fine example of a small shallow marl lake, one of very few in this locality. This open lake has a pronounced whitish appearance and a flora of lime-encrusted Thread-leaved Water crowfoot (*Ranunculus trichophyllus*) and a little Curled pondweed (*Potamogeton crispus*). Shoreweed (*Littorella uniflora*) is locally abundant on the shoreline, where it grows with Many-stalked spike-rush (*Eleocharis multicaulis*), Pink Water speedwell (*Veronica catenata*), Lesser water-plantain (*Baldellia ranunculoides*) and some Amphibious bistort (*Polygonum amphibium*). Although small it seems in a relatively natural state and is adjacent to a good limestone pavement area.

There are two small turloughs present within the site. Both are well grazed and consist of a short turf peaty vegetation with Common sedge (*Carex nigra*), Lesser spearwort (*Ranunculus flammula*), Creeping buttercup (*Ranunculus repens*) (turlough form), Lesser marshworth (*Apium inundatum*), Cuckoo flower (*Cardamine pratensis*), Marsh pennyworth (*Hydrocotyle vulgaris*), Water mint (*Mentha aquatica*), along with Common marsh-bedstraw (*Galium palustre*), Creeping bent grass (*Agrostis stolonifera*), Jointed Rush (*Juncus articulatus*) and Common spike-rush (*Eleocharis palustris*).

A number of bird species were seen during field visits, including, Snipe (*Gallinago gallinaga*), Mute Swan (*Cygnus olor*), and Curlew (*Numenius arquata*).

This site supports the Red Data Book species Mountain Aven (*Dryas octopetala*).

Landuse at this site consists mainly of the traditional practise of winter grazing by cattle. This is a low intensity farming practise generally confined to the Burren in Ireland and one that is vital to the maintenance of the high scientific interest of this site.

Recent agricultural improvement has damaged the scientific interest of part of the site, through loss of habitat in the turlough and limestone pavement areas.

This site is important as it contains an excellent example of alpine heath and limestone grassland interspersed with limestone outcrop. The alpine heath vegetation on the eastern part of the site is superior in quality to many of the areas proposed for NHA designation in the Burren.

SITE NAME: GALWAY BAY COMPLEX cSAC/pNHA

SITE CODE: 000268

Situated on the west coast of Ireland, this site comprises the inner, shallow part of a large bay which is partially sheltered by the Aran Islands. The Burren karstic limestone fringes the southern sides and extends into the sublittoral. West of Galway city the bedrock geology is granite. There are numerous shallow and intertidal inlets on the eastern and southern sides, notably Muckinish, Aughinish and Kinvarra Bays. A number of small islands composed of glacial deposits are located along the eastern side. These include Eddy Island, Deer Island and Tawin Island. A diverse range of marine, coastal and terrestrial habitats, including several listed on Annex I of the EU Habitats Directive, occur within the site, making the area of high scientific importance.

Galway Bay South holds a very high number of littoral communities (12). They range from rocky terraces, to sandy beaches with rock or sand dunes behind. The area has the country's only recorded example of the littoral community characterized by *Fucus serratus* with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata. This community has very high species richness (85 species), as do the sublittoral fringe communities on the Finavarra reef (88 species). The rare sea urchin *Paracentrotus lividus* and the foliose red alga *Phyllophora sicula* are present at Finavarra, whereas the red alga *Rhodymenia delicatula* and the rare brown alga, *Ascophyllum nodosum* var. *mackii,* occur in Kinvara and Muckinish Bays. Sublittorally, the area has a number of distinctive and important communities. Of particular note is that Ireland's only reported piddock bed thrives in the shallows of Aughinish Bay. The rare sponge, *Mycale contarenii,* is also found here. There is further interest in an extensive maerl bed of *Phymatolithon calcareum* which occurs in the strong tidal currents of Muckinish Bay. There is also maerl off Finavarra Point and in Kinvara Bay (*Lithothamnion corallioides*, *Lithophyllum dentatum* and *Lithophyllum fasciculatum*). An oyster bed in Kinvara Bay and seagrass (*Zostera* spp.) beds off Finavarra Point are also important features. Other significant habitats which occur include secondary maerl beds and communities strongly influenced by tidal streams.

Salt marshes are frequent within this extensive coastal site, with both Atlantic and Mediterranean marshes well represented. Most of the salt marshes are classified as the bay type, with the substrate being mud or mud/sand. There is one lagoon type and one estuary type. Lagoon salt marshes are the rarest type found in Ireland. The best examples of salt marsh are located in inner Galway bay, east of a line running between Galway city and Kinvara. In this area the coastline is highly indented, thus providing the sheltered conditions necessary for extensive salt marsh development. Common salt marsh species include Thrift *(Armeria maritima),* Red Fescue *(Festuca rubra),* Common Scurvygrass *(Cochlearia officinalis),* Sea Lavender *(Limonium humile),* Common Saltmarsh-grass *(Puccinellia maritima),* Saltmarsh Rush *(Juncus gerardii)* and Sea Rush *(Juncus maritimus*). On the lower levels of the salt marshes and within pans there occurs Glasswort *(Salicornia europaea* agg*.).* A noteworthy feature of the salt-marsh habitat within this site is the presence of dwarfed brown seaweeds in the vegetation. These are also known as "turf fucoids" and typical species include *Fucus* spp., *Ascophyllum nodosum* and *Pelvetia canaliculata*. A number of locally rare vascular plant species also grow in salt-marsh areas within the site. These include *Puccinellia distans* and Sea Purslane (*Halimione portulacoides)*, which are both relatively rare in the western half of the country.

Shingle and stony beaches can be found throughout the site, with the best examples along the more exposed shores to the south and west of Galway city and to the north and east of Finnavara, Co. Clare. In general, these shingle shorelines are sparsely vegetated and frequently occur interspersed with areas of sandy beach and/or bedrock shore. The associated flora is dominated by plant species of frequently disturbed maritime habitats. To the south and west of Galway city, typical plants include Curled Dock (*Rumex crispus),* Common Couch *(Elymus repens),* Sea Sandwort *(Honkenya peploides),* Sea Beet *(Beta vulgaris),* Scentless Mayweed *(Matricaria maritima),* Silverweed *(Potentilla anserina)* and *Atriplex* spp.. Two rare plant species are associated with the habitat: Fat Hen (*Hyoscyamus niger),* a threatened species listed in the Irish Red Data Book, grows on shingle beach to the south of Lough Atalia; there are also old records for the threatened plant species Sea Kale (*Crambe maritima)*.

An excellent range of lagoons of different types, sizes and salinities occurs within the site. This habitat is given priority status on Annex I of the Habitat Directive. One unusual type of lagoon, karstic rock lagoon, is particularly well represented. This type of lagoon is common on the Aran Islands, but on mainland Ireland, all but one are confined to this one site including the best example of all karstic lagoons in the country (Lough Murree). The flora of the habitat is rich and diverse, reflecting the range of salinities in the different lagoons, and typically brackish with two species of Tasselweed (*Ruppia spp.)*, two Red Data charophytes *Chara canescens* and *Lamprothamnion papulosum*, and *Chaetomorpha linum* (all lagoonal specialists). The fauna of the lagoon is also rich, diverse and lagoonal. At least 10 lagoonal specialist species were recorded in 1996 and 1998 from the combined habitat of all the lagoons which is one of the highest number for any lagoonal habitat in the country. Many of the species appear to be rare. The lagoons within this site are an excellent representative of the habitat type and of high conservation importance.

Other terrestrial habitats within this site which are of conservation importance, although having only a minor presence, include an area of fen dominated by Saw Sedge (*Cladium mariscus*) at Oranmore village, a turlough of moderate size at Ballinacourty, limestone pavement mainly along the southern shore, dry calcareous grassland, wet grassland and an area of deciduous woodland at Barna.

Inner Galway Bay provides extensive good quality habitat for Common Seals, a species listed on Annex II of the EU Habitats Directive. In 1984, this seal colony was one of the top three sites in the country, with over 140 animals recorded. The seals use a range of haul-out sites distributed through the bay - these include inner Oranmore Bay, Rabbit Island, St. Brendan’s Island, Tawin Island, Kinvarra Bay, Aughinish Bay and Ballyvaughan.

Galway Bay is a very important ornithological site. The shallow waters provide excellent habitat for Great Northern Divers (35), Black-throated Divers (28), Scaup (39), Long-tailed Duck (27) and Red-breasted Merganser (232). (Figures given are peak average maxima over the 3 winters 1994/95 to 1996/97). All of these populations are of national importance. The intertidal areas and shoreline provides feeding and roosting habitat for wintering waterfowl, with Brent Goose (517) having a population of international importance and a further 11 species having populations of national importance. Four of the regular wintering species are listed on Annex I of the EU Birds Directive - Golden Plover, Bar-tailed Godwit and the two diver species. Breeding birds are also of importance, with significant populations of Sandwich Terns (81 pairs in 1995) and Common Terns (99 pairs in 1995), both also being listed on Annex I of the EU Directive. A large Cormorant colony (c.300 pairs in 1989) occurs on Deer Island.

Fishing and aquaculture are the main commercial activities within the site. A concern is that sewage effluent and detritus of the aquaculture industry could be deleterious to benthic communities. Reef and sediment communities are vulnerable to disturbance or compaction from tractors accessing oyster trestles. The *Paracentrotus lividus* populations have been shown to be vulnerable to over-fishing. Extraction of maerl in Galway Bay is a threat. Owing to the proximity of Galway city, shoreline and terrestrial habitats are under pressure from urban expansion and recreational activities. Eutrophication is probably affecting some of the lagoons and is a continued threat. Drainage is a general threat to the turlough and fen habitats. Bird populations may be disturbed by aquaculture activities.

This large coastal site is of immense conservation importance, with several habitats listed on Annex I of the EU Habitats Directive, three of which have priority status (lagoon, *Cladium* fen, turlough). The examples of shallow bays, reefs, lagoons and salt marshes are amongst the best in the country. The site has an important Common Seal colony, a species listed on Annex II of the EU Habitats Directive, and six regular Annex I Bird Directive species. The site also has four Red Data Book plant species, plus a host of rare or scarce marine and lagoonal animal and plant species.

30.8.1999

SITE NAME: LOUGH FINGALL COMPLEX

SITE CODE: 000606

This site is situated immediately south-east of Ballindeereen and within 2-3 km of Galway Bay. It is within the stretch of flat low-lying bare limestones known as the Ardrahan limestones, which extend from the foot of the Burren hills northwards towards Craughwell.

The site comprises a complex of habitats, the dominant being turloughs and limestone pavement, both of which are priority Annex I habitats on the EU Habitats Directive. The turloughs are oligotrophic (nutrient-poor) and calcareous in character. Their catchments areas are relatively small and water tends to remain in them for considerable periods of time. The surface waters usually occupy distinct separate basins in most years but during extreme floods these can be linked together as one large expanse of open water. Taken together these turloughs represent one of the largest expanses of oligotrophic turlough vegetation in the country.

Ballinderreen turlough occupies a flat limestone pavement basin and supports extensive areas of Black Bog-rush (*Schoenus nigricans*) and Sedge (*Carex* spp.) fen vegetation. Marl ponds occur in the lower lying parts, with Shoreweed (*Littorella uniflora*), Bulbous Rush (*Juncus bulbosus*), Manystalked Spike-rush (*Eleocharis multicaulis*), Alternate Water-milfoil (*Myriophyllum alternifolium*) and a little Horned Pondweed (*Zannichellia palustris*) and Stonewort (*Chara hispida* var*. major*). Rare plants found at this turlough include Fen Violet (*Viola persicifolia*), a Red Data Book species, Water Germander (*Teucrium scordium*) and Marsh Fern (*Thelypteris palustris*). A smaller area to the south-east of Ballinderreen, Frenchpark turlough, contains a Black Bog-rush/Purple Moor-grass (*Molinia caerulea*) stand with patches of Saw Sedge (*Cladium mariscus*) within it. Cuildooish turlough is of linear shape with a high central section. It has level limestone pavement forming its eastern side and is alligned and lies parallel with Lough Fingall, which is effectively also a turlough. There is much Buckthorn (*Rhamnus catharticus*) scrub here and at the northern end of the main lake. Carraghadoo turlough has a shallow basin without standing water in summer and with less peat. Creeping Willow (*Salix repens*) and Common Sedge (*Carex nigra*) are the main species here. The shores of Tullaghnafrankagh Lough flood during winter and have a similar if slightly more eutrophic (nutrient-rich) vegetation. Alder Buckthorn (*Frangula alnus*), a Red Data Book species, grows on sloping limestone pavement close to the limit of winter flooding in several places.

Limestone pavement occurs throughout the site. It varies from the classic bare open pavement, with little vegetation, to pavement and shattered limestone blocks interspersed with calcareous grassland, heath, turlough and scrub. A rich and diverse flora occurs, with many of the typical Burren species represented - Bloody Crane's-bill (*Geranium sanguineum*)*,* Herb-Robert (*G. robertianum*)*,* Rustyback (*Ceterach officinarum*)*,* Burnet Rose (*Rosa pimpinellifolia*)*,* Wood Sage (*Teucrium scorodonia*) and the rarer species Spring Gentian (*Gentiana verna*) and Mountain Avens (*Dryas octopetala*).

Four further habitats listed on Annex I of the EU Habitats Directive occur on the site - orchid-rich calcareous grassland, *Cladium* fen, two priority habitats, juniper scrub and lowland alpine heath. Orchid species present include Fly Orchid (*Ophrys insectifera*)*,* Lesser Butterfly-orchid (*Platanthera bifolia*)*,* Early-purple Orchid (*Orchis mascula*) and several *Dactylorhiza* species. In the past, the scarce Dense-flowered Orchid (*Neotinea maculata*) has been recorded from the site.

Lough Fingall, Cloghballymore Lough and Cahernalinsky Lough are shallow infilling lakes with stands of Saw Sedge (*Cladium mariscus*) and other fen and wetland vegetation such as Common Reed (*Phragmites australis*) and Tufted-sedge (*Carex elata*).

Juniper scrub and lowland alpine heath occur in close association with one another. The juniper scrub is dominated by Juniper (*Juniperus communis*) with Hawthorn (*Crataegus monogyna*), Blackthorn (*Prunus spinosa*) and *Rosa* species. Lowland alpine heath is characterised by Bearberry (*Arctostaphylos uva-ursi*) and Mountain Avens (*Dryas octopetala*), a rare vegetation type known from a few areas in the Burren, the Lough Fingall area and the Moycullen area near Lough Corrib.

Cloghballymore House provides a summer breeding site for the Lesser Horseshoe Bat (*Rhinolophus hipposideros*), a species listed on Annex II of the EU Habitats Directive. The bats use the large roof space, although a smaller number roost in a boiler house, gaining access by means of gaps around the pipes. The surrounding mixed woods provide suitable foraging habitat within a short radius of the day roost site. In 1993 more than 200 bats were counted at this site, which makes it of international importance.

The site is of local importance for wintering waterfowl, particularly Lapwing (max. count 381 in 1995/96), and has breeding Lapwing (6 pairs 1996). Some scarce invertebrate species have been recorded from the Lough Fingall area.

The main landuse in the site is cattle grazing which is mostly of light to moderate intensity. Clearance of limestone pavement and scrub has taken place in the past and burning is a threat to the heath habitats. A drainage scheme to relieve exceptional flooding has been implemented recently. There are no immediate threats facing the bat population.

This site is of great conservation importance for the presence of six EU Habitats Directive habitats, including four priority habiatats. The transitions and gradations between habitats, for example between turloughs, lakes and limestone pavement, gives rise to a range of physical conditions that favour many uncommon species. In addition, the site supports an internationally important population of Lesser Horseshoe bats.

31.8.1999

SITE NAME: KILTIERNAN TURLOUGH

SITE CODE: 001285

Kiltiernan Turlough is a simple, linear depression running south-westwards from the main Galway-Limerick road. It has a flattish basin which lies approximately 2 m below road level and includes about eight further depressions which are joined in times of high water. The site includes a low ridge on the south-eastern side. Towards the west the topography becomes flatter and the basin breaks into separate hollows.

The site comprises a relatively dry turlough with a limited, though regular, flood in winter. The vegetation is predominantly of species-poor grassland dominated by White Clover (*Trifolium repens*), Silverweed (*Potentilla anserina*) and Creeping Bent (*Agrostis stolonifera*), with some areas of species-rich grassland found in the western half. Beside the road, the rocky outcrops support limestone grassland with narrow fringes of scrub along each side. The scrub is predominantly of Blackthorn (*Prunus spinosa*), but some Buckthorn (*Rhamnus catharticus*) and Alder Buckthorn (*Frangula alnus*), a rare Red Data Book species, also occur.

