

# SERIES OF ECOLOGICAL ASSESSMENTS ON ARTERIAL DRAINAGE MAINTENANCE No 8

## Ecological Impact Assessment (EcIA) of the Effects of Statutory Arterial Drainage Maintenance Activities on Turloughs (EU Code 3180)



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## Foreword

This Ecological Impact Assessment follows on from the strategic approach outlined in  
**“Series of Ecological Assessment on Arterial Drainage Maintenance No. 1: Screening of NATURA 2000 Sites for Impacts of Arterial Drainage Maintenance Operations.”**

It examines the impacts of statutory arterial drainage maintenance activities on turloughs, outlines measures to mitigate any negative impacts, and possible enhancement opportunities.

### **Environment Section**

# **Ecological Impact Assessment of the Effects of Statutory Arterial Drainage Maintenance Activities on Turloughs**



Shrute Turlough swallow hole July 2007

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## **Executive Summary**

The objective of this ecological impact assessment is to determine the effects of statutory arterial drainage maintenance activities on protected Turlough habitats in accordance with Section 31 of the European Communities (Natural Habitats) Regulations, 1997. Annex I of the Regulations refers to natural habitats of European interest that require legal protection and referred to as Special Areas of Conservation. Designated as a priority habitat type, Turloughs are provided such legal protection.

Turlough or tuar loch, meaning dry lake in Irish, have been described by Goodwillie, 1992 as temporary waterbodies highly influenced by groundwater levels and rainfall. The changes in water levels in Turlough habitats lead to the creation of lakes in winter and reappearance of grassland during summer months with receding lake waters.

In total six Special Areas of Conservation were assessed. Five of the Turloughs surveyed were historically associated with arterial drainage schemes while a sixth Turlough (Thomastown Turlough) was subject to localised flood relief works. A further three Natural Heritage Areas surveyed were included in the survey as they are representative of Turlough habitats subject to scheduled arterial drainage maintenance or flood relief works

The report concludes the following:

- Based on the ecological survey the current arterial drainage maintenance regime should pose no ecological threat to Levally Lough Turlough, Lisnageeragh Bog and Ballinastack Turlough and Rosstaff Turlough.
- Arterial drainage channels proposed for Lough Lurgheen Bog/ Glenamaddy Turlough 00301 and Carrowkeel Turlough 00475 were never excavated. Scheme maps for both these Turloughs need to be updated.
- A survey of the site revealed that the flood peak management works at the ecological limit of the Turlough does not affect the integrity of Thomastown Turlough
- Ecologically, Shrute Turlough was found to be quite diverse and compared favourably with previously documented plant species. Exposed marl at Killower Turlough provided orchids and insectivorous plants with a suitable habitat.
- At Belclare Turlough, however, any further arterial drainage works to be undertaken in future for flood relief or flood management will need to be carefully assessed as there is a probable risk that such works would have a negative impact on the Turlough habitat.

## **1.0 Introduction**

This study was commissioned by the Office of Public Works in 2007 to assess the ecological impact of Arterial Drainage Maintenance activities on Turloughs. The report is entitled

“Ecological Impact Assessment of the effects of statutory Arterial Drainage maintenance activities on *Turloughs EU code 3180*”. This is a detailed study which has been carried out as part of the framework set out in the Office of Public Works document “Screening of Natura 2000 sites for Impacts of Arterial Drainage Maintenance Operations” Office of Public Works, 2007. In this study Turlough habitats are identified as a habitat of ecological importance.

In this chapter a history of the Office of Public Works and an overview of current practices will be provided. The current legal obligations and commitment to environmental policy as published in the Office of Public Works framework document will be identified. An overview of current European and National legislation for habitat and species protection will be considered.

The final section of this chapter will outline the objective of this report. Details of the project brief, the assessment criteria employed during the course of ecological survey and the Turlough sites chosen are provided.