Grassland modified by trampling and overgrazing occurs in the main depressions. Here the main species found are Northern Bedstraw (*Galium boreale*) and Creeping Cinquefoil (*Potentilla reptans*), which grow in clumps with much Silverweed and Greater Plantain (*Plantago major*). Hollows in this vegetation contain Common Sedge (*Carex nigra*) and Amphibious Bistort (*Polygonum amphibium*). In the less intensified eastern section of the site the Red Data Book species Fen Violet (*Viola persicifolia*) occurs.

Lapwing, Pochard, Teal and Wigeon have been recorded at the site; other bird species may visit from the nearby Tullaghnafrankagh Lough.

Land use on the site comprises grazing, particularly in the eastern half, with some areas of tillage found in the west.

Kiltiernan Turlough is an example of a partly modified, relatively dry turlough, without any accumulation of peat. It includes a variety of typical dry Turlough vegetation types and is notable for the presence of the rare plant species, Alder Buckthorn and Fen Violet. Turloughs are important habitats that are listed, with priority status, on Annex I of the E.U. Habitats Directive and, as such, are of considerable conservation significance.

30.11.2004

SITE NAME: INNER GALWAY BAY SPA

SITE CODE: 004031

Galway Bay SPA is a very large, marine-dominated, site situated on the west coast of Ireland. The inner bay is protected from exposure to Atlantic swells by the Aran Islands and Black Head. Subsidiary bays and inlets (e.g. Poulnaclough, Aughinish and Kinvarra Bays) add texture to the patterns of water movement and sediment deposition, which lends variety to the marine habitats and communities. The terraced Carboniferous (Viséan) limestone platform of the Burren sweeps down to the shore and into the sublittoral. The long shoreline is noted for its diversity, with complex mixtures of bedrock shore, shingle beach, sandy beach and fringing salt marshes. Intertidal sand and mud flats occur around much of the shoreline, with the largest areas being found on the sheltered eastern coast between Oranmore Bay and Kinvarra Bay. A number of small islands composed of glacial deposits are included, such as Deer Island, along with some rocky islets.

The southern part of Galway Bay holds a very high number of littoral communities. They range from rocky terraces to sandy beaches with rock or sand dunes behind. The intertidal sediments of Galway Bay support good examples of communities that are moderately exposed to wave action. A well-defined talitrid zone in the upper shore gives way to an intertidal, mid-shore zone with sparse epifauna or infauna. On the lower, flat part of the shore, the tubes of the deposit-feeding terebellid worm, *Lanice conchilega*, are common on the surface. Nereid and cirratulid polychaete worms (*Hediste diversicolor*, *Arenicola marina*), small crustaceans and bivalves (*Angulus tenuis*, *Cerastoderma edule* and *Macoma balthica*) are present. Sublittorally, the area has a number of distinctive and important communities. Of particular note is that Ireland's only reported piddock bed thrives in the shallows of Aughinish Bay. The rare sponge, *Mycale contarenii*, is also found here. Of additional interest is the presence of an extensive maerl bed of *Phymatolithon calcareum* which occurs in the strong tidal currents of Muckinish Bay. There is also maerl off Finavarra Point and in Kinvarra Bay (*Lithothamnion corallioides*, *Lithophyllum dentatum* and *Lithophyllum fasciculatum*). An oyster bed in Kinvarra Bay and seagrass (*Zostera* spp.) beds off Finavarra Point are also important features.

Salt marshes are frequent within this extensive coastal site, with the best examples located east of a line running between Galway City and Kinvarra. In this area the coastline is highly indented, thus providing the sheltered conditions necessary for extensive salt marsh development. Common salt marsh species present include Thrift (*Armeria maritima*), Red Fescue (*Festuca rubra*), Common Scurvygrass (*Cochlearia officinalis*), Lax-flowered Sea-lavender (*Limonium humile*), Common Saltmarsh-grass (*Puccinellia maritima*), Saltmarsh Rush (*Juncus gerardi*) and Sea Rush (*Juncus maritimus*). On the lower levels of the salt marshes and within pans is found Glasswort (*Salicornia europaea* agg.). Shingle and stony beaches occur throughout the site, with the best examples found along the more exposed shores to the south and west of Galway City and to the north and east of Finnavara. In general, these shingle shorelines are sparsely vegetated, with such species as Curled Dock (*Rumex crispus*), Common Couch (*Elymus repens*), Sea Sandwort (*Honkenya peploides*) and Sea Beet (*Beta vulgaris*).

Galway Bay is one of the most important ornithological sites in the western region. It supports an excellent diversity of wintering wetland birds, with divers, grebes, cormorants, dabbling duck, sea duck and waders all well represented. There are internationally important wintering populations of Great Northern Diver (83) and Brent Goose (676), and nationally important populations of an additional sixteen species, i.e. Black-throated Diver (25), Cormorant (266), Mute Swan (150), Wigeon (1,157), Teal (690), Shoveler (88), Red-breasted Merganser (249), Ringed Plover (335), Golden Plover (2,030), Lapwing (3,969), Dunlin (2,149), Bar-tailed Godwit (447), Curlew (697), Redshank (505), Greenshank (20) and Turnstone (182) – all figures are average peaks for the 5 seasons 1995/96-1999/00. Of note is that the populations of Red-breasted Merganser and Ringed Plover represent 6.7% and 3.3% of the respective national totals. Black-throated Diver is a scarce species in Ireland and the Galway Bay population is the most regular in the country. Other species which occur in notable numbers include Little Grebe (35), Grey Heron (102), Long-tailed Duck (19) and Scaup (40).

The bay is an important wintering site for gulls, especially Black-headed Gull (1,815), Common Gull (1,011) and Herring Gull (216). In addition, the following species also use the site: Red-throated Diver (13), Great Crested Grebe (16), Mallard (200), Shelduck (139), Common Scoter (79), Oystercatcher (575), Grey Plover (60), Black-tailed Godwit (45) and Great Black-backed Gull (124). The site provides both feeding and roost sites for most of the species, though some birds also commute to areas outside of the site. The wintering birds of Galway Bay have been monitored annually since 1980/81.

The site has several important populations of breeding birds, most notably colonies of Sandwich Tern (81 pairs in 1995) and Common Tern (99 pairs in 1995). A large Cormorant colony occurs on Deer Island – this had 205 pairs in 1985 and 300 pairs in 1989.

Inner Galway Bay provides good quality habitat for Common Seal, a species that is listed on Annex II of the E.U. Habitats Directive. In 1984, this seal colony was one of the top three sites in the country, with over 140 animals recorded. The seals use a range of haul-out sites distributed through the bay. The site provides optimum habitat for Otter.

While there are no imminent threats to the birds, a concern is that sewage effluent and detritus of the aquaculture industry could be deleterious to benthic communities and could affect food stocks of divers, seaduck and other birds. Bird populations may also be disturbed by aquaculture activities. Owing to the proximity of Galway City, shoreline habitats are under pressure from urban expansion and recreational activities.

This large coastal site is of immense ornithological importance, with two wintering species having populations of international importance and a further sixteen species having populations of national importance. The breeding colonies of Sandwich Tern, Common Tern and Cormorant are also of national importance. Also of note is that seven of the regularly occurring species are listed on Annex I of the E.U. Birds Directive, i.e. Red-throated Diver, Black-throated Diver, Great Northern Diver, Golden Plover, Bar-tailed Godwit, Sandwich Tern and Common Tern.

22.2.2005

APPENDIX D

Consulatation Responses

Iascach Intíre Éireann
Inland Fisheries Ireland

RPS
Project No
Recipient Maeve
Register No. 2.
File Ref
Date Rec'd 20 APR 2011
PM
Copied to A I C Sign Date
Scanned Date

19th April 2011.

Ms. Maeve Walsh,
Senior Scientist,
R.P.S Consulting Engineers,
Lyrr Building,
IDA Business & Technology Park,
Mervue,
Galway.

Dear Maeve,

SCOPING OF ENVIRONMENTAL ASSESSMENT FOR THE PROOSED DUNKELLIN RIVER AND AGGARD STREAM FLOOD RELIEF SCHEMES.

I refer to your letter dated 29th March 2011 and comment as follows.

1. The preferred approach should involve the use of EREP methods in which the natural features of the riparian and instream environment would be protected as far as practicable and enhanced. All potential receptor species such as atlantic salmon, brown trout, freshwater crayfish, etc.. should be identified.

2. The scheme should seek to enhance the angling amenity in the zone from Kilcolgan Bridge to Kileely Bridge as Inland Fisheries Ireland hold the fishing rights to his zone. (645 yards of the north bank in Stradbally East.)

3. Although not part of this scheme, it would be beneficial if the long pipe culvert was replaced with a box culvert at Croomacrin /Knocknaboley, New Innn on a tribuatary of Dunkellin River.

4. Normal constraints should apply regarding timing.

5. Sediment transport which could affect the oyster fishery downstream should be minimised.

While it is recognised that drainage is being undertaken in order the improve the flood conveyance of the channels, low flow channels should be maintained and counter measures taken to retain water in zones that are subject to extreme low flows. I.F. I maintains a fish counter at Kileely which should not be adversly affected by the project.

I.F.I and O.PW have developed an established working relationship which should ensure good liasion as the scheme progresses.

Yours sincerely,

K. Rogers

Kevin Rogers
Senior Environmental Officer

APPENDIX E

Relevé Survey Results

				Relevé No	T1 R1	T1R2	T1R3	T1R4	T1R5	T1R6	T1R7	T1R8	T1R9	T1R10	T1R11	T1R12	T1R13	T2R1	T2R2	T2R3	T2R4	T2R5	T2R6	T2R7	T2R8	T2R9	T2R10	T2R11	T2R12	T2R13	T2R14	T2R15	T2R16	T2R17	T2R18	T2R19
Angiosperms	Threat Status	Turlough Specialist	[3180] Species	Goodwillie 1992 Code	2C	2C	2C	5B	5B	5B	5B	5B	5B	2A	2A	2A	2C	Bare Ground	2C	2C	5B	5B	5B	5B	9A	5B	5B	9A	9A	9A	5B	5B	5B	2C	GA1 Fossitt 2000 habitat. Outside of Turlough community area	
Dicots:																																				
Achillea millefolium							*												*															*		
Apium inundatum	LC																																			
Baldellia ranunculoides ‡																																				
Bellis perennis					*	*	*												*				*	*									*	*		
Callitriche obtusangula																																				
Callitriche palustris		*	*																																	
Callitriche stagnalis																																				
Caltha palustris																																				
Cardamine flexuosa								*																												
Cardamine hirsuta																																				
Cardamine pratensis																																				
Cerastium fontanum																			*																	
Cirsium arvense					*														*															*		
Comarum palustre																																				
Eleocharis palustris																																				
Filipendula ulmaria																																				
Frangula alnus		*																			*															
Galium boreale																				*	*	*								*						
Galium palustre																					*		*				*	*		*	*	*	*			
Galium verum																																		*		
Glyceria fluitans																												*	*	*						
Hippuris vulgaris																																				
Hydrocotyle vulgaris																											*					*				
Iris pseudacorus																																				
Scorzoneroides autumnalis							*									*																	*			
Leontodon hispidus																																*				
Limosella aquatica		*	*																																	
Littorella uniflora ‡																																				
Lotus corniculatus																			*															*		
Matricaria discoidea						*																														
Mentha aquatica																					*	*					*	*	*	*	*					
Mentha pulegium																																				
Myosotis scorpioides					*			*													*							*	*	*	*					
Nasturtium officinale agg.																												*	*							
Nuphar lutea																																				
Odontites vernus					*		*																													
Parnassia palustris																														*						
Persicaria amphibia																																				
Persicaria hydropiper																												*	*							
Persicaria minor			*																																	
Plantago lanceolata																			*															*		
Plantago major						*	*												*	*	*		*	*								*	*			
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Polygonum amphibium																																				
Potamogeton gramineus																																				
Potamogeton natans																																				
Potamogeton pectinatus																																				
Potamogeton polygonifolius ‡																																				
Potentilla anserina						*	*	*											*	*	*	*	*	*			*	*		*	*	*	*	*		
Potentilla fruticosa		*																																		
Potentilla reptans								*											*	*			*	*						*	*	*	*			
Prunella vulgaris																																				
Prunus spinosa																																				
Ranunculus flammula																																				
Ranunculus repens		*			*	*	*													*										*	*	*				
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Ranunculus trichophyllus																																				
Rhamnus cathartica																																				
Rorippa amphibia																												*	*							
Rorippa islandica		*	*																																	
Rorippa sylvestris																																				
Rorripa spp.																									*				*							
Rumex acetosa					*																	*														
Rumex crispus						*		*											*			*	*	*												
Sparganium emersum																																				
Stellaria media																																				
Taraxacum officinale					*														*																	
Teucrium scordium		*																																		
Thymus polytrichus																																				
Trifolium pratense																																				
Trifolium repens					*	*	*												*	*												*	*	*		
Urtica dioica					*																															
Veronica beccabunga																																				
Veronica catenata																																				
Veronica chamaedrys					*	*														*																
Viola persicifolia		*																																		
Viola canina																						*		*												
Viola sp										*	*																									
Monocots:																																				
Agrostis stolonifera							*	*												*	*	*	*	*			*	*	*	*	*	*	*			
Alopecurus aequalis			*																																	
Alopecurus geniculatus																																				
Anthoxanthum odoratum																																				
Carex flacca						*																				*								*		
Carex flexuosa																																				
Carex hirta																																				
Carex hostiana								*																*												
Carex nigra						*	*	*											*	*	*		*	*			*					*				
Carex panicea																																				
Carex viridula agg.																																				
Cynosurus cristatus																																				
Deschampsia caespitosa																																				
Eleocharis acicularis																																				
Eleocharis multicaulis ‡			*																																	
Eleocharis palustris																																				
Eleogiton fluitans ‡																																				
Equisetum arvense																																				
Schedonorus arundinaceus																																				
Festuca rubra					*														*															*		
Glyceria fluitans																																				
Holcus lantaus																																				
Juncus acutiflorus																																				
Juncus articulatus																																				
Juncus bufonius																																				
Juncus bulbosus ‡																																				
Lolium perenne					*														*																	
Molinia caerulea																																				
Phalaris arundinacea																																				
Poa annua																																				
Poa pratensis						*														*																
Poa trivialis					*																															
Schoenoplectus erectus																																				
Schoenus nigricans																																				
Bryophytes																																				
Mosses:																																				
Calliergon cuspidatum																																				
Cinclidotus fontinaloides			*																*																	
Drepanocladus revolvens																											*									
Drepanocladus sendtneri	NT																																			
Fontinalis antipyretica																																				
Fontinalis spp.																																				
Pseudocalliergon lycopodioides	VU																																			
Pseudocalliergon trifarium	VU																																			
Scorpidium revolvens																																				
Liverworts:																																				
Riccia cavernosa			*																																	
Pteridophytes:																																				
Ophioglossum vulgatum																																				
Algae:																																				
Cladophora spp																												*	*							

Species indicative of oligotrophic conditions are given a ‡. Regional Red List status (VU= vulnerable; NT= near threatened) is given, where relevant (Lockhart et al., 2012b).
Releves as shown in NIS Figure 6.1 are numbered from north to south.