### **1.1 Historical Background and functions of statutory arterial drainage maintenance**

In 1842 arterial drainage schemes were commenced, under the Drainage (Ireland) Act, 1842, providing drainage loans to facilitate the drainage of land. The Great Famine of 1846 led to an increase in the rate of arterial drainage schemes, as did the Landed Property Improvement Act, 1847, in the West of Ireland (National Archives of Ireland). A number of other acts dealing with drainage works and drainage maintenance were passed between 1863 and the early 1930s.

The government established the Browne Commission, which deliberated in the period 1938 – 40 and produced a comprehensive plan to deal with drainage and flooding for Ireland. The Arterial Drainage Act, 1945 included many of these recommendations. Under this act the Commissioners of Public Works were enabled to carry out schemes on a whole catchment to prevent or substantially reduce periodic flooding and to improve drainage of land, with the main motivation to improve agricultural productivity. In the late 1980s and early 1990s, it became apparent that, while it was not cost beneficial to carry out drainage works on entire catchments, there were still significant localised flooding problems. The Arterial Drainage (Amendment) Act, 1995 addressed this issue by allowing for localised flood relief schemes.

Office of Public Works schemes completed between 1945 and 1995 include:

- 34 arterial drainage schemes on river catchments
- 5 estuarine embankment schemes (benefiting 650,000 acres of land)
- 11,505km of rivers and streams, collectively known as channels
- 733 km of tidal and river embankment
- 18,500 bridges. A significant portion of these bridges are road bridges where Local Authorities are responsible for the structural integrity and the Office of Public Works is responsible for flood conveyance.
- 742 sluices
- 9 pumping stations (Office of Public Works website).

## **1.2 Legal and policy context for this ecological assessment**

A series of legal instruments i.e. European Directives and National Regulations have been developed to preserve, protect and conserve species diversity within European Union (EU) member states. The Wildlife Act, 1976 was passed to conserve and protect both flora and fauna by developing wildlife refuges associated with land, inland waterways and marine environments. The Birds and Habitats Directives (Council Directives 79/409/EEC and 92/43/EEC), provide protection for wild birds in the European Union, and provide for the development of a network of protected ecological habitats (Natura 2000). In 1997, both Directives were transposed to Irish law in the European Communities (Natural Habitats) Regulations, 1997, which provides a legal framework for the conservation of habitats and species (National Parks and Wildlife Service website).

Section 31 of European Communities (Natural Habitats) Regulations, 1997, requires that many works undertaken by the State within a European site by a minister of government or the Commissioners must undertake an appropriate assessment outlining the impact of the work with respect to the conservation aspect of the site. In 2007 the Office of Public Works published a report titled “Screening of Natura 2000 Sites for Impacts of Arterial Drainage Maintenance Operations”. The screening report outlines the strategic approach to fulfilling the legal requirement of environmental assessment prior to works undertaken by the Office of Public Works in European sites. By cross-referencing channels within European protected sites with conservation aspects, a series of ecological impact assessments have been identified with respect to species or habitat protection.

Universally referred to as Biodiversity, the three basic elements for biological diversity are species population, genetic diversity within populations and the habitat to



support species populations (Eanna Ni Lamhna, 2007). Since 1997 The European Communities (Natural Habitats) Regulations, 1997 has been amended to provide a more comprehensive level of protection in 1998 and 2005. Additional protection was afforded to listed floral species under the Flora (Protection) Order, 1999 with the Wildlife (Amendment) Act, 2000 provided enhanced legal protection for species and habitats (National Parks and Wildlife Service website).

### **1.3 Objective and scope of the study**

This ecological assessment entitled “Ecological Impact Assessment of the effects of statutory Arterial Drainage maintenance activities on *Turloughs EU code 3180*” has been commissioned by the Office of Public Works to comply with European legislation, namely European Communities (Natural Habitats) Regulations, 1997. This requirement was listed in the Office of Public Works report titled Screening of Natura 2000 Sites for Impacts of Arterial Drainage Maintenance Operations. Turloughs designated as Special Areas of Conservation (SAC) and or Special Protected Areas (SPAs) subject to arterial drainage maintenance activity require an appropriate assessment, for works or operations, which are likely to have a significant effect on the conservation aspect of the site (Section 31 of the European (Natural Habitat) Regulations, 1997)

The objective of this ecological impact assessment was to determine the effects of statutory arterial drainage maintenance activities on protected Turlough habitats in accordance with Section 31 of the European Communities (Natural Habitats) Regulations, 1997. Each Turlough was ecologically assessed in terms of:

- Protected species and habitat
- Turlough dynamics both physical and ecological
- Impact of Arterial Drainage Maintenance activity on Turlough ecology.