				Relevé No	T3R1	T3R2	T3R3	T3R4	T3R5	T3R6	T3R7	T3R8	T3R9	T3R10	T3R11	T3R12	T3R13	T3R14	T3R15	T3R16	T3R17	T3R18	T3R19	T3R20	T3R21	T3R22	T3R23	T3R24	T3R25	T3R26	T3R27	T4R1	T4R2	T4R3	T4R4	T4R5	T4R6	T4R7	T4R8
Angiosperms	Threat Status	Turlough Specialist	[3180] Species	Goodwillie 1992 Code	Gravel Path		2C	2C	2C	9A	9A	9A	No access possible due to deep water		9A	9A	No access possible due to deep water	7A	7A	7A	7A	No access possible due to deep water		No access possible due to deep water		6A	9A	5B	No access possible due to deep water	5A	5A	Gravel Path Area outside Turlough area				2C	2A	9A	9A
Dicots:																																							
Achillea millefolium																																							
Apium inundatum	LC																																						
Baldellia ranunculoides ‡																																							
Bellis perennis							*																													*			
Callitriche obtusangula																		*																					
Callitriche palustris		*	*																																				
Callitriche stagnalis																																							
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Cardamine flexuosa																				*	*																*		
Cardamine hirsuta																										*													
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Eleocharis palustris															*					*	*																		
Filipendula ulmaria																																							
Frangula alnus		*																																					
Galium boreale															*																								
Galium palustre												*				*			*	*	*															*	*		*
Galium verum																																							
Glyceria fluitans											*		*			*												*											*
Hippuris vulgaris															*																								
Hydrocotyle vulgaris																*				*	*																		
Iris pseudacorus																																							
Scorzoneroides autumnalis																																				*			
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Matricaria discoidea																																							
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Mentha pulegium																																							
Myosotis scorpioides											*	*	*			*	*		*		*	*					*	*	*								*	*	*	*
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Potentilla fruticosa		*																																					
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Veronica chamaedrys							*																																
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Monocots:																																							
Agrostis stolonifera							*	*							*	*			*	*	*					*		*								*	*	*	*
Alopecurus aequalis			*																																				
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Anthoxanthum odoratum																																							
Carex flacca																																							
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Carex hirta																*																							
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Carex viridula agg.																																							
Cynosurus cristatus																																							
Deschampsia caespitosa																																							
Eleocharis acicularis																																							
Eleocharis multicaulis ‡			*																																				
Eleocharis palustris																*			*																				
Eleogiton fluitans ‡																																							
Equisetum arvense																																							
Schedonorus arundinaceus																																							
Festuca rubra							*																																
Glyceria fluitans																																							
Holcus lanatus																																				*			
Juncus acutiflorus																																							
Juncus articulatus																*																							
Juncus bufonius																																							
Juncus bulbosus ‡																																							
Lolium perenne																*																							
Molinia caerulea																																							
Phalaris arundinacea																																							
Poa annua																																							
Poa pratensis																																							
Poa trivialis																																							
Schoenoplectus erectus																		*																					
Schoenus nigricans																																							
Bryophytes																																							
Mosses:																																							
Calliergon cuspidatum																																							
Cinclidatus fontinaloides			*																																	*	*		
Drepanocladus revolvens																																							
Drepanocladus sendtneri	NT																																						
Fontinalis antipyretica																																							
Fontinalis spp.																																							
Pseudocalliergon lycopodioides	VU																																						
Pseudocalliergon trifarium	VU																																						
Scorpidium revolvens																																							
Liverworts:																																							
Riccia cavernosa			*																																				
Pteridophytes:																																							
Ophioglossum vulgatum																																							
Algae:																																							
Cladophora spp											*	*	*																										*

Species indicative of oligotrophic conditions are given a ‡. Regional Red List status (VU= vulnerable; NT= near threatened) is given, where relevant (Lockhart et al., 2012b).
Releves as shown in NIS Figure 6.1 are numbered from north to south.

Angiosperms	Threat Status	Turlough Specialist	[3180] Species	Relevé No	T4R9	T4R10	T4R11	T4R12	T4R13	T4R14	T4R15	T4R16	T4R17	T4R18	T4R19	T4R20	T4R21	T4R22	T4R23	T4R24	T4R25	T5R1	T5R2	T5R3	T5R4	T5R5	T5R6	T5R7	T5R8	T5R9	T5R10	T5R11	T5R12	T5R13	T5R14	T5R15	T5R16	T5R17	T5R18
				Goodwillie 1992 Code	9A	9A	9A	11B	No access possible due to deep water		11B	7A	7A	7A	6A	6A	6A	6A	6A	WN2 woodland		5B	5B	5B	5B	9A	10A	10A but too deep to do a Relevé	10A	10A	10A but too deep to do a Relevé	11B	11B	7A	7A	8A	7A	7A	7A
Dicots:																																								
Achillea millefolium																							*	*																		
Apium inundatum	LC																																							
Baldellia ranunculoides ‡																																								
Bellis perennis																							*	*	*																
Callitriche obtusangula											*																		*	*		*	*						
Callitriche palustris		*	*																																					
Callitriche stagnalis																																								
Caltha palustris												*																										*	*
Cardamine flexuosa															*																											
Cardamine hirsuta																																								
Cardamine pratensis													*																						*	*			
Cerastium fontanum																																								
Cirsium arvense																								*																	
Comarum palustre																																								
Eleocharis palustris												*	*																					*	*	*	*	*	
Filipendula ulmaria																																								
Frangula alnus		*																																						
Galium boreale																									*	*													
Galium palustre					*	*						*	*	*		*		*									*												*	*	*
Glyceria fluitans					*	*		*			*															*	*	*		*	*				*	*				*
Hippuris vulgaris																														*								
Hydrocotyle vulgaris													*																													
Iris pseudacorus																																								
Scorzoneroides autumnalis														*																												
Leontodon hispidus																																								
Limosella aquatica		*	*																																					
Littorella uniflora ‡																																								
Lotus corniculatus																									*																
Matricaria discoidea																																								
Mentha aquatica					*	*							*	*					*								*										*		*	*	
Mentha pulegium																																								
Myosotis scorpioides					*	*		*			*	*	*	*	*	*	*	*								*	*		*	*				*	*	*	*		*
Nasturtium officinale agg.						*		*				*	*			*	*													*					*			*	*	*
Nuphar lutea																																								
Odontites vernus																																								
Parnassia palustris																																								
Persicaria amphibia					*	*		*			*	*															*										*	*	*	*	*
Persicaria hydropiper					*																																		
Persicaria minor			*																																					
Plantago lanceolata																									*																
Plantago major														*	*			*							*																		
Plantago maritima																																								
Polygonum amphibium																																								
Potamogeton gramineus																																								
Potamogeton natans																																								
Potamogeton pectinatus																																								
Potamogeton polygonifolius ‡																																								
Potentilla anserina												*		*	*			*	*				*	*	*	*	*										*	*	*	*	*	
Potentilla fruticosa		*																																						
Potentilla reptans																									*	*													
Prunella vulgaris																																								
Prunus spinosa																																								
Ranunculus flammula																																								
Ranunculus repens		*										*	*	*					*			*		*	*										*	*	*	*	*	
Ranunculus spp.																																								
Ranunculus trichophyllus								*			*																		*	*		*	*						
Rhamnus cathartica																																								
Rhamnus cathartica																																								
Rorippa amphibia																	*	*	*													*					*			*		*
Rorippa islandica		*	*																																					
Rorippa sylvestris																																		*					
Rorripa spp.					*																																		
Rumex acetosa																									*																
Rumex crispus						*								*		*			*					*		*	*	*										*	*	*	*		*
Sparganium emersum											*																						*	*						
Stellaria media																																								
Taraxacum officinale																							*	*																		
Teucrium scordium		*																																						
Thymus polytrichus																																								
Trifolium pratense																																								
Trifolium repens														*					*			*																		
Urtica dioica																																		*					
Veronica beccabunga																														*											
Veronica catenata					*	*					*	*				*		*	*										*				*		*	*	*	*	*	*		*
Veronica chamaedrys																								*																	
Viola persicifolia		*																																						
Viola canina																																								
Viola sp																																								
Monocots:																																								
Agrostis stolonifera												*	*	*	*	*	*	*	*			*	*	*		*								*	*	*	*	*	*
Alopecurus aequalis			*																																					
Alopecurus geniculatus													*																													
Anthoxanthum odoratum																																								
Carex flacca																								*		*															
Carex flexuosa																																								
Carex hirta																								*		*															
Carex hostiana														*																												
Carex nigra													*	*					*																					
Carex panicea																																								
Carex viridula agg.																																								
Cynosurus cristatus																																								
Deschampsia caespitosa																																								
Eleocharis acicularis																									*															
Eleocharis multicaulis ‡			*																																					
Eleocharis palustris																									*															
Eleogiton fluitans ‡																																								
Equisetum arvense																																*	*						
Schedonorus arundinaceus																																								
Festuca rubra																								*	*																
Glyceria fluitans																																								
Holcus lantaus																																								
Juncus acutiflorus																																								
Juncus articulatus													*	*																												
Juncus bufonius															*																											
Juncus bulbosus ‡																																								
Lolium perenne																																								
Molinia caerulea																																								
Phalaris arundinacea																																								
Poa annua																																								
Poa pratensis																*																				*			
Poa trivialis																																								
Schoenoplectus erectus																																								
Schoenus nigricans																																								
Bryophytes																																								
Mosses:																																								
Calliergon cuspidatum													*																													
Cinclidatus fontinaloides			*																				*				*												
Drepanocladus revolvens																																								
Drepanocladus sendtneri	NT																																							
Fontinalis antipyretica																																								
Fontinalis spp.																														*								
Pseudocalliergon lycopodioides	VU																																							
Pseudocalliergon trifarium	VU																																							
Scorpidium revolvens																																								
Liverworts:																																								
Riccia cavernosa			*																																					
Pteridophytes:																																								
Ophioglossum vulgatum																																								
Algae:																																								
Cladophora spp					*	*					*																*	*	*	*		*	*						

Species indicative of oligotrophic conditions are given a ‡. Regional Red List status (VU= vulnerable; NT= near threatened) is given, where relevant (Lockhart et al., 2012b).
Releves as shown in NIS Figure 6.1 are numbered from north to south.

				Relevé No	T5R19	T5R20	T5R21	T5R22	T5R23	T5R24	T5R25	T5R26	T6R1	T6R2	T6R3	T6R4	T6R5	T6R6	T6R7	T6R8	T6R9	T6R10	T6R11	T6R12	T6R13	T6R14	T6R15	T6R16	T6R17	T6R18	T6R19	T6R20	T6R21	T6R22	T6R23	T7R1	T7R2	T7R3	T7R4
Angiosperms	Threat Status	Turlough Specialist	[3180] Species	Goodwillie 1992 Code	7A	6A	6A	6A	5B	5B	2B	WN2 Wood land	10A	10A	10A	10A	10A	10A	5B	5B	5B	10A	10B	6A. Both points adjcent to each other. Only one relevé taken.		5B	5B	5B	5B	5B	GA1 Fossitt 2000	GA1 Fossitt 2000 habitat	GA1 Fossitt 2000	GA1 Fossitt 2000 habitat	GA1 Fossitt 2000 habitat	5B	7A	7A	7A
Dicots:																																							
Achillea millefolium											*																					*	*	*	*	*				
Apium inundatum	LC																							*															
Baldellia ranunculoides ‡																																							
Bellis perennis					*	*					*																	*		*										
Callitriche obtusangula															*		*		*	*			*																
Callitriche palustris		*	*																																				
Callitriche stagnalis																		*																					
Caltha palustris																																							
Cardamine flexuosa							*																																
Cardamine hirsuta																																							
Cardamine pratensis																						*																	
Cerastium fontanum						*																																	
Cirsium arvense																																							
Comarum palustre																									*														
Eleocharis palustris																																							
Filipendula ulmaria																																							
Frangula alnus		*																																					
Galium boreale																																							
Galium palustre										*																					*									
Galium verum																																							
Glyceria fluitans																			*	*				*															
Hippuris vulgaris														*			*																						
Hydrocotyle vulgaris																																							
Iris pseudacorus																																							
Scorzoneroides autumnalis										*														*															
Leontodon hispidus						*																																	
Limosella aquatica		*	*																																				
Littorella uniflora ‡																																							
Lotus corniculatus																																							
Matricaria discoidea																																							
Mentha aquatica																																							
Mentha pulegium																																							
Myosotis scorpioides					*		*	*						*			*	*		*	*		*	*		*	*											*		*
Nasturtium officinale agg.																			*	*		*		*															
Nuphar lutea													*																										
Odontites vernus																																							
Parnassia palustris																																							
Persicaria amphibia																	*		*																				
Persicaria hydropiper																																							
Persicaria minor			*																																				
Plantago lanceolata																												*												
Plantago major					*	*	*			*												*						*	*	*	*							*		
Plantago maritima																																							
Polygonum amphibium																																							
Potamogeton gramineus																																							
Potamogeton natans																																							
Potamogeton pectinatus																*							*																
Potamogeton polygonifolius ‡																																							
Potentilla anserina					*	*	*	*	*	*											*	*		*	*		*	*	*	*	*						*	*	*	*
Potentilla fruticosa		*																																					
Potentilla reptans									*													*																	
Prunella vulgaris																												*												
Prunus spinosa																																							
Ranunculus flammula																																							
Ranunculus repens		*			*		*	*	*	*			*			*					*	*			*		*	*	*		*	*	*	*	*	*	*	*		
Ranunculus spp.																*							*																
Ranunculus trichophyllus																																							
Rhamnus cathartica																																							
Rorippa amphibia							*																	*															
Rorippa islandica		*	*																																				
Rorippa sylvestris																			*	*																			
Rorripa spp.																																							
Rumex acetosa																																							
Rumex crispus					*	*	*			*			*						*	*	*	*		*	*												*	*	*	*
Sparganium emersum														*	*	*	*		*				*																
Stellaria media																																*	*	*	*	*				
Taraxacum officinale																												*			*									
Teucrium scordium		*																																					
Thymus polytrichus																																							
Trifolium pratense																																							
Trifolium repens					*					*	*																	*			*	*	*	*	*	*	*			
Urtica dioica																																							
Veronica beccabunga																			*																				
Veronica catenata																*	*	*	*				*	*															
Veronica chamaedrys																													*	*									
Viola persicifolia		*																																					
Viola canina																																							
Viola sp																																							
Monocots:									*	*																													
Agrostis stolonifera					*	*	*	*													*	*		*	*		*		*	*							*	*	*	*
Alopecurus aequalis			*																																				
Alopecurus geniculatus							*																		*		*		*									*		*
Anthoxanthum odoratum																																*	*	*	*	*				
Carex flacca																												*												
Carex flexuosa																																							
Carex hirta								*																	*														
Carex hostiana																					*	*																	
Carex nigra					*			*													*						*	*	*	*	*						*			
Carex panicea																																							
Carex viridula agg.																																							
Cynosurus cristatus											*																					*	*	*	*	*				
Deschampsia caespitosa																																							
Eleocharis acicularis																																							
Eleocharis multicaulis ‡			*																																				
Eleocharis palustris																					*				*														
Eleogiton fluitans ‡																																							
Equisetum arvense																*							*																
Schedonorus arundinaceus																																							
Festuca rubra						*					*																*	*	*	*	*	*	*	*	*	*				
Glyceria fluitans																																							
Holcus lantaus																																*	*	*	*	*				
Juncus acutiflorus																													*		*									
Juncus articulatus										*																													
Juncus bufonius																																							
Juncus bulbosus ‡																																							
Lolium perenne																																							
Molinia caerulea																																							
Phalaris arundinacea													*																										
Poa annua						*					*																					*	*	*	*	*				
Poa pratensis							*														*											*	*	*	*	*				
Poa trivialis																																							
Schoenoplectus erectus													*																										
Schoenus nigricans																																							
Bryophytes																																							
Mosses:																																							
Calliergon cuspidatum																																							
Cinclidotus fontinaloides			*																																				
Drepanocladus revolvens																																							
Drepanocladus sendtneri	NT																																						
Fontinalis antipyretica																																							
Fontinalis spp.															*																								
Pseudocalliergon lycopodioides	VU																																						
Pseudocalliergon trifarium	VU																																						
Scorpidium revolvens																																							
Liverworts:																																							
Riccia cavernosa			*																																				
Pteridophytes:																																							
Ophioglossum vulgatum																																							
Algae:																																							
Cladophora spp														*	*	*	*																						

Species indicative of oligotrophic conditions are given a ‡. Regional Red List status (VU= vulnerable; NT= near threatened) is given, where relevant (Lockhart et al., 2012b).
Releves as shown in NIS Figure 6.1 are numbered from north to south.

Angiosperms	Threat Status	Turlough Specialist	[3180] Species	Relevé No	T7R5	T7R6	T7R7	T7R8	T7R9	T7R10	T7R11	T8R1	T8R2	T8R3	T8R4	T8R5	T8R6	T8R7	T8R8	T8R9	T8R10	T8R11	T8R12	T9R1	T9R2	T9R3	T9R4	T9R5	T9R6	T9R7	T9R8	T9R9	T9R10
				Goodwillie 1992 Code	5B	5B	5B	5B	5B	5B	5B	Inaccessible area to survey due to flooding and dense scrub		5B	5B	5B	5B	Validated as GA1 but not consistent with 5B type					Validated as GA1 but not consistent with 5B type. No access available to carry out relevé.					5B	5B	5B	5B	2C	2C
Dicots:																																	
Achillea millefolium																																	
Apium inundatum	LC																																
Baldellia ranunculoides ‡																																	
Bellis perennis											*			*																*	*	*	
Callitriche obtusangula																																	
Callitriche palustris		*	*																														
Callitriche stagnalis																																	
Caltha palustris																																	
Cardamine flexuosa																																	
Cardamine hirsuta																																	
Cardamine pratensis																																*	
Cerastium fontanum							*																										
Cirsium arvense																															*		
Comarum palustre																																	
Eleocharis palustris																																	
Filipendula ulmaria																																	
Frangula alnus		*																															
Galium boreale																																	
Galium palustre																																	
Galium verum																																	
Glyceria fluitans																																	
Hippuris vulgaris																																	
Hydrocotyle vulgaris																																	
Iris pseudacorus																												*	*				
Scorzoneroides autumnalis																																*	
Leontodon hispidus																																	
Limosella aquatica		*	*																														
Littorella uniflora ‡																																	
Lotus corniculatus																																	
Matricaria discoidea																																	
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Mentha pulegium																																	
Myosotis scorpioides																																	
Nasturtium officinale agg.																																	
Nuphar lutea																																	
Odontites vernus																																	
Parnassia palustris																																	
Persicaria amphibia																																	
Persicaria hydropiper																																	
Persicaria minor			*																														
Plantago lanceolata											*																						
Plantago major							*				*			*	*	*	*													*			
Plantago maritima																																	
Polygonum amphibium																																	
Potamogeton gramineus																																	
Potamogeton natans																																	
Potamogeton pectinatus																																	
Potamogeton polygonifolius ‡																																	
Potentilla anserina						*	*								*	*	*	*										*	*				
Potentilla fruticosa		*																															
Potentilla reptans						*																											
Prunella vulgaris																																	
Prunus spinosa																																	
Ranunculus flammula																																	
Ranunculus repens		*			*	*	*				*			*	*	*	*	*										*	*			*	
Ranunculus spp.																																	
Ranunculus trichophyllus																																	
Rhamnus cathartica																																	
Rorippa amphibia																																	
Rorippa islandica		*	*																														
Rorippa sylvestris																																	
Rorripa spp.																																	
Rumex acetosa																																	
Rumex crispus						*					*					*	*	*													*		
Sparganium emersum																																	
Stellaria media																																	
Taraxacum officinale																																	
Teucrium scordium		*																															
Thymus polytrichus																																	
Trifolium pratense											*																			*			
Trifolium repens											*				*			*												*	*	*	
Urtica dioica																												*	*				
Veronica beccabunga																																	
Veronica catenata																																	
Veronica chamaedrys																																	
Viola persicifolia		*																															
Viola canina																																	
Viola sp																																	
Monocots:						*																											
Agrostis stolonifera					*		*				*			*	*	*	*	*												*	*	*	
Alopecurus aequalis			*																														
Alopecurus geniculatus														*	*		*														*		
Anthoxanthum odoratum																																	
Carex flacca																																	
Carex flexuosa																																	
Carex hirta																																	
Carex hostiana																																	
Carex nigra					*	*					*																			*		*	
Carex panicea																																	
Carex viridula agg.																																	
Cynosurus cristatus																																*	
Deschampsia caespitosa																																	
Eleocharis acicularis																																	
Eleocharis multicaulis ‡			*																														
Eleocharis palustris																																	
Eleogiton fluitans ‡																																	
Equisetum arvense																																	
Schedonorus arundinaceus																																	
Festuca rubra							*				*																	*	*	*			
Glyceria fluitans																																	
Holcus lanatus																																	
Juncus acutiflorus																																	
Juncus articulatus																																	
Juncus bufonius																																	
Juncus bulbosus ‡																																	
Lolium perenne											*																					*	
Molinia caerulea																																	
Phalaris arundinacea																																	
Poa annua							*							*				*													*		
Poa pratensis																																	
Poa trivialis																																	
Schoenoplectus erectus																																	
Schoenus nigricans																																	
Bryophytes																																	
Mosses:																																	
Calliergon cuspidatum																																	
Cinclidatus fontinaloides			*																														
Drepanocladus revolvens																																	
Drepanocladus sendtneri	NT																																
Fontinalis antipyretica																																	
Fontinalis spp.																																	
Pseudocalliergon lycopodioides	VU																																
Pseudocalliergon trifarium	VU																																
Scorpidium revolvens																																	
Liverworts:																																	
Riccia cavernosa			*																														
Pteridophytes:																																	
Ophioglossum vulgatum																																	
Algae:																																	
Cladophora spp																																	

Species indicative of oligotrophic conditions are given a ‡. Regional Red List status (VU= vulnerable; NT= near threatened) is given, where relevant (Lockhart et al., 2012b).
Releves as shown in NIS Figure 6.1 are numbered from north to south.

APPENDIX F

Aquatic Macroinvertebrates & Waterbeetle Records

Table F.1 - Aquatic Macroinvertebrates within the Craughwell & Dunkellin River & Aggard Stream

TAXA	EPA Quality Category	SITE		
		Craughwell R.	Dunkellin R.	Aggard Stream
Irish Grid Reference		M 51039 19935	M 45496 18387	M 50385 19237
MAY FLIES (Ephemeroptera)				
Heptageniidae:	A	*		
Heptagenia sulphurea		5		
Ecdyonurus dispar		8		
Rhithrogena sp.		1		
Baetis muticus	B	3	15	3
Baetis rhodani	C	51	100+	300+
Seratella ignita	C	21	9	35
STONE FLIES (Plecoptera)				
Protonemoura spp.	A	2	2	
Leuctra spp.	B	100+	37	3
CADDIS FLIES (Trichoptera)				
Lepidostoma hirtum	B	1		
Rhyacophila dorsalis	C	23	5	2
Hydropsychidae	C	37	88	1
Glossosomatidae	B	1		7
Polycentropidae	C	*	*	
Plectrocnemia sp.		1		
Polycentropus flavomaculatus		2	12	
Wormaldia subnigra	C	28		
Limnephilidae:	C	*		
Anabolia nervosa		1		
TRUE FLIES (Diptera)				
Chironomidae	C	50	37	16
Simuliidae	C	87		75
Tipulidae	C	1		16
BEETLES (Coleoptera)				
Hydraenidae	C		1	
Dytiscidae	C	1		
Elmidae	C	32	54	44
F/W SHRIMPS (Crustacea)				
Gammarus sp.	C	96	34	300+
Austropotamobius pallipes	C	3	2	3
Asellus aquaticus	D			5
SNAILS (Mollusca)				
Bithynia tentaculata	C		2	
Ancyclus fluviatilis	C	2		
Planorbis spp.	C		5	12
Potomapyrgus spp.	C	58	5	38
Physa sp.	**C**			1
TAXA	**EPA** Quality Category	**SITE** Craughwell R.	Dunkellin R.	Aggard Stream
Valvata macrostoma	**C**			5
Lymnaea stagnalis	D		2	
Lymnaea peregra	D		7	6
WORMS (Annelida)				
Oligochaetae	E	20	23	3
EPA Q Value		**Q4**	**Q3-4**	**Q3**
Total BMWP Score		131	86	86
ASPT		6.2	5.4	4.78

TAXA	EPA	SITE		
%EPT		45%	61%	40%

Table F.2 Existing waterbeetle records from Rahasane Turlough, H15, South East Galway, courtesy of Dr A. O'Connor, NPWS.

Species	Grid ref.	Record Date	Year	Collector
Agabus nebulosus	M474186	24-Aug-04	2004	Waldron, Mr F.
Agabus sturmii	M474186	24-Aug-04	2004	Waldron, Mr F.
Cercyon tristis	M474186	12-Nov-03	2003	Waldron, Mr F.
Hygrotus impressopunctatus	M474186	12-Nov-03	2003	Waldron, Mr F.
Hygrotus impressopunctatus	M474186	24-Aug-04	2004	Waldron, Mr F.
Elmis aenea	M474186	12-Nov-03	2003	Waldron, Mr F.
Elmis aenea	M474186	24-Aug-04	2004	Waldron, Mr F.
Graptodytes bilineatus	M474186	24-Aug-04	2004	Waldron, Mr F.
Haliplus sibiricus	M474186	12-Nov-03	2003	Waldron, Mr F.
Helophorus brevipalpis	M474186	12-Nov-03	2003	Waldron, Mr F.
Helophorus brevipalpis	M474186	24-Aug-04	2004	Waldron, Mr F.
Helophorus minutus	M474186	12-Nov-03	2003	Waldron, Mr F.
Helophorus minutus	M474186	24-Aug-04	2004	Waldron, Mr F.
Hydrobius fuscipes	M474186	12-Nov-03	2003	Waldron, Mr F.
Hydrobius fuscipes	M474186	24-Aug-04	2004	Waldron, Mr F.
Hydroporus palustris	M474186	12-Nov-03	2003	Waldron, Mr F.
Hydroporus palustris	M474186	24-Aug-04	2004	Waldron, Mr F.
Hydroporus planus	M474186	12-Nov-03	2003	Waldron, Mr F.
Hydroporus planus	M474186	24-Aug-04	2004	Waldron, Mr F.
Hygrotus inaequalis	M474186	12-Nov-03	2003	Waldron, Mr F.
Hygrotus inaequalis	M474186	24-Aug-04	2004	Waldron, Mr F.
Hygrotus quinquelineatus	M474186	12-Nov-03	2003	Waldron, Mr F.
Hygrotus quinquelineatus	M474186	24-Aug-04	2004	Waldron, Mr F.
Megasternum concinnum	M474186	12-Nov-03	2003	Waldron, Mr F.
Noterus crassicornis	M474186	24-Aug-04	2004	Waldron, Mr F.
Agabus bipustulatus	M4820	12-Jun-89	1989	Bilton, Dr D.T
Agabus nebulosus	M4820	12-Jun-89	1989	Bilton, Dr D.T
Helophorus aequalis	M4820	12-Jun-89	1989	Bilton, Dr D.T
Helophorus brevipalpis	M4820	12-Jun-89	1989	Bilton, Dr D.T
Helophorus grandis	M4820	12-Jun-89	1989	Bilton, Dr D.T
Hydroporus palustris	M4820	12-Jun-89	1989	Bilton, Dr D.T
Hydroporus planus	M4820	12-Jun-89	1989	Bilton, Dr D.T
Hygrotus quinquelineatus	M4820	12-Jun-89	1989	Bilton, Dr D.T
Ilybius ater	M4820	12-Jun-89	1989	Bilton, Dr D.T
Ilybius fuliginosus	M4820	12-Jun-89	1989	Bilton, Dr D.T

Laccophilus minutus	M4820	12-Jun-89	1989	Bilton, Dr D.T

Species	**Grid ref.**	**Record Date**	**Year**	**Collector**
Helophorus brevipalpis	~	~	2001	Dr A. O'Connor
Hygrotus quinquelineatus	~	~	2001	Dr A. O'Connor
Helophorus brevipalpis	~	~	2002	Dr A. O'Connor
Helophorus grandis	~	~	2002	Dr A. O'Connor
Helophorus minutus	~	~	2002	Dr A. O'Connor
Agabus nebulosus	~	~	2002	Dr A. O'Connor
Coelambus impressopunctatus	~	~	2002	Dr A. O'Connor
Haliplus obliquus	~	~	2002	Dr A. O'Connor
Helophorus minutus	~	~	2002	Dr A. O'Connor
Helophorus brevipalpis	~	~	2002	Dr A. O'Connor
Hydroporus planus	~	~	2002	Dr A. O'Connor
Hydroporus palustris	~	~	2002	Dr A. O'Connor
Hygrotus quinquelineatus	~	~	2002	Dr A. O'Connor
Laccophilus minutus	~	~	2002	Dr A. O'Connor

APPENDIX G

OPW Standard Operating Procedures

The Office of Public Works

Arterial Drainage Maintenance Service

Environmental Management Protocols

&

Standard Operating Procedures

The Office of Public Works
Environment Section
West Region Drainage Maintenance
Headford
Co. Galway
Telephone: +353 (0)93 35 456
Fax: +353 (0)93 35 631

The Office of Public Works
Arterial Drainage Maintenance
Environmental Management Protocols &
Standard Operating Procedures

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ENVIRONMENTAL MANAGEMENT PROTOCOLS

ARTERIAL DRAINAGE MAINTENANCE SERVICE
(APPLICABLE TO ENGINEERS, TECHNICIANS AND FOREMEN)

PART I – OPERATIONS MANAGEMENT

COMMUNICATIONS - STATUTORY STAKEHOLDERS

- By the end of September of each year, each Drainage Region to forward a ***draft*** copy if its Annual Works Programme for the coming year to OPW's Environment Section, and to the Inland Fisheries Ireland (IFI) EREP Project Manager who will review it for appropriate sites and study locations for the Environmental River Enhancement Programme 2008 -2012.
- By end of November of each year, each Drainage Region to forward the relevant sections of the Finalised Annual Maintenance Programme for the coming year with a copy of appropriate scheme maps, to the National Parks & Wildlife Services (NPWS) Regional Managers and the IFI Directors.
- When compiling the programme the type of works proposed should be indicated for each channel under the headings A-F to facilitate the Screening for Appropriate Assessment (AA).

  A – Silt & Vegetation Management
  B – Aquatic Vegetation Cutting
  C – Bank Protection
  D – Bush Cutting/Branch Trimming
  E – Tree Cutting
  F – Bridge/ Structure Repairs
- Ideally, approximate timing (season/month) and approximate duration of works should be included for each channel.
- Works that fall within SACs, SPAs or NHAs are to be highlighted on the programme.
- As a follow up, the Drainage Regions offer the opportunity for a meeting with the stakeholders to discuss the programme and where a meeting is requested, preferable for this to take place as early as possible in the year.
- Prior to entry onto a channel contained wholly or partly within an SAC, SPA or NHA, three weeks notice in advance of entry, and for SAC & SPA an AA Screening Statement/Conclusion Statement must be completed and forwarded through the NPWS District Conservation Officer.

INTERIM STAKEHOLDERS MEETINGS

- In addition to the start of the year stakeholder meeting to overview the Annual Works Programme, Regional Offices will offer and facilitate a schedule of more frequent and catchment focused meetings.
- The need and the frequency of these meetings will be determined on a regional basis in partnership with the relevant stakeholders.
- Typically a frequency of every 2-3 months to discuss the following 2-3 months work on the catchment, identifying any further environmental sensitivities, appropriate mitigating measures, follow up joint site visits where deemed beneficial and flagging any opportunities for added benefit in proposed River Enhancement works.
- Typical attendance includes a range of OPW Management Staff, i.e. Engineer, Technician and/or Foreman, NPWS Rangers and/or DCO and IFI Officers.
- OPW Engineer will compile minutes of the meeting to record attendance and a brief account

of main decisions and follow up actions.

- Any channel specific information resulting from these meetings, such as timing requests should be entered into the Records Database in accordance with the National Recording Process.
- Fruitful consultations with statutory stakeholders such as NPWS and IFI are of critical importance to continuously improving environmental performance. However, in the interest of maximising the efficiency of stakeholders input, Management Staff are as far as practical, to plan their consultative requirements and address a range of aspects in any one discussion forum. Interim Stakeholder Meetings or similar forums offer good opportunities to maximise consultation efficiencies.

CORRESPONDENCE

- All Environment related correspondence/complaints should be logged on the Engineering Services Correspondence Database as per normal protocol. Complaints received should be forwarded to the Environment Section should assistance be required.

WALKOVER SURVEYS

- As a component to the EREP Project, on a number of channels, EREP team will request for Walkover Surveys as an opportunity to discuss in detail on site the environmental options for a particular channel with a range of relevant stakeholders.
- Typical attendance will be an IFI EREP representative, a range of OPW Management Staff and relevant Operational Crew if deemed beneficial, local IFI Officer and/or NPWS Ranger or DCO.
- OPW Management Staff to liaise with EREP team and coordinate the site visit with local IFI and NPWS to facilitate their participation if these stakeholders wish to attend.
- Environmental procedures as agreed on-site will be recorded by IFI EREP team and issued to the OPW Engineer as part of the design guidance for the particular Enhanced Maintenance works.
- Regional Management Staff to ensure that Operational Staff carry out the works in accordance with the agreed procedures.

NATURA 2000 SITE ASSESSMENTS

- All scheduled maintenance operations in the vicinity of a Natura 2000 Site i.e. an SAC or SPA, will require Screening for Appropriate Assessment and Stage II Appropriate Assessment where required.
- By the end of September of each year, each Drainage Region to forward a ***draft*** copy if its Annual Works Programme for the coming year to OPW's Environment Section to facilitate this process.
- Environment Section will procure the Ecological Consultant, collate all the channel lists and issue completed AA Screening Statements/Conclusion Statements to the respective OPW engineers as completed.
- The Ecological Consultant will consult with OPW management to define the precise extents of proposed works in each Natura 2000 Site.
- In addition, the Ecological Consultant will be carrying out walkover surveys for pre and post maintenance works for a representative number of the sites and OPW Management will be required to facilitate the same.
- OPW Management Staff will issue the relevant completed Assessments directly to the NPWS District Conservation Officer.In addition, Environment Section will issue all of the Assessments to the Development Applications Unit, DEHLG, Dun Sceine, Harcourt Lane,

Dublin 2.