To objectively determine the ecological impact of arterial drainage activity on Turlough habitats and associated protected species, a survey of Office of Public Works drainage channels within designated Turlough areas was undertaken including all accessible channels detailed on Office of Public Works maps Appendix I. A restricted ecological survey was carried out at Glenamaddy Turlough due to the high water levels experienced during the summer months of July and August.

In total six Special Areas of Conservation were assessed. Five of the Turloughs surveyed were historically associated with arterial drainage schemes while a sixth Turlough

(Thomastown Turlough) was subject to localised flood relief works. A further three Natural Heritage Areas surveyed were included in the survey as they are representative of Turlough habitats subject to scheduled arterial drainage maintenance or flood relief works. Rosstaff, Belclare and Killower Turloughs have been designated as Natural Heritage Areas under the Wildlife Amendment Act, 2000. Inclusion of these Turloughs in this study reflects the importance of these habitats nationally.

The information collected during the course of the survey included species lists, land use, evidence of arterial drainage maintenance and the presence or absence of freshwater at each Turlough site. A literary review of Turlough data, discussions with members of Statutory Bodies and landowners provided an additional insight into Turlough dynamics.

## **2.0 Description of the Special Area of Conservation**

Special Areas of Conservation were legally established as nature refuges under Article 3 of the Habitats Directive (Council Directive 92/43/EEC). The purpose of this legislation was to develop an ecological network of Special Areas of Conservation across all European Union states that collectively would be known as Natura 2000.

Turlough or tuar loch, meaning dry lake in Irish, refers to the fluctuating water level observed in Turlough habitats. Turloughs are often described as temporary waterbodies which are highly influenced by groundwater levels and rainfall. In winter this leads to lake formation and its disappearance in summer when water volumes are reduced (Goodwillie, 1992).

Six of the nine Turlough habitats surveyed for this ecological impact assessment have been designated as Special Areas of Conservation. The other three have been designated as Natural Heritage Areas based on the Scientific Interest associated with each site (Natura 2000).

## **2.1 Description of conservation aspects**

Detailed in the European Council Directive 92/43/EEC under a series of Annexes are habitats, flora and fauna and the designation criteria for Special Areas of Conservation. The Annex listed from I to VI are described below:

- Annex I: “Natural habitat types of community interest whose conservation requires the designation of Special Area of Conservation”. This includes priority habitats for example Turloughs and important habitats which are non-priority habitats.
- Annex II: “Animal and plant species of community interest whose conservation requires the designation of a Special Area of Conservation”. All species listed in Annex II are deemed to be of ecological significance to Europe therefore they and their habitats are designated as Special Areas of Conservation.
- Annex III: “Criteria for selecting sites eligible for identification as sites of community importance and designation as Special Areas of Conservation”. This is a two stage process with stage 1 assesses the relative importance of Annex I habitats and Annex II considers species on a national scale. Stage 2 assesses the findings of stage 1 in a European context.
- Annex IV: “Animals and plant species of community interest in need of strict protection”. This provides protection for the flora and fauna listed in Annex IV but

does not require that all habitats supporting these species to be designated as Special Areas of Conservations.

- Annex V: “Animal and plant species of community interest that taking in the wild may be subject to management measures”. Under Irish Law, namely the Habitats Regulations 1997, a license is required for activities that result in species management.
- Annex VI: “Prohibited methods of capture and killing and modes of transport”. This applies to the transportation and movement and proper treatment of animal and birds.