- Preferably for the Assessments to be forwarded to the DCO as soon as it is completed, but in any case with a minimum of three weeks notice before commencement of the works.
- Management Staff to implement all prescribed mitigating measures and ensure that Operational Staff are made aware of all relevant site specific mitigating measures.

Current version of Designated Sites GIS Layers available on Socialtext

Environmental River Enhancement Programme (EREP)

- After reviewing the draft Annual Works Programme, IFI EREP team will revert to the respective Regional Engineers Office and request follow up meetings as required to discuss aspects of the programme in relation to the EREP.
- Enhancement sites require ground truthing to ensure they are technically feasible as envisaged. This is to be coordinated by the IFI EREP team with local IFI and OPW personnel as required.
- Sites shortlisted by IFI EREP team for Capital Enhancement works are emanating from a screening process of technical feasibility in terms of gradient and water quality. In the future, sites selected will increasingly be resulting from other requirements such as the Water Framework Directive Programme Of Measures under Morphology.
- IFI EREP team in consultation with the local IFI and OPW, will prioritise sites on a basis of best return for investment. IFI EREP team will liaise with the Regional Offices to assist in identifying channels deemed suitable for capital enhancement which should be integrated with the following years work programme. In some cases, a situation may arise where the site selected is not overlapping with the current Annual Works Programme but where feasible and subject to any third party agreement, OPW will accommodate these works.
- Similarly for enhanced maintenance works, IFI EREP team in consultation with the local IFI and OPW, will select sites again that are technically feasible and offer best return for investment. These sites will normally be from channels on the current Annual Works Programme.
- IFI EREP team will coordinate all the scientific monitoring works, provide the enhancement design details and guidance to OPW Management Staff and maintain a reasonable level of site supervision, proportional to the complexity of the works and the experience of the OPW Staff involved.
- Consultations with local IFI through the Interim Stakeholder meetings are encouraged to identify sites suitable for Enhancement works and in some cases the local IFI may also be in a position to produce an enhancement design. All enhancement designs and works are to be coordinated through the IFI EREP team to facilitate formal recording into the national EREP project and allow for biodiversity and/or hydromorphology monitoring if required. Local IFI may coordinate with IFI EREP team or alternatively OPW Regional Staff coordinate directly with the EREP team.
- A small portion of channels have more infrequent maintenance cycles and these cases can offer particularly good opportunities for enhanced maintenance type works. Channels programmed where maintenance works have not being carried out for in excess of 10 years, to be flagged to IFI EREP team for possible Walkover Surveys and guidance on appropriate EDM procedures.
- Management Staff to ensure that as far as practical, all Operational crews have an opportunity to get experience on these projects.

- Each Regional Engineer is to make provision in the Annual Works Programme for Plant & Labour resources in addition to provisions in the Annual Budget for materials subject to expenditure constraints. Typical resources are as follows:

Capital Enhancement

Region	Target (Km)	Capital Costs	Machine Weeks	ManWeeks
East Region	20	€200,000	30	60
South West Region	14	€140,000	21	42
West Region	16	€160,000	24	48
	50	**€500,000**	**75**	**150**

Enhanced Maintenance *(in conjunction with routine maintenance)*

Region	Target (Km)	Capital Costs	Machine Weeks	ManWeeks
East Region	20		15	0
South West Region	14		11	0
West Region	16		12	0
	50		**38**	**0**

- Progress targets for EREP to be shown on monthly production reports.
- OPW are the primary contact point for liaison with landowners including the organising of access and egress for machinery and materials. Brochures on EREP are available in all Regional Offices. Additional copies can be obtained through OPW Environment Section.
- Management Staff are encouraged to maximise the use of all available on-site materials such as stone from historical spoil heaps as opposed to importing materials at a higher cost.
- In addition, Management Staff are encouraged to maximise synergies with other funding sources such as Fisheries Development grants attained by local Angling Clubs which could combine with OPW plant and labour to supply materials.
- In all cases, Inland Fisheries Ireland are the statutory authority to give design guidance to OPW. Angling Clubs or other sectoral funding sources to liaise with the Fisheries authorities in respect of all design and environmental monitoring requirements.
- As-Built plans are to be completed by the IFI EREP team for all enhancement works. This will entail a site visit by IFI and relevant OPW Staff where requested. These will be retained by IFI as well as any relevant design information.
- IFI EREP team will forward a copy of the As-Built plans to Environment Section who will upload the same to Socialtext for access to the information by all Staff.
- At the end of the year, IFI EREP team will forward Environment Section a GIS layer of that year's works for uploading to OPWs GIS records.

Current version of Enhancement GIS Layer available on Socialtext

National Recording Process

- Weekly Record Cards can contain information on Lamprey, Crayfish, Kingfisher, Mussels, Otter and other site specific environmental information as arises.
- Environmental information on Cards will be recorded onto the Records Database by each Drainage office. The latest Records Database has been revised to integrate environmental records.
- On an interim basis, a copy of all Cards with environmental information to be copied and

forwarded to Environment Section by each Drainage Office. This is to allow Environment Section to review the detail of information being recorded, feedback to the Operational crews through the Management Staff and attain a national consistency in the style of information being recorded.

- All relevant information to be uploaded to GIS by Environment Section.
- All other relevant environmental information sourced by Management Staff whether from direct observations or through stakeholder consultations, should be entered into the Records Database.
- Relevant environmental information sourced through the EREP project and related research will be forwarded by IFI EREP team to Environment Section directly for centralised GIS uploading.
- On an annual basis, Environment Section will compile an update of Weekly Records Cards species records and make available to all Staff via Socialtext to assist in tracking progress.
- On an ongoing basis, Environment Section will make available the various OPW compiled species records to other authorities to assist in contributing to any appropriate national conservation knowledge.
- As described above, each drainage office will upload onto the Records Database all environmental information from the Weekly Record Cards and all other broader environmental information attained by Management Staff. Within a few years, it's envisaged that multiple regional Staff will be able to use the new Records Database, and then environmental information from all sources will be uploaded directly by a whole host of Staff. Typically this will include any mitigating agreements for particular channels agreed with stakeholders or any other individuals observation such as protected species presence noted during a separate site visit.

Salmonids

- As far as practicable, the maintenance works are to be scheduled to accommodate salmonid (Salmon & Trout) spawning areas, as is in place across all regions for many years. This is a widespread measure on many catchments and is most applicable to medium gradient channels with gravel substrate.
- Prior to works commencing, consult with local IFI. Ideally, consultations to be conducted through Interim Stakeholder Meetings or alternatively, direct contact in respect of the specific site.
- Maintenance operations on salmonid spawning beds typically carried out between July and September but timing subject to adjustment due to local knowledge of IFI.
- Raking of spawning gravels to improve spawning capacity also typically carried out between July and September.
- River enhancement works to enhance both the fisheries and the broader ecology of the drainage channel are covered under the EREP project.
- In the future, as the extent of completed enhancement works increases, there is a risk of damage to structures due to future maintenance. All channels scheduled for maintenance to be checked against GIS records for presence of previous enhancement works. Where a presence is indicated, carry out a site visit as appropriate and in consultation with IFI , devise on-site procedures to protect or enhance existing instream structures.

Current version of Enhancements & Spawning GIS Layers available on Socialtext.

Lamprey (Brook, River & Sea) & Crayfish

- All channels scheduled for maintenance to be checked against GIS records for presence of Lamprey or Crayfish.

- In accordance with the SOPs, Operational Staff will closely observe the spoil three times daily and report to the Foreman any Lamprey or Crayfish located.
- Mitigating procedures to apply when:
  - GIS records indicate species presence, or
  - Operational Staff locate Lamprey or Crayfish during operations, or
  - Where particularly suitable habitat is identified by an environmental stakeholder.
- If significant populations are encountered, notify IFI EREP team and facilitate scientific studies if site deemed suitable by IFI.
- If significant populations are encountered, notify NPWS Ranger and local IFI Officer and conduct site visit as necessary.
- Combination of Mitigating Measures to be selected as applicable to the site while balancing the Flood Risk Management requirements and a sustainable approach to the conservation of Lamprey and/or Crayfish.
- Identify extent of channel applicable and the mitigating measures to apply.
- Inform Operational Staff of mitigating requirements.

Suite of relevant Mitigating Measures as follows:

On site measures

- Skip sections to retain intact habitat either in one long reach or multiple short reaches.
- Maintenance in an upstream direction to avoid secondary disturbance of a species moving downstream. Balance with the advantage of maintenance in a downstream direction where instream vegetation minimises siltation.
- Confine maintenance to 2/3 of channel width leaving marginal vegetation and silt intact.
- Maximise use of weed cutting bucket particularly where aquatic vegetation removal is the primary objective. This is effective for Lamprey juveniles as they are in the silt. For Crayfish, cutting of "Flaggers" type vegetation is effective but cutting of "water celery" mat type vegetation is less effective as it can result in Crayfish being removed within the weed mass.

Forward planning measures

- Annual maintenance of the channel in shorter segments sequentially completing the same over a number of years. Balance with maintaining reasonably operational efficiency in terms of machinery moving, transport, access and egress.
- Longer time periods between maintenance cycles e.g. move from 4-6 years to 7 to 8 years. Balance with overall river ecology as longer maintenance cycles will lead to more heavy-scale works.
- Timing of maintenance to accommodate Lamprey spawning. Stakeholder consultations between OPW and local IFI for salmomid mitigating purposes, to include consideration of Lamprey spawning. This is to be applied to channels where Lamprey spawning habitat is known as informed by IFI or other stakeholder. For River & Brook Lamprey, no works on relevant spawning channel from end March to start of June subject to adjustment due to local knowledge of IFI. For Sea Lamprey, as they spawn during the summer months, restrictions from late April to early July are required. To be applied to channels where Sea Lamprey spawning is known as informed by IFI or other stakeholder and timing subject to adjustment due to local knowledge of IFI. Note that Sea Lamprey are much less widespread so envisaged that the scale of this mitigation will be very limited.
- Loosening spawning bed gravels. Stakeholder consultations between OPW and IFI for salmonid gravel loosening purposes, now to include consideration of Lamprey spawning as above.
- Enhance channel profile such as skewed cross section and promote deposition of silt along margins. Integrate with IFI discussions on planning the EREP to avail of enhancement

opportunities particularly for channels where Lamprey or Crayfish presence is recorded.

- Modification of OPW structures which impede upstream migration. Identification of weirs as barriers to be as informed by IFI or other stakeholder. Where modification designs required, liaison with IFI EREP team to integrate the improvement works into the EREP project. Identification of a bridge apron step attained through ongoing site inspections by OPW Management Staff or other stakeholder. In consultation with IFI, steps at bridges to be modified by a rock armour type ramp or similar. Envisaged that these measures will be of a limited scale on drained channels.

GIS Records:

- Where Lamprey or Crayfish are discovered, Operational Staff will have recorded the same on the Weekly Record Cards. Cards with species location information will be uploaded to the Records Database as stated in the National Recording Process.
- All new Lamprey spawning location information attained through stakeholder consultation to be recorded on the Records Database in accordance with the National Recording Process.
- All database records of species location will be uploaded to GIS by Environment Section.
- IFI EREP team conducting ongoing research on Lamprey & Crayfish as a component of the EREP works. Scientific data calculating species density for some sites will be developed and to be supplied by IFI to OPW and uploaded to GIS by Environment Section.

Current version of relevant SOPs: *V2 April 2009*
Current version of relevant GIS Layers available on Socialtext.

OTTER

- Research to date indicates that Otters are widespread across all sizes of drainage channels nationally, hence it is prudent to assume that Otter use any particular site.
- In accordance with the Otter SOP, Operational Staff will walkover the works area one week in advance in conjunction with the Health & Safety assessment noting dense cover with access directly to the water that is to be avoided where feasible.
- In addition, any recognisable signs of Otter presence observed such as Spraints, Footprints or suspected Holts, will be recorded on the Weekly Record Cards. These signs were identified in Otter Awareness Training carried out across all regions in 2008.
- While holts are usually well concealed, where Operational Staff observe a suspected holt such as a burrow opening, in consultation with Management Staff, subject to flood risk management functions, no works to within a 50m buffer each side.

Bridge mammal crossing enhancement

- As a component of ongoing consultations with NPWS and other stakeholders, evidence may arise from time to time as to a particular spot for Otter road kill. Typically this can arise where the Otter always traverses the roadway as opposed to going through the bridge. While this scenario is not known to be a widespread issue in Ireland, the highest risk locations are on the National Primary Roads which have the heaviest traffic volumes.
- There are 170 National Primary Road bridges on OPW channels as listed in the table referenced below and Management Staff are to have particular regard to these locations if evidence arises on a possible road kill "hot spot".
- Enhancement works will typically take the form of a bolt-on wildlife ledge or similar. Design and configuration is to carried out in consultation with NPWS and relevant Local Authority.
- On an annual basis, Environment Section will review the national website www.biology.ie which records Otter road kill reports from the public. Any road kill location which overlaps with an OPW channel will be flagged by Environment Section to the relevant Management

Staff.

- Current understanding is that Otter road kill is not a significant issue in Ireland. It's envisaged that while the justification for bridge mammal crossing works may arise for some scenarios, these measures will be of a limited scale on drained channels.

Current version of Otter SOP: V2 April 2009
Current version of National Primary Roads & OPW Bridges: March 2009

Freshwater Pearl Mussel

- GIS records from NPWS show the locations of the 91 known FWPM populations in Ireland.
- The following OPW channels have been identified as containing FWPM:

Channel	Scheme	Location	Most Recent Record
CH9	Corrib Headford	Oughterard	2009
C1/21/3	Moy	Approx 500yrds from outfall to into L. Cullin	2004
C1 Sect M&N	Moy	Ballygallagart	2004
C1/21/14	Moy	Crossmolina	2008
C1	Dunmanway FRS	d/s of the Long Bridge	2003
C1	Owvane	Approx 1400 yrds from outfall	2002
C1	Feale	d/s Listowel near Scartleigh cemetary	2006
**Owenaher	Moy	u/s of C1/54	1996
**Brown Flesk River	Maine	Trib of C1 Maine near Farranfore	1987
** Galey River	Feale	Approx 1400yrds u/s of C1/18 near Ahavoher Br.	1950
**River Liffey	Ryewater	(Lucan) Approx 3.5km d/s C1 Ryewater outfall	1894

** Although not on OPW channels - these channels may or may not contain populations of FWPM. Works in the vicinity which could impact on a possible population need to be considered in close consultation with local NPWS knowledge.

- While highly unlikely to have instream works in a FWPM habitat, if a new population located by Operational Staff during operations, works to cease.
- Notify NPWS and in consultation with NPWS, area to be skipped or non in-stream works carried out as agreed for the specific site.
- For operations in the vicinity of known populations, mitigating procedures to apply:
- Consult with NPWS and local IFI and conduct site visit as necessary.
  - Typically only selective non in-stream works adjoining the population.
  - Works such as removal of a fallen tree is to be completed by lifting clear of the channel to minimise any channel bed disturbance due to the branches being dragged.
  - Assess need for silt management procedures for works upstream of the population and implement in consultation with NPWS.

Current version of relevant SOPs: V2 April 2009
Current version of FWPM GIS Layer available on Socialtext.

Swan & Duck Mussels

- Swan and Duck Mussels are not strictly a protected species, however they are of conservation interest.
- Both species are similar in appearance and habitat requirements and distinguishing between them is not necessary unless local environmental stakeholders can identify the exact species.

- As the Mussel SOP, if Operational Staff locate the same, Management Staff will be notified.
- Where significant populations are encountered notify NPWS Ranger and local IFI Officer, and where they are interested in visiting the site, facilitate a site visit as necessary.
- Identify extent of channel applicable and the mitigating measures to apply.
- Typical Mitigating Measures include:
  - Operational Staff to observe spoil and return any Mussels to the channel whom are expected to recolonise the channel bed.
  - Maximise use of weed cutting bucket particularly where aquatic vegetation removal is the primary objective.
  - Skip sections to retain intact habitat either in one long reach or multiple short reaches.
  - Confine maintenance to 2/3 of channel width leaving marginal vegetation and silt intact.
- Record species presence on the Weekly Record Cards which will be recorded on the Records Database.

Current version of relevant SOPs: V2 April 2009

Kingfisher

- Avoid disturbing nesting sites in banks.
- Visual sightings of Kingfisher by Operational Staff to be recorded on the Weekly Record Cards.
- Sightings by Management Staff to be recorded on the Weekly Record Cards where works in progress or on other occasions, record by separate map or channel reference format.
- All sightings to be recorded on the Records Database in accordance with the National Recording Process.
- All database records of species location will be uploaded to GIS by Environment Section.
- On an annual basis, Environment Section will issue the records to Birdwatch Ireland whom will add to the national Kingfisher database.

Current version of Kingfisher GIS Layer available on Socialtext.

Birds

- Removal of any abnormally dense layer of vegetation is to be executed between September and February (inclusive) to minimise impacts on nesting birds unless there are other overriding requirements such as Health & Safety.
- For SPAs containing important over-wintering bird populations, in consultation with the NPWS, regard to be given to timing or phasing of the works to minimise potential disturbance.

Bats

- While the removal of large mature trees is not typically a requirement of maintenance works, where the case arises, in consultation with NPWS, regard to be given to the likelihood of bat roosting habitat.
- Typical mitigating measure would be to leave tree in fallen position for 24hrs to allow any bats vacate.
- Masonry bridges offer niches and crevices suitable for bat roosts and where masonry bridges are scheduled for maintenance works, regard to be given to the likelihood of bat roosting habitat. Typical maintenance works at low level such as wing wall repair or underpinning foundations have limited potential to impact on bat roosts. Where the case arises that repair works are to be above the high water level such as the upper arch, in consultation with

NPWS, assess the potential for the works impacting on bat roosts.

- Typical mitigating measure would be to contract a bat specialist to survey for bat presence before works commence, to avoid entombment of any bats.

Wetlands - Bogs, Fens & Turloughs

- All channels scheduled for maintenance which overlap SAC designations to be checked against the list of channels that impinge on Raised Bog, Fen habitat or Turloughs and have regard to any NPWS agreements noted *.
- OPW Management Staff to consult with NPWS for expert opinion as to any evidence of ongoing ecological decline of the Bog, Fen or Turlough and judgement on, if the drainage datum set by the Drainage Scheme and its maintenance is an ongoing contributing factor by affecting the hydrological regime of the same.
- Where a likely impact is identified, conduct site visit as necessary and in consultation with NPWS, mitigating measures to be selected such as:
- Skipping the channel in question while taking cognisance of the flood risk management requirements.
- Maximise use of weed cutting bucket particularly where aquatic vegetation removal is the primary objective.
- Inspection by OPW line management to assess the possibility of over digging the channel below the original design datum. Presence of an existing water level control such as a bridge floor to be established and alternative reference datum to be installed if deemed warranted.

** Environment Section currently developing a list of channels which overlap with Raised Bog, Fen habitat and Turloughs within SACs. Channels that are subject to a previous NPWS agreement /understanding of the extent of maintenance will be recorded.*

Current version of Wetlands channels list available on Socialtext.

Invasive Species – Plants

- Multiple invasive plant species are widespread nationally as described in the SOP and prudent to assume that one or more of these plants can be present on any works site.
- At present the OPW does not have any direct responsibility for the management of Invasive species. However to ensure OPW operations are not a vector for these invasives, measures are required to reduce the risk of spread.
- Ensure machine washing equipment transported to site for all appropriate machinery movements as described in the Invasive Species SOP.
- Ongoing EDM site audits by Environment Section will include confirmation that machine washing was executed in accordance with the SOP for the last applicable machine transfer.
- In some cases, OPW will assist other authorities in the control of invasive species. In these projects, the works are typically carried out in partnership between a number of authorities such as IFI, NPWS and relevant Local Authority. As scenarios arise where OPW are requested to assist in an invasive species control project, Management Staff are encouraged to support the multi-authority partnership model which will maximise resource efficiencies for all parties while still achieving a broader environmental good.

Current version of relevant SOP: *V2 March 2009*

Invasive Species – Zebra Mussel

- Zebra Mussels are present in the River Shannon, Grand Canal and are in many lakes such as

L Derg, L Ree, L Garra, L Key, L Derragh, Derravaragh, L Sheelin and L Corrib. This species is spreading and it is prudent to assume that works in any large sluggish river or near a lake has potential to contain Zebra Mussel.

- For any proposed works in the vicinity of potential Zebra Mussel waters, flag for Operational Staff and ensure particular attention to cleaning procedures for all equipment prior to removal from site.
- Any new location of Zebra Mussel uncovered during operations, notify NPWS and IFI for their information.
- Record on Weekly Record Sheet which will be uploaded on the Records Database in accordance with the National Recording Process.
- On an annual basis, Environment Section will collate the records nationally and issue to any relevant authorities to assist in tracking the species spread.

Current version of relevant SOP: *V2 May 2009*

Tree Management

- A small portion of channels have more infrequent maintenance cycles typically where self cleaning gradients are present. These sites can entail abnormally dense tree cover which may be required to be managed for conveyance or fisheries purposes. Removal of any abnormally dense layer of vegetation is to be executed between September and February (inclusive) to minimise impacts on nesting birds unless there are other overriding requirements.
- IFI requests to reduce "tunnelling" on drainage channels to be accomodated where feasible. OPW Management Staff to facilitate a site visit with the IFI Officer as required and devise a selective approach to the tree removal so as to retain a dappling of shade along the channel length.
- Excess woody vegetation to be collected and utilised by the following in order of preference:
    - Reused by adjoining landowner for domestic firewood.
    - Subject to landowners agreement, stockpile excess to form natural cover and niche habitat, preferably with some connection of cover to the channel e.g. along a hedge leading to the water.
    - Shred and spread along the adjoining top of bank allowing the material to degrade rapidly and recolonisation of the underlying vegetation.

Environmental Drainage Maintenance (EDM) Guidelines

- A portion of operational crews will be audited annually for implementation of the EDM Guidelines and other standard environmental procedures as adopted.
- Auditing will be carried out separately by both IFI and OPW Environment Section on a rotational basis to ensure all operational crews are audited at least once every three years.
- Audit results will be recorded on a standard format with the following feedback:
    - All audit results will be forwarded to the relevant Engineer for that Drainage Scheme within two working weeks.
    - In the event of an audit showing elements of unreasonable non-compliance with procedures, the relevant Engineer will be notified within one working day.
    - Audit results will be forwarded to OPW Systems Co-ordinator for inclusion in monthly regional benchmarking reports.
    - IFI EREP team will compile an overall summary of their findings in their end of year report under the EREP project.
- Design for Enhanced Maintenance works under EREP will include a design element for full

scale implementation of the EDM Guidelines such as Boulder Replacement and Excavating Pools.

- Management Staff to ensure that as far as practical, all Operational crews have an opportunity to get experience on these projects.

Current version of EDM Guidelines: April 2011
Current version EDM Audit Sheet: April 2011

PART II – DEPOT MANAGEMENT

Depot Waste Management

- 12 Waste Management Plans are available on Socialtext covering the 12 Drainage Offices.
- Environment Section will review 2 plans per annum and audit implementation.
- Updated Plans together with an overview of findings will be forwarded to the relevant Coordinator and uploaded to Socialtext.

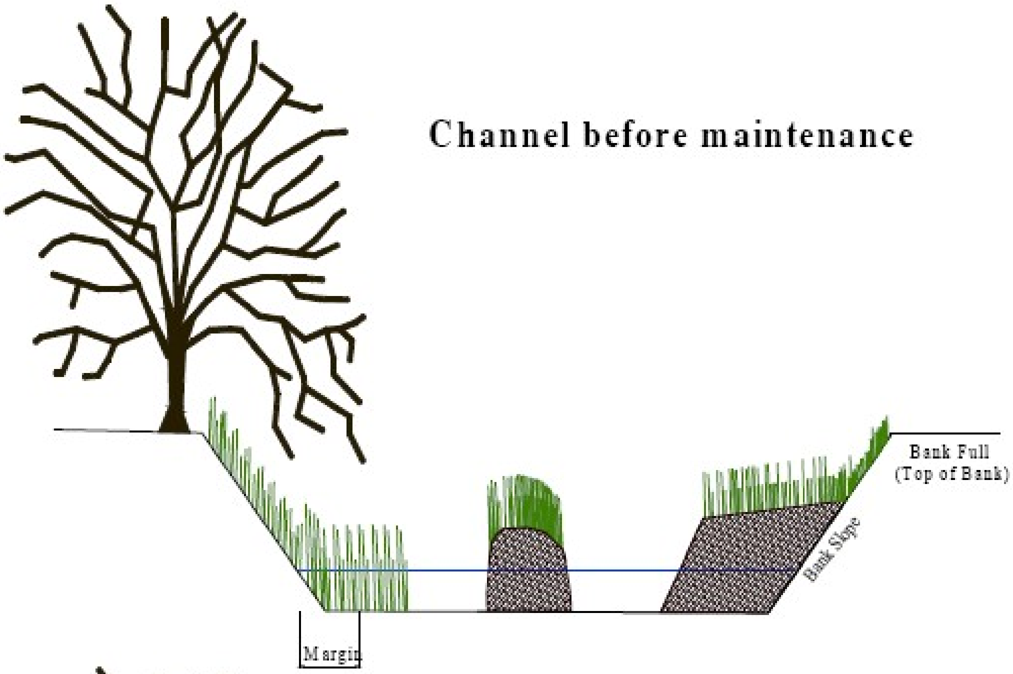
Future Revisions

- Envisaged that this set of Protocols will be a fluid document and will be periodically updated as procedures are revised or new procedures introduced. In addition, to be used as a framework document for quality control purposes to reference the latest versions of all supporting information.

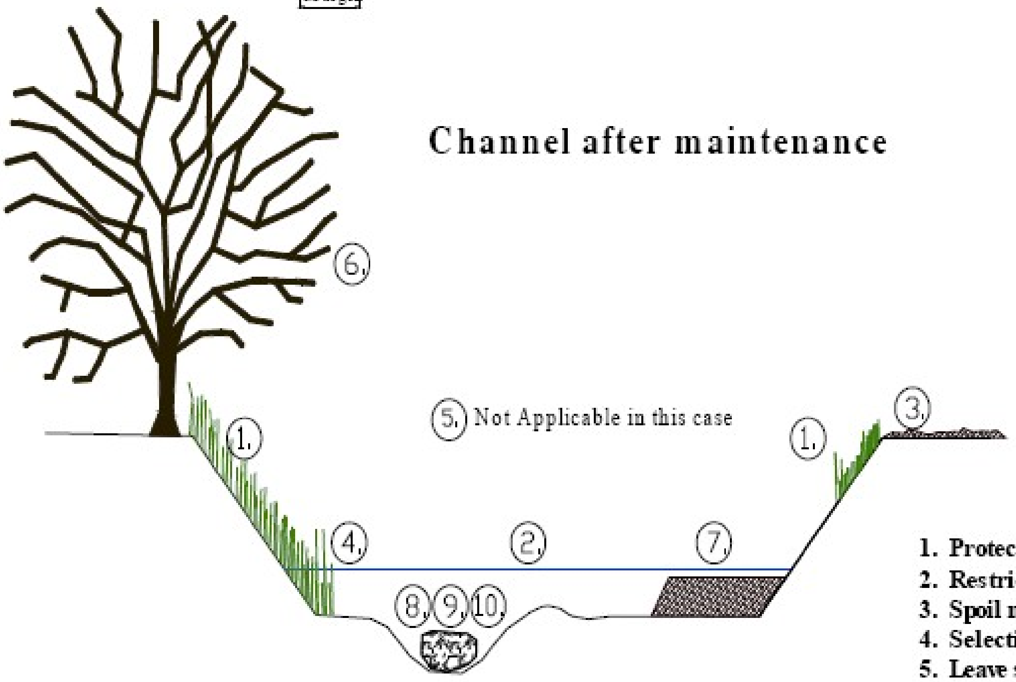
Environmental Drainage Maintenance
Guidance Notes

10 Steps to Environmentally Friendly Maintenance

Channel before maintenance



Channel after maintenance



1. Protect bank slopes
2. Restrict maintenance to channel
3. Spoil management
4. Selective vegetation removal
5. Leave section untouched
6. Management of trees
7. Manage berm to form two stage channel
8. Replace stones and boulders
9. Loosen gravel beds
10. Re-profile channel bed

Iascach Intíre Éireann
Inland Fisheries Ireland

April 2011

Environmental Strategies for Channel Maintenance

1. Protect bank slopes

1.1 Do not disturb the non-working bank slope

1.2 Minimise any effect on working bank

1.3 Leave margin of vegetation at foot of each bank slope

2. Restrict maintenance to channel

2.1 Remove only necessary silt – **no new diggings**

2.2 Remove instream material only

2.3 Retain marginal vegetation

2.4 Check spoil regularly. ***See Lamprey & Crayfish SOPs***

3. Spoil Management

3.1 Maximise spoil placement on bank full line or spoil heaps
and
3.2 Minimise spoil placement on bank slopes

3.3 Spread spoil as thinly as possible

3.4 Allow water to drain out of bucket over the water – lets small fish, lamprey and crayfish escape

4. Selective Vegetation Removal

4.1 Retain a band of vegetation on both sides at water's edge

4.2 Selectively manage instream vegetation

4.3 Maximise use of weed-cutting bucket

4.4 Avoid maintenance in coarse fish channels from 1st April to 1st July

4.5 Retain 1/3 to ½ of instream floating type vegetation, such as *Ranunculus* (water crowfoot) – see photo to right

5. Leave sections untouched

5.1 If channel capacity is not affected, leave section alone

6. Management of Trees

6.1 Remove trees that are blocking the flow

6.2 Tree-cutting window 1st September to 28th February

6.3 Remove overhanging branches to known flood level

6.4 Use saw secateurs for removal, not excavator bucket

6.5 Manage Trees to reduce very heavy shading

6.6 Manage briars and scrub.
See Otter SOP

7. Manage berms to form two-stage channels

7.1 Retain berm where channel capacity is not affected

7.2 Remove top of berms to low flow levels

7.2 Remove vegetation and soil from gravel berms

7.3 Replace sod to the berm where feasible

7.4 Only narrow berms if 'excessively' wide for the channel (i.e. greater than a third of the channel width

8. Replace stone and boulders

8.1 Reinstate boulders and gravels as removed by maintenance operations

8.2 Reinstate suitably sized boulders into channel from spoil heaps where feasible

8.3 Boulders should be placed at or below low flow level and spaced out

9. Work in gravel bed channels

9.1 Loosen or toss bed gravels to wash out fines

9.2 Only considered between 1st July and 30th September

9.3 No work in gravel bed / spawning channels in fisheries 'closed season' *Note:* This varies locally check with local IFI

10.1 Excavate bed to form deeper pool areas and shallow riffles

10.2 Overdeepen the channel along one side and place spoil on opposite side –particularly on curves and bends

10.3 Use existing boulders to form **simple** low-level structures

10.4 Record where such works are carried out

Actions during Maintenance Operations

- Machine gangs to closely observe the spoil three times daily for Lamprey (and Crayfish).
- Where Lamprey encountered:
  - Contact area Foreman immediately.
  - Foreman to contact Engineering Staff in line with the Environmental Management Protocols.
  - Record the location and abundance of Lamprey on the time card.

Measures as directed by Foreman to minimise impact may include:

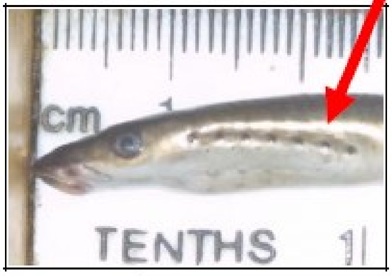
- Skip a defined stretch of channel.
- Confine maintenance to 2/3 of channel width leaving marginal vegetation and silt intact.
- Maximise use of weed cutting bucket particularly where aquatic vegetation removal is the primary objective.