Designated as a priority habitat, Turloughs are provided legal protection under Annex I of the European Council Directive 92/43/EEC. In a European context a similar habitat to Turloughs is that of glacial hollows, for example poljes in Yugoslavia. In South Wales a similar habitat to that of the Turloughs has been reported on limestone bedrock, however this habitat differs from Irish Turloughs as the marginal areas of the habitat are devoid of buckthorn and whitethorn, they lack Turlough black moss and grazed vegetation (Trinity College Dublin Botany website).

Tabulated below are the Turlough habitats surveyed as part of this ecological report. The European site code, Turlough name, conservation status and habitat details are listed. Of the nine sites surveyed six are designated as Special Areas of Conservation and three as Natural Heritage Areas.

<b>Site Code</b>	<b>Site name</b>	<b>Conservation status</b>	<b>Priority habitats (EU habitat code)</b>
0295	Levally Lough	Special Area of Conservation	Turlough (3180)
0296	Lisnageeragh Bog and Ballinastack Turlough	Special Area of Conservation	Turlough (3180) Active Raised Bog (7110)
0301	Lough Lurleen Bog/ Glenamaddy Turlough	Special Area of Conservation	Turlough (3180) Active Raised Bog (7110)
0475	Carrowkeel Turlough	Special Area of Conservation	Turlough (EU 3180)
0480	Thomastown Turlough (Clyard Kettle-Holes)	Special Area of Conservation	Turlough (3180) Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i> (7210)
0525	Shrule Turlough	Special Area of Conservation	Turlough (3180)
0234	Belclare Turlough	Natural Heritage Area	Turlough (3180)

Site Code	Site name	Conservation status	Priority habitats (EU habitat code)
0282	Killower Turlough	Natural Heritage Area	Turlough (3180)
0385	Rosstaff Turlough	Natural Heritage Area	Turlough (3180)

Table 1 A list of Turlough habitats surveyed and designation status.

## 2.2 Site evaluations

Turloughs are often described as fluctuating or seasonal lakes with water levels higher in winter than in summer. For some Turlough habitats the winter lake is replaced by a dry field ideal for grazing, whereas other Turlough retain a level of water all year round. Other characteristics associated with Turlough habitats surveyed include the deposits of white marl, the random scatter of large boulders towards the centre of the lake area and the exit hole for the lake water otherwise known as a swallow hole (Goodwillie, 1992). Details of the conservation status of the Turloughs surveyed are provided below (Natura, 2000; National Parks and Wildlife Service).

### 2.2.1 Levally Lough 000295

Levally Lough has been described as a fluctuating lake or Turlough, an Annex I priority habitat. Although the water level at Levally Lough changes seasonally, a quantity of water is retained in the Turlough annually. A stream to the north east feeds into the Turlough.

Levally Lough is important for waterfowl and winter migratory birds. The Golden Plover, an Annex I species of the Birds Directive, has been recorded at the site. Birds recorded at the Turlough in summer months include Mallard, Coot, Moorhen, Lapwing and Black-headed Crow.



Fig. 1 Levally Lough from a north east to south direction (August 2007)

### **2.2.2 Lisnageeragh Bog and Ballinastack Turlough 000296**

Two Annex I priority habitats occur at this site, active raised bog and Turlough habitat. The Turlough habitat is influenced by the mineral rich groundwater and peat deposits from the adjoining raised bog habitat. In winter the flooded Turlough reaches the level of the base of the raised bog habitat. The Turlough is an important site for wintering waterfowl. Three bird species listed in Annex I of the Birds Directive, namely the Greenland White Fronted Goose, the Whooper Swan and the Golden Plover, have been recorded at the Turlough.



Fig. 2 A section of the Ballinastack Turlough containing water (August 2007)

### **2.2.3 Lough Lurleen Bog/ Glenamaddy Turlough 000301**

Lough Lurleen Bog / Glenamaddy Turlough Special Area of Conservation consist of a lake, raised bog (priority habitat) and a Turlough (priority habitat). The three habitats are closely linked with the raised bog feeding the lake which then flows into the Turlough. The water level in the Glenamaddy Turlough can rise quickly as a result of heavy rain and is prone to flash flooding.

Glenamaddy Turlough is a large Turlough covering in excess of 170 hectares. Four bird species listed on Annex I of the Birds Directive have been recorded at the Turlough, the Greenland White-fronted Goose, Bewick's Swan, Whooper Swan and the Golden Plover.





Fig. 3 The western edge of the Turlough in a north to south west direction (July 2007)

#### **2.2.4 Carrowkeel Turlough 000475**

Designated as a Special Area of Conservation Carrowkeel Turlough is categorised as an oligotrophic (nutrient poor) environment. The Turlough has been found to support a large selection of plant species probably due to the presence of standing water all year round.

Marsh stitchwort, considered to be a rare plant, occurs on the Turlough. A number of wintering wildfowl, including mallard and swans, regularly visit the Turlough. An ecological assessment of the Carrowkeel Turlough by Goodwillie (1992) concluded that the Turlough was an important site for aquatic flora.



Fig. 4 Carrowkeel Turlough from a north east to south west direction (August 2007).

### **2.2.5 Thomastown Turlough (part of Clyard Kettle Holes) 00480**

The Clyard Kettle holes consist of a number of lakes and Turlough systems. Physical difference between the Turloughs is reflected in the variety of plant communities associated with each site. Designated as a candidate Special Area of Conservation, the Clyard Kettle Holes consist of Cladium Fen and Turlough habitats, both priority Annex I habitats.

To the north of the Clyard Kettle holes in the Thomastown townland is the Thomastown Turlough. The Turlough surface area consists of moist improved grassland on the southern boundary of the Turlough and a wetter area to the north.



Fig. 5 Thomastown Turlough at the wetter northern end facing south (August 2007).

### **2.2.6 Shrile Turlough 000525**

Up to eighteen different plant communities have been recorded on the Shrile Turlough making it the second most diverse Turlough habitat. Of the plant communities present the Turlough supports the largest stand of dry Common Sedge (*Carex nigra*) of Irish Turloughs, the second largest population of Great Fen Sedge, the third largest population of Creeping Cinquefoil (*Potentilla reptans* species), and populations of wet annuals and rare plants such as Red Goosefoot (*Chenopodium rubrum*) and Northern Marsh Yellow Cress (*Rorippa islandica*).

The diversity of vegetation present at the Shrile Turlough is of ecological significance and consequently has been designated as a candidate Special Area of Conservation. Unlike other Turloughs little or no ornithological data is available.





Fig. 6 Shrle Turlough from a south to north west direction (July 2007).

### **2.2.7 Belclare Turlough 000234**

The Belclare Turlough is bordered by Belclare village to the south and Killower Turlough to the north. Designated as a proposed Natural Heritage Area, Belclare Turlough is an important site for Golden Plover and White-Fronted Greenland Geese, along with seven other wildfowl species during winter months. In summer no standing water is evident in the Belclare Turlough. A combination of peat and marl deposits in the northern part of the Turlough support a variety of plant species. To the south of the Turlough improved agricultural grassland is the dominant habitat.



Fig. 7 A view of Belclare Turlough in a south east to south west direction (July 2007).

### **2.2.8 Killower Turlough 000282**

The Killower Turlough lies to the north of the Belclare Turlough and Belclare village. The Killower Turlough is a proposed Natural Heritage Area as the Turlough is visited by Whooper Swan and Greenland White-Fronted Geese during winter months. A total of fourteen bird species have been recorded at the site.



Fig. 8 A view of Killower Turlough from south to north (August 2007).

### **2.2.9 Rosstaff Turlough 000385**

Designated as a proposed Natural Heritage Area, Rosstaff Turlough is situated north west of Headford on the Mayo side of the Black River. The site is of ornithological importance with Annex I bird species, namely the Golden Plover, Whooper Swan and Greenland White-fronted Geese, visiting the Turlough in winter. Other wildfowl that visit the Turlough include Teal, Lapwing, Mallard and Dunlin. Ringed Plover, Snipe, Tufted Duck, Pochard Grey Heron and Redshank have been known to breed at the site.



Fig. 9 Rosstaff Turlough looking north east from a south west viewing point (July 2007).