Lamprey in the spoil

RIVER, BROOK & SEA LAMPREY IDENTIFICATION CARD

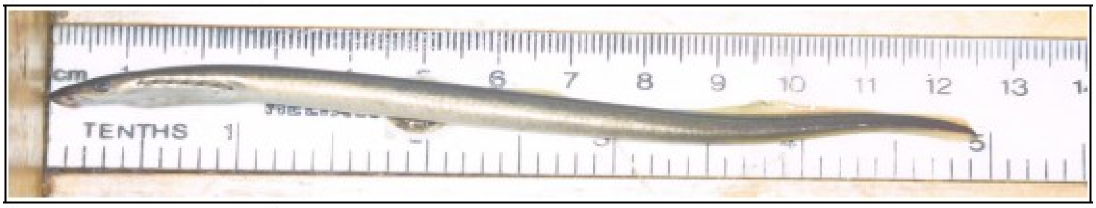
Lamprey and young eels can look very similar. These key identifying features can be used to distinguish the two species

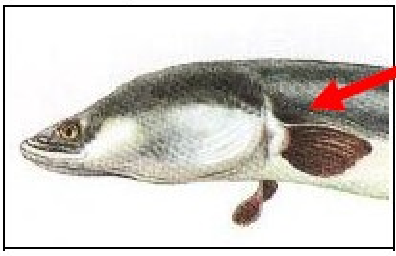
Gill Pores



Lamprey:

- Gill Pores (Holes)
- No Fins
- No Jaw
- Average length 8 to 15cm (3 to 6 inches)





No Gill pores

Eels: No Gill Pores

Paired Fins

Jawed Mouth

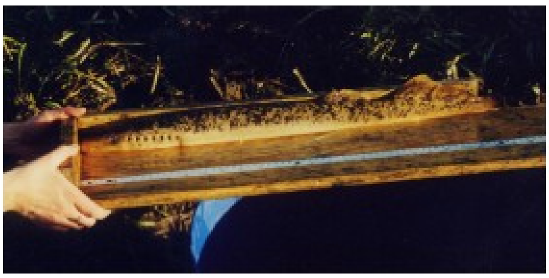
Average length 65cm (26 inches)

Juvenile Lamprey:

- Juvenile Lampreys live in the sediment.
- It is in this juvenile phase that they can be removed from the sediment during maintenance.

Adult Lamprey:

- Largest is the Sea Lamprey species.
- Also are River and Brook Lamprey
- Length from 30 to 60cm (12 to 24 inches).



Actions during Maintenance Operations

- Machine gangs to closely observe the spoil three times daily for Crayfish (and Lamprey).
- Where Crayfish encountered:
  - Contact area Foreman immediately.
  - Foreman to contact Engineering Staff in line with the Environmental Management Protocols.
  - Record the location and abundance of Crayfish on the time card.

Measures as directed by Foreman to minimise impact may include:

- Skip a defined stretch of channel.
- Confine maintenance to 2/3 of channel width leaving marginal vegetation and silt intact.
- Maximise use of weed cutting bucket particularly where aquatic vegetation removal is the primary objective.

Crayfish in the spoil

WHITE-CLAWED CRAYFISH

Identification

- Resemble small lobsters.
- Colour varies from light to dark green-brown, with large front claws.
- Adults typically 7cm - 10cm (3" - 4") long.
- Juveniles can be a small as 2cm (1") long.
- Prefer channels with
    - dense weed cover (flaggers / watercelery) or
    - with a mixture of rocks / gravels that provide crevices for cover.

Week before Maintenance Operations begin:

- Operational staff will walkover works area one week in advance in conjunction with the PRA noting areas of dense cover with access directly to the water. (As identified during Otter Awareness Training)
- These areas of suitable cover should be avoided where feasible during maintenance.
- Suspected presence of an Otter holt to be reported immediately to area Foreman, who will contact Engineering Staff in line with the Environmental Management Protocols.
- Signs of Otter presence observed such as Spraints, Footprints or suspected Holts, to be recorded on the Weekly Record Cards.

Measures to minimise disturbance may include:

- Retain suitable cover where possible.
- Areas of dense scrub to be avoided by large plant.
- Skip stretch of channel in proximity of suspected holt.

Otters

- Widespread presence on OPW channels.
- Shy animals and not normally seen.
- Adults 1 metre long and weigh 10kg.
- Streamlined profile.

OTTER

Holts

- Usually well concealed.
- Typically burrows, or spaces under banks, tree roots or dense cover.

Spraints

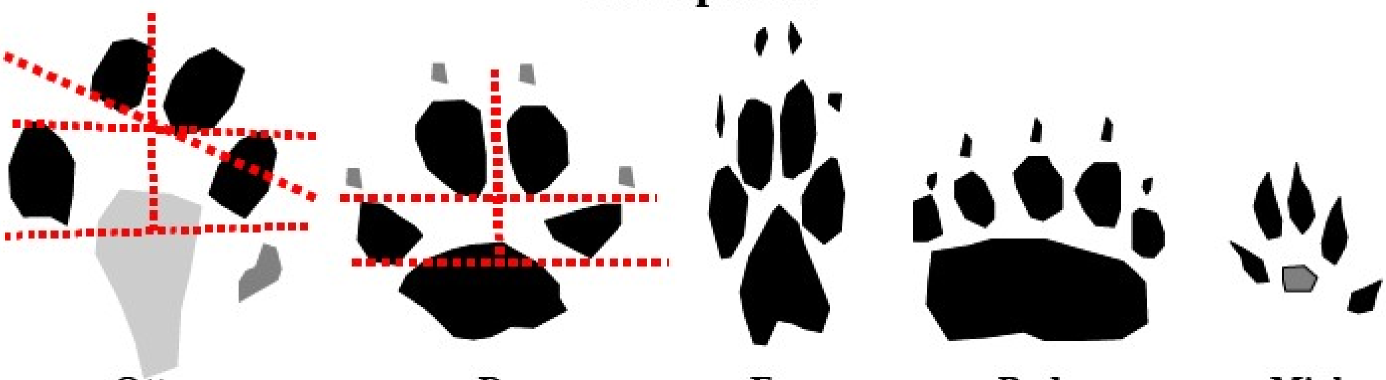
- Found on rocks, paths, channel junctions.
- Dark, oily, sweet smelling.

Suitable areas of cover

Dense bankside vegetation, particularly where there is direct covered access to the water.

Any isolated clumps of dense vegetation giving cover along an open length of channel.

Foot-prints



Otter (Non-symmetrical toes) | **Dog** (Symmetrical toes) | **Fox** | **Badger** | **Mink**

FRESH WATER PEARL MUSSELS

Before Maintenance Operations begin:

- Maintenance must not commence where a known population of Fresh Water Pearl Mussel exists (as listed in the Environmental Management Protocols).

- In the unlikely event of new population of Fresh Water Pearl Mussel being encountered during maintenance,
  - **All works must cease immediately.**
  - Contact area Foreman.
  - Record the location of Mussels on the time card.

Measures to minimise disturbance may include:

- Placing of straw bales to prevent movement of silt.
- Any exceptional / emergency works to be carried out in close consultation with the NPWS.
- For exceptional / emergency works e.g. fallen tree obstruction – these to be lifted clear of the channel to prevent disturbing the channel bed.

MUSSELS

Fresh Water Pearl Mussels *(Margaritifera margaritifera)*

- Shells very thick & heavy – shaped like a kidney.
- Shell colour is dark-brown – black, to blue & black.
- Adults range in length from approx. 6 cm – 12 cm (2.5 – 5 inches) and can live for over 100 years.
- Suitable rivers are reasonably fast flowing, with very clean, good quality water, gravel bed, preferably with large cobbles.

Not to be confused with Duck & Swan Mussel

- Egg-shaped shells 12 -16cm (5-6 inches) long.
- Thin shiny shells, usually brownish yellow with traces of green.
- Found in slow moving water.
- If encountered, contact area Foreman and return Mussels to channel.
- Record location of Mussels on time card

Measures to reduce the risk of spread of invasive species

All excavators, weed cutting boats, tractors, dumpers & other machinery employed on maintenance must be thoroughly cleaned down using a power washer unit prior to being;

(a) transported by Low- Loader

(b) moving to another catchment within the Region

(c) moving to another Region.

Notify your supervisor immediately if you see any of the invasive species listed.

Full details of all species are available in the CFB's Field guide to the Identification of Aquatic Invasive Species

Giant Hogweed

Found on the banks of many rivers througho
Ireland.
Can grow to a height of 4 metres.
Seeds are carried by water and spread ve
quickly.
!!!Avoid contact with the sap of this plant
it can cause extensive lesions or blistering
the skin.

Japanese Knotweed

Grows up to 2-3m in height along roadsid
and river corridors throughout the country.
Even a tiny piece of this plant can produce
new plant.
Leaves are heart-shaped with a pale stri
down the centre.
In Summer cream flowers arise from the ti
of the red-flecked stems.

Himalayan Balsam

Grows in dense strands up to 3m high, and is fou
widespread across Ireland along banks of rivers.
Seed pods explode scattering seeds.
Dies back in Autumn exposing bare banksides
erosion.
White or pink flowers, smooth hollow stem, ov
shaped pointed leaves with jagged edges.

Curly waterweed – *Lagarosiphon major*

Found in lakes and slow flowing waterways up to 6m deep.
Spread by fragmentation from one watercourse to another on
boat hulls, trailers, outboard motors or angling equipment.
Significant weed stands located in Lough Corrib.

Zebra Mussels

Distinctive stripy shell, very small (1-3cm).
Attach in clusters to hard surfaces – boats, pipes, buoys.
Refer to the Zebra Mussel Standard Operating Procedure.

All photographs courtesy of Central Fisheries Board

Actions for Maintenance Operations

1) Zebra Mussels detected on site

- Where Zebra Mussels are found, remark on the extent of Mussels on the Weekly Report Card and notify the Foreman/Technician.
- Technicians/Engineers to notify Environment Section of location and grid reference.
- Environment Section to update the National Database.

2) Maintenance close to R. Shannon or infested lakes

- Where a machine is working close to the R. Shannon or an infested lake, ensure that prior to the machine transferring to a new site, buckets and tracks are thoroughly cleaned of any material such as silt or vegetation.
- Ganger / Driver to visually inspect the bucket, tracks and any equipment that was in the water to ensure no Mussels are present.

3) Maintenance close to outlets/inlets of any lakes

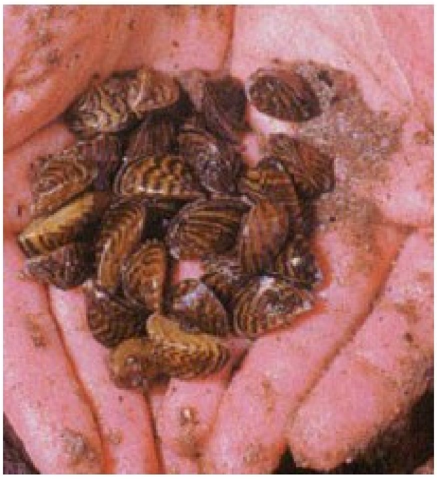
- Where a machine is working close to any lake, ensure that prior to machine transferring to a new site, buckets are clean of any material such as silt or vegetation.
- Ganger / Driver to visually inspect the bucket and other equipment that was in the water to ensure no Mussels are present.

4) Boats and other equipment

- Boats or other water based equipment that is to be transferred between river catchments should be thoroughly cleaned on the outside, drained of any bilge water and inspected for the presence of Mussels.
- If it's suspected that the equipment was in contact with Zebra Mussel waters, steam clean the hull and trailer and leave the boat or equipment out of water for four weeks prior to moving.

OPW Role

Although it is a relatively low risk, OPW could spread Zebra Mussels if aquatic vegetation or excavated material containing Mussels is inadvertently transported to another non-infested channel. Adult Mussels can survive for up to four weeks out of water hence its critical not to transport the same. Larvae are tiny and barely visible but will not survive on a machine bucket if there is no silt, stones or vegetation to shelter it.



Environmental Threat

Zebra Mussels are thumbnail-sized black & orange striped shellfish. They grow into dense clusters and attach to any underwater hard surface. They are an invasive species that damage the natural ecology of the infested waters. They expand into catchments through been transported by man's activities e.g. transferring fishing boats. Once in a particular lake or river, if conditions are favourable, they will multiply and spread with the currents. It is envisaged that they will keep expanding their territory unless man makes a concerted effort to prevent transport of the Mussels into non-infested waters.

OPW Site Audit Form

Region: ______________________ **CDS:** ______________________

Channel (name & code):______________ Section (chg – chg):______________

Foreman: ______________________ Driver(s): ______________________

Auditor: ______________________ **Date**:______________________

Site surveyed from- working bank: ☐ non-working bank: ☐

GPS Reference:______________________ Photographs: Yes ☐ No ☐

Weather Conditions:______________________ Water levels: ______________________

Wetted/Base width: 0-3m ☐ 3-6m ☐ 6-10m ☐ 10-15m ☐ >15m ☐

Velocity Rating: Slow ☐ Moderate ☐ Fast ☐ Torrential ☐

Bed Type: ______________________ Machine Number:______________________

OPW SOP AWARENESS / COMPLIANCE

Invasive Species SOP:	Poor / Fair / Good / Excellent
Protected Species SOP's:	Poor / Fair / Good / Excellent
Spill Kit Present:	YES / NO

Environmental Drainage Maintenance Constraints

Maintenance Constraints		Working Bank	Non Working Bank
Ownership:	Woodland		
Ownership:	Tillage		
Ownership:	Position of Fencing		
Availability of suitable stone			
Placement of spoil			
Time of year:	Tree cutting		
Time of year:	Wildlife		
Time of year:	Fisheries		
Potential Habitat for Annex II Species	Lamprey		
	Crayfish		
	Otter		
	Pearl mussel		
	Salmon		

Comments on Audit Findings

Maintenance Strategies Achieved - *(based on section recently maintained)*							
	Maintenance Options	Working Bank		Non-working Bank		Instream Channel	
		Suitability	Compliance*	Suitability	Compliance*	Suitability	Compliance*
1	**Protect Bank Slopes**						
	Non-working bank left intact						
	Protect working bank slope						
2	**Restrict Maintenance to Channel**						
	Restrict maintenance to open channel						
	Use of SOPs for lamprey and crayfish						
3	**Spoil Management**						
	Best practice placement of spoil						
	Spread spoil thinly						
	Let water drain from bucket over channel						
4	**Selective Vegetation Removal**						
	Manage instream vegetation (Attn SOPs)						
	Retain marginal vegetation both sides						
	Potential for weed cutting bucket						
	Outside coarse fish spawning *(April 1st to July 1st)*						
5	**Leave Sections Intact**						
	Sections skipped						
6	**Management of Trees**						
	Remove trees blocking flow						
	Observe tree cutting window						
	Remove low hanging branches to known flood level						
	Use chainsaw/secuters for tree removal or thinning						
	Tree thinning management						
	Manage scrub - Otter & Birds SOP						
7	**Manage Berms to form 2 Stage Channels**						
	Retain berms (no maintenance)						
	Top berm to just over summer water flow						
	Re-sod berms where suitable						
	Only narrow berms if OVER-WIDE						
8	**Replace Stone & Boulders**						
	Replace stone and gravel coming out in digging bucket (No New Diggings)						
	Replace large stones/boulders into channel from old spoil						
9	**Working in Gravel Bed Channels**						
	Loosen/toss gravels *(between July 1st & Sept. 30th)*						
	No instream works outside of Fisheries Window *(between July 1st & Sept. 30th)*						
	Use of silt barriers in winter/spring						
10	**Re-profile Channel Bed**						
	Dig pool - riffle sequences						
	Reprofile cross-section						
	Use existing stone to create 'simple' instream structures						

*based on rating system: 0-10, with 0=no compliance and 10=full compliance

	Working Bank	Non-working Bank	Instream Channel
Total Compliance (%)			

OVERALL COMPLIANCE (%)

Department of the Environment, Heritage and Local Government / An Roinn Comhshaoil, Oidhreachta agus Rialtais Áitiúil

National Parks & Wildlife Service (NPWS) / An tSeirbhís Páirceanna Náisiúnta agus Fiadhúlra, 7 Ely Place, Dublin 2.
Regional Information/Eolas Reigiúnach . . . . (01) 888 2000
Locall/Glaoch Áitiúil: 1890 20 20 21
Fax/Faics: . . . . (01) 888 3272
Internet/Idirlíon: . . . . www.npws.ie & www.environ.ie
E-mail/Ríomhphost: . . . . natureconservation@environ.ie

Eastern Division / Rannán an Oirthir
Divisional Manager: . . . . (01) 8883243
Divisional Ecologist: . . . . (01) 6678256

South Eastern Region/Réigiún an Oirdheiscirt
(Carlow, Kilkenny, Wexford & Wicklow (incl. Wicklow Mountains National Park))
Regional Office: . . . . (0404) 45800
Regional Manager: . . . . (0404) 45802
Deputy Regional Manager: . . . . (0404) 45801
Education Centre: . . . . (0404) 45656
Information Office (Wicklow Mtns Nt Park). . . . (0404) 45425
District Conservation Officer:
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District Conservation Officer:
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Regional Manager: . . . . (045) 520 622
Deputy Regional Manager: . . . . (045) 520 644
District Conservation Officer:
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District Conservation Officer:
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Western Division/Rannán an Iarthair
Divisional Manager: . . . . (091) 704 206
Divisional Ecologist: . . . . (091) 704 208

Western Region/Réigiún an Iarthair
(Mayo, Galway West)
Regional Manager: . . . . (095) 41054
Deputy Regional Manager: . . . . (098) 49996

District Conservation Officer: (Galway West) . . . . (095) 41054
District Conservation Officer: (Mayo). . . . . (098) 49996