## **2.3 Site integrity**

In Turlough habitats water levels increase during the winter, and decrease during the summer. Flooding of Turloughs is linked to a number of factors such as the capacity of the swallow holes to transport water, climatic conditions, namely rainfall, the volume of water entering the Turlough system and the storage capacity of the Turlough. During the ecological survey both physical and biological parameters were observed. Physical parameters focused on evidence of human activity and the Turlough boundaries. Biological parameters included habitats (classified according to Fossitt, 2000), species diversity and the condition of Turlough ecology. See appendix II for site maps and associated channels.

### **2.3.1 Levally Lough 0295**

Habitats observed adjacent to Office of Public Works channel SG 30/3 were those of freshwater and grassland habitats. Improved agricultural grassland (GA1), the dominant habitat was grazed by sheep to the east of the site and heavily grazed by horses to the west. Freshwater habitats included a drainage ditch (FW4), namely the Office of Public Works channel and for the purpose of this report the aquatic environment of the Turlough basin, will be classified as Turlough habitat (FL6).

Land uses adjacent to the Turlough include the built environment consisting of roads which border two thirds of the Turlough boundary and a number of buildings. Crossing the Turlough grassland posts carrying electrical power lines were observed. Fences of post and wire denoted field boundaries.

### **2.3.2 Lisnageeragh Bog and Ballinastack Turlough 0296**

Grassland, woodland and freshwater habitats were recorded in the vicinity of the Turlough swallow holes. Wet grassland (GS4) was the dominant habitat surrounding the Turlough swallow holes. Freshwater habitats included a drainage ditch (FW4), not an Office of Public Works channel and the aquatic area evident within the Turlough swallow hole, Turlough habitat (FL6). Hedgerows (WL1) denoted Turlough field boundaries.

Although no animals were present on the Turlough field during the course of the survey it was evident that cattle had grazed the Turlough grassland. Hoof marks were evident in the exposed marl deposits adjacent to the Turlough swallow hole, the gradual recolonisation by ruderal plants of marl areas and the height of the number of flowering structures and seed heads of plants present would suggest that cattle grazed the field in early summer. Cattle and horses were observed grazing nearby fields. A single track, stone walls

and electrical pylons (in nearby fields) were the only evidence of human activity close to the Turlough.

### **2.3.3 Lough Lurleen Bog/ Glenamaddy Turlough**

Between the first visit to Glenamaddy Turlough on the 25<sup>th</sup> July and the last visit on the 21<sup>st</sup> August there was little apparent change in the water level at Glenamaddy Turlough. As the water was in close proximity to the road R362 it was assumed that the Turlough was close to its winter water level. Therefore, land use was based on the dry land surrounding the flooded Turlough.

Fen and grassland habitats were the dominant habitat types observed around the outer edge of the flooded Turlough. A rich fen and flush (PF1) habitat was recorded adjacent to the Office of Public Works channels SG 18/4/1 SG 18/4/2. Wet grassland was observed adjoining Office of Public Works channel SG 18/4/3. Scrub (WS1) was evident along the national primary road R362 at the top of the Office of Public Works drainage channel SG 18/4. The aquatic environment of flooded Turlough land will be referred to as Turlough (FL6) habitat.

The main activities were agricultural i.e. cattle grazing and turf cutting on surrounding bog land. The built environment surrounding the Glenamaddy Turlough included roads, houses, agricultural outhouses, a grave yard and other buildings in close proximity. Roads border two thirds of the Turlough boundary.

### **2.3.4 Carrowkeel Turlough**

Three main habitats were observed at Carrowkeel Turlough, dry-humid acid grassland (GS3), hedgerows (WL1) and Turlough (FL6). The sloping edges of the Turlough basin have been classified as dry-humid acid grassland due to the floral diversity and the dry land underfoot. At the base of the sloping land was the permanent freshwater area and recently flooded grassland which together will be classified as Turlough habitat (FL6). A hedgerow denoted the boundary to the east.