Mid Western Region/Réigiún an Lár-Iarthair
(Clare, Galway (except Galway West above)
Regional Office: . . . . (091) 704200
Regional Manager: . . . . (091) 704 201
Deputy Regional Manager: . . . . (091) 870341
District Conservation Officer:(Clare). . . . . (065) 682 2711
District Conservation Officer:
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Divisional Ecologist: . . . . (021) 4619903

Mid Southern Region/Réigiún an Lár-Deiscirt
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Regional Manager: . . . . (067) 44287
Deputy Regional Manager: . . . . (021) 4619904
District Conservation Officer:
(East Cork, Tipperary SR & Waterford) . . . . (021) 4619905
District Conservation Officer:
(Limerick & Tipperary NR) . . . . (067) 44135

South Western Region/Réigiún an Iardheiscirt
(West Cork & Kerry)
Regional Office: . . . . (064) 31440
Regional Manager: . . . . (064) 70145
Deputy Regional Manager: . . . . (064) 70143
District Conservation Officer:
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District Conservation Officer:
(South & West Cork and South & West Kerry). . . (028) 37347

Northern Division/Rannán an Tuaiscirt
Divisional Manager: . . . . (071) 966 6020
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Northern Region/Réigiún an Tuaiscirt
(Donegal, Leitrim West & Sligo)
Regional Office: . . . . (074) 913 7090
Regional Manager: ... . (074) 972 1837
Deputy Regional Manager: . . . . (074) 913 7090
District Conservation Officer:
(Donegal Nth & Glenveagh National Park) . . . (074) 913 7440
District Conservation Officer:
(Donegal, Leitrim West & Sligo) . . . . (071) 966 6178

North Midlands Region/An Réigiún Lár Tíre Thuaidh
(Cavan, Leitrim East, Longford, Monaghan, Roscommon & Westmeath)
Regional Office: . . . . (071) 9666178
Regional Manager: . . . . (071) 966 6934
Deputy Regional Manager: . . . . (044) 934 2661
District Conservation Officer:
(Cavan, Leitrim, Longford & Monaghan) . . . . . (049) 433 5750
District Conservation Officer:
(Roscommon & Westmeath) . . . . (044) 933 7007

National Parks & Nature Reserves/Páirceanna Náisiúnta
Ballycroy National Park County Mayo, Lagduff More, Ballycroy, Westport, Co. Mayo. . . . . (098) 49996
Burren National Park, NEPS Building, St. Francis Street, Ennis, Co. Clare . . . . (065) 6822662
Connemara National Park, Letterfrack, Co. Galway . . . . (095) 41054
Coole Park Nature Reserve, Gort, Co. Galway . . . . (091) 631 804
Glenveagh National Park, Church Hill, Letterkenny, Co. Donegal . . . . (074) 9137090
Killarney National Park, Muckross House, Killarney, Co. Kerry . . . . (064) 31440
Wexford Wildfowl Reserve, North Slob, Wexford . . . . (053) 9123129
Wicklow Mountains National Park, Kilafin, Laragh, Co. Wicklow . . . . (0404) 45800

Inland Fisheries Ireland March 2011

IFI Region	Director	Address	Telephone	Region/Scheme
IFI Blackrock	William Walsh	15a Main Street Blackrock Co. Dublin	01 2787022	East: Glyde & Dee, Boyne, Blackwater, Bally-Teigue
IFI Ballina	John Connelly	Ardnaree House Abbey Street Ballina Co. Mayo	096 22788	West: Moy, Bonet
IFI Ballyshannon	Dr. Milton Matthews,	Station Road Ballyshannon Co. Donegal	071 9851435	West: Donegal schemes, Kilcoo, Duff
IFI Limerick	Sean Ryan	Ashbourne Business Park Dock Road Limerick	061 300238	East: Inny, Brosna West: Boyle, Ballyglass South: Killimor, Carrighahorig, Nenagh, Groody, Maigue, Deel, Feale
IFI Macroom	Dr. Patrick Buck	Sunnyside House, Macroom Co. Cork	026 41221	South: Maine, Owvane
IFI Clonmel	Suzanne Campion	Anglesea Street Clonmel Co. Tipperary	052 80055	East: Brickey
IFI Galway	Amanda Mooney	The Weir Lodge Earl's Island Galway	091 563118	West: Corrib Headford, Mask,
IFI	Dr. Ciaran Byrne	Unit 4 Swords Business Campus Balheary Rd Swords Co. Dublin	01 8842600	All
EREP Project Manager	**Dr. Karen Delanty**	**Unit 4 Swords Business Campus Balheary Rd Swords Co. Dublin**	**01 8842624**	**All**

(Note: Completed flood relief schemes are not listed but proposed works should be discussed with the relevant local IFI)

OPW Bridges (numbering 170) intersecting National Primary Roads.

Scheme	Channel ID	Bridge No.	National Route type	Bridge Name
Glyde and Dee	C2 (7C)	B80	N01	
Glyde and Dee	C2 (7E1)	B839	N01	
Glyde and Dee	C2 (7E1)	B840	N01	
Broadmeadow and Ward	C2/1	B230	N02	
Broadmeadow and Ward	C2/1	B239	N02	
Broadmeadow and Ward	C2	B204	N02	Coolatrath br.
Broadmeadow and Ward	C2/3	B243	N02	
Broadmeadow and Ward	C1/6/1	B86	N02	
Broadmeadow and Ward	C1/6/1/1	B96	N02	
Broadmeadow and Ward	C1/6	B68	N02	
Broadmeadow and Ward	C1	B16	N02	
Boyne	C1	B4	N02	Slane br.
Glyde and Dee	C2 (7H)	B101A	N02	
Glyde and Dee	C2 (17)	B179	N02	
Glyde and Dee	C2 (14B)	B118	N02	
Glyde and Dee	C2 (14)	B867	N02	
Glyde and Dee	C2 (1)	B30	N02	
Glyde and Dee	C2 (13)	B111	N02	
Glyde and Dee	C2 (16B4)		N02	
Glyde and Dee	C1 (1)	B15	N02	Aclint Br
Glyde and Dee	C29 (2)	B441	N02	
Glyde and Dee	C29 (3)	B443	N02	
Glyde and Dee	C25 (8)	B341	N02	
Glyde and Dee	C25 (7D1)	B672	N02	
Monaghan Blackwater	C1/1/5	B7	N02	
Monaghan Blackwater	C1/1/5/6/1	B1	N02	
Monaghan Blackwater	C1/3/5/2	B8	N02	
Monaghan Blackwater	C1/3/6/3	B1	N02	Hoaf Br
Boyne	C1/8/24	BX1	N03	
Boyne	C1/8/23	B733	N03	
Boyne	C1/8/21	B723	N03	
Boyne	C1/8/16	B644	N03	
Boyne	C1/8	B126	N03	Clavens Br
Boyne	C1/8/8	B294	N03	
Boyne	C1/12/1	B875	N03	Dillon's Br
Boyne	C1/12/7	B915	N03	
Owenmore	Behy Bridge	BX1	N04	
Boyle	C6/7/5	B2	N05	Ballanagare Br
Boyle	C6/7/1/4	B2	N05	
Boyle	C6/7/1	B3	N05	Cloonshanville Br
Boyle	C1/3/2/1	B4	N05	
Boyle	C1/9/1	B1	N05	
Boyle	C1	B4	N05	Old Lung Bridge
Boyle	C1/8	B1	N05	New Lung Bridge
Boyle	C1/45	B8	N05	
Moy	C1/31/2	B3	N05	
Moy	C1/31	B4	N05	
Moy	Not on a channel	B2	N05	Trimoge
Moy	Not on a channel	B2	N05	
Moy	Not on a channel	B1	N05	
Moy	C1/30/3/1	B1	N05	
Moy	C1/28/2	B3	N05	
Moy	C1/28/1	B4	N05	
Moy	C1/25	B6	N05	
Moy	C1/23/3	B2	N05	
Moy	C1/23	B9	N05	
Moy	Not on a channel	B1	N05	
Moy	C1/21/1/5/2/2	B3	N05	
Moy	C1/21/1/5/2/11	B2	N05	
Moy	C1/21/1/5/1/15	B1	N05	

Moy	C1/21/1/5/2/18	B1	N05	
Moy	C1/21/1/5/2/19	B2	N05	
Moy	C1/21/2/5/2/20/4	B1	N05	
Boyle	C1/44/15	B2976	N06	
Boyle	C1/44/17	B2984	N06	
Boyle	C1/64/1/11/6	B3337	N06	
Boyle	C1/64/1/11	B3303	N06	Miltownpass Br.
Boyle	C1/64/1/11/4	B3319	N06	
Boyle	C1/64/1/11/4/2	B3331	N06	
Boyle	C1/64/1/13/2	B3330	N06	
Boyle	C1/64/1/13	B3372	N06	Rochfort Br.
Boyle	C1/64/1/13/4	B3384	N06	
Brosna	C27 (1)	B150	N06	
Brosna	C1 (1)	B11	N06	Kilbeggan Br.
Brosna	C17 (1)	B143	N06	
Brosna	C17 (SE)	B726	N06	
Brosna	C17 (5)	B138	N06	New Br
Brosna	C17 (4)	B135	N06	
Corrib Clare	C1	B3	N06	Quincentennial Br.
Nenagh	C1/9	B23	N07	Ollatrim Br
Nenagh	C1/9/24	B4	N07	
Monaghan Blackwater	C1/1/6/1	B11	N12	Tyholland Br
Blanket Nook	C1/3	B23	N13	
Swilly embankments	E9	B1	N14	
Swilly embankments	C1/5	B9	N14	
Deele and Swillyburn	C1	B6	N14	
Deele and Swillyburn	C1/11	B19	N14	
Deele and Swillyburn	C2	B20	N14	
Abbey	C1/4	B39	N15	
Abbey	C1/4	B31	N15	
Abbey	C1/3A	B30B	N15	
Abbey	C1/2	B21 - B23	N15	
Abbey	C1/1	B18	N15	
Duff	C1	B1	N15	
Bonet	C1/12/3	B1	N16	
Bonet	C1/12	B5	N16	
Bonet	C1/12	B4	N16	
Bonet	C1/12	B2	N16	
Bonet	C1	B5	N16	
Bonet	C1/13/2	B1	N16	
Bonet	C1/13	B1	N16	
Moy	C1/50/2	B3	N17	
Moy	C1/50	B4	N17	
Moy	C1/48/3	B2	N17	
Moy	C1/48	B3	N17	
Moy	C1/45/4	B2	N17	
Moy	C1/45	B13	N17	
Moy	C1/30/5/9	B3	N17	
Moy	C1/30/5/9	B15	N17	
Corrib Mask	CM4/43/4	B2	N17	
Corrib Mask	CM4/34	B10	N17	
Corrib Mask	CM4/34/2	B2	N17	
Corrib Clare	C3/30	B8	N17	
Corrib Clare	C3/30/4	B1	N17	
Corrib Clare	C3/26	B2	N17	
Corrib Clare	C3/26/9	B1	N17	
Corrib Clare	C3/26/1	B3	N17	
Corrib Clare	C3/12/2	B1	N17	
Corrib Clare	C3	B14	N17	
Corrib Clare	C3	B2	N17	Claregalway bridge
Fergus	D7	B3	N18	
Owenagarney	C2	B1	N18	
Owenagarney	C4	B3	N18	
Coonagh Embankments	C10	B9	N18	

Coonagh Embankments	D13	B113	N18	
Coonagh Embankments		B1	N18	
Maigue	C1/36	B1	N20	Helena's br.
Maigue	C1/37/1	B3	N20	
Maigue	C1/37	B1	N20	
Maigue	C1	B23	N20	Creggane br.
Maigue	C1/33	B1	N20	Cappanafaha br.
Maigue	C1/30	B2	N20	Ballynabanoge br
Maigue	C1/26	B1	N20	
Maigue	C1/15	B10	N20	
Maigue	C1/10/5	B3	N20	
Maine	C1/28	BX1	N21	
Maine	C1/34	B117	N21	
Maine	C1/35	BX2	N21	
Deel SR	C12/2/2	B125	N21	
Deel SR	C12/2/2/2	B127	N21	
Deel SR	C12/2/1	B123	N21	
Deel SR	C10	B95	N21	Ballyfraley br.
Deel SR	C8	B76	N21	Reens br.
Maigue	C1/17/10	B1	N21	
Maigue	C1/17/8	B2	N21	
Maigue	C1/17/5	B1	N21	
Maigue	C1	B1	N21	Adare br.
Maigue	C1/15	B5	N21	
Maine	C1	B3	N22	Maine br.
Maine	C1/32	B110	N23	Dysert br.
Maine	C1/33	B114	N23	Killfinnaun br.
Maine	C1	B9	N23	Herbert br.
Groody	C1/4	B29	N24	
Groody	C1	B4	N24	
Groody	C1/7	B53	N24	
Groody	C1/9	B56	N24	
Moy	C1/9/1	B1	N26	
Moy	C1/9	B2	N26	
Moy	F/282	B	N26	
Moy	C1/14	B1	N26	
Moy	RIVER	B3	N26	
Moy	C1/37	B1	N26	
Moy	C1/38	B1	N26	
Moy	RIVER	B2	N26	Cloongullaun br.
Moy	C1/39	B3	N26	
Moy	C1/39	B6	N26	
Moy	C1/39	B9	N26	
Moy	C1/39/3	B1	N26	

Otter Wildlife Passes and OPW Drainage Channels

- It has been brought to the attention of the OPW that there may be a need for small mammal passes on some of the maintained channels.

- The National roads constitute less than 6 percent of roads in this country, approx. 3 National Primary and 3 percent National Secondary. In spite of this they a carry over 42 percent of the traffic. It is for this reason that the focus will be on the National Primary road crossings.

- The national road kill survey was analysed and the data from the web site "www.biology.ie" was cross-referenced against OPW channel locations and the results were inconclusive, as the web page is not widely used. It appears for now that OPW channel road crossings have no affect on the deaths of otters as per this information.

Next Steps:

1) Consult NPWS throughout all regions to review any evidence of otter road kills on National Primary roads or are they aware of any other such road deaths.

1. Where there appears to be mammal deaths on National Primary roads that intersect OPW channels it will be seriously considered to install in the bridge (where possible) a small mammal pass to allow ease of access for otters.

Otter Habitat Disruption

- Otters, along with their breeding and resting places, are protected under the provisions of the Wildlife Act, 1976, as amended by the Wildlife (Amendment) Act, 2000. They are also included in Annex I and Annex IV of the Habitats Directive, which is transposed into Irish Law in the European Communities (Natural Habitats) Regulations (S.I. 94 of 1997), as amended.

Otter Pass Details

- Mammal Ledges and underpasses should be constructed parallel to the watercourse.
- Underpasses should be of a diameter of 600mm up to a length of 20m. Where lengths exceed this the pipe should be increased to 900mm diameter
- An underpass should be no more than 50m of the watercourse with channels or fencing guiding the animals to it.

Where there is sufficient space under the bridge for a ledge the following should be provided:

- Fencing: See "figure 1; Specification for Mammal Resistant Fencing" in the NRA, National Roads Authority, Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes, for more detail. Also, Design Manual for Roads and Bridges, DMRB Volume 10, Section 1, Part 5, Chapter 9.
- A bolt on ledge can be used under a bridge where there is no dry passage. The bolt on ledge should provide otters with a dry walkway of between 300mm and 450mm wide, constructed from 4.5mm Durbar patterned galvanised plate.
- At some sites, considerations of responsibility, cost, aesthetics or practicality might indicate the use of a solid ledge; this is most likely where an existing otter-ledge has proved to be sited too low to offer dry passage at spate conditions. A solid ledge can be created in 3 ways; concrete bagging, shuttering plus new concrete and concrete blocks.
- See (OPW, 2007), (DMRB, 2001) and (NRA 2006) for further Details

References

- NRA (2006) – National Roads Authority, Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes.
- NRA (2005) – National Roads Authority, Guidelines for the Crossing of Watercourses During the Construction Of National Road Schemes.
- OPW (2007) – Series of Ecological Assessments on Arterial Drainage Maintenance No. 4, Ecological Impact Assessment (EcIA) of the Effects of Statutory Arterial Drainage Maintenance Activities on the Otter (Lutra lutra).
- OPW (2006) – Screening of Natura 2000 Sites for Impacts of Arterial Drainage Maintenance Operations. Environment Section, Engineering Services, Office of Public Works.
- DMRB (2001) - Design manual for roads and bridges (DMRB). Volume 10, Section 4 Environmental Design and Management Nature Conservation. Part 4 HA 81/99 Nature conservation advice in relation to otters. Section 1, Part 9 HA 81/99.