Cattle were grazing in a nearby field during the course of the survey. Speaking to the landowner on site it was mentioned that cattle regularly grazed the Turlough field as part of the management plans for the site as part of the Rural Environmental Protection Scheme (REPS). Although no duck hunting takes place these days the landowner did mention that ducks would have been hunted in times past. The built environment adjoining the Turlough included an access and county road. Houses and agricultural outhouses were in close proximity to the Turlough.

### **2.3.5 Thomastown Turlough (Clyard Kettle-Holes) 0480**

Habitats observed at Thomastown Turlough were hedgerow (WL1), improved agricultural grassland (GA1) and Turlough habitat (FL6). Hedgerows denoted the Turlough field boundary to the northwest of the site. Grassland adjoining the flooded Turlough land was classified as wet grassland. The freshwater area and land under Turlough flood will refer to as Turlough (FL6) habitat in flora and fauna listing (see Appendix).

Nearby fields were grazed by cattle and sheep during site investigations. No evidence of grazing was evident in the Turlough field. It is highly probable that the field was too wet for grazing during the summer months 2007. The absence of tree saplings in the Turlough field would indicate that flooding and grazing have restricted tree growth around the Turlough.

Stone walls, post and wire fencing and a drainage channel to the east of the Turlough reflect human activity. Roads and houses were observed in close proximity to the Turlough. During the survey period, flood relief work, carried out by the Office of Public Works, was in progress to redirect excess Turlough water from the Thomastown Turlough into a nearby arterial drainage channel. The drainage work is designed to manage peak flooding experienced and ease the threat of flooding experienced on roads and houses in the surrounding area.

### **2.3.6 Shrile Turlough 0525**

A variety of habitats were observed at the Shrile Turlough including grassland, peatland, freshwater and woodland habitats. Rich fen and flush (PF1) was the only peatland habitat adjoining Office of Public Works channels, located to the north of channel SM122/2 running perpendicular to channel SM122/2/1 and the far western point of channel SM122/2. Grassland on sloping ground to the south of channel SM 122/2/1 was categorised as dry-humid grassland (GS3). Improved agricultural grassland (GA1) was evident to the east of the Turlough and north of channel SM 122/1. All other grassland adjoining Office of Public Works channels was classified as wet grassland (GS4). Scrub (WS1) was the only woodland habitat adjacent to Office of Public Works channel. Scrub development was evident to the north of channel SM122/2 close to the bridge at Ballybackagh.



Freshwater habitats consisted of drainage ditches (FW4), reed and large sedge swamps (FS1) and reservoir (FL7) at Lough Lee. Office of Public Works channels (drainage ditches FW4), crossing Shrle Turlough were identified as SM 122/1, SM 122/2 and SM 122/2/1. The reed and large sedge swamps (FS1) was recorded directly north of the two swallow holes on the northern side of channels SM 122/1, SM 122/2. Rising flood waters were observed at Shrle Turlough between the month of July and August, from the initial site investigation (July) and the ecological survey (August).

Land use at Shrle Turlough includes drinking water abstraction at Lough Lee and agricultural activity. Along the northern section of the Turlough sheep were grazing the land while cattle grazed the land to the south around the swallow holes. To the west of the Turlough, on dry calcareous and neutral grassland, grass was being cut for silage.

Stone walls and post and wire fences were frequently observed on the Turlough denoting field boundaries. Local access roads provided access to Turlough fields while the N84 national road crosses over the east of the Turlough. Houses and agricultural out houses were observed in close proximity to the Turlough. A local authority building for drinking water abstraction is present at Lough Lee and a small cluster of houses lie to the north west of the Turlough.

#### **2.3.7 Belclare Turlough 0234**

Habitats observed at Belclare Turlough were primarily improved agricultural grassland (GA1), drainage ditches (FW4) and rising Turlough flood waters, Turlough (FL6) habitat. Office of Public Works drainage ditches are identified as channels SG 43/1 and SG 43/1/1. All grazed land adjoining Office of Public Works channels were categorised as wet grassland.

The land surrounding the Turlough swallow hole was heavily grazed by sheep and horses. Nearby fields were grazed by cattle. Stone walls and post and barbed wire fencing along with spoil heaps from drainage operations are indicative of human activity. The built environment comprise of Belclare village on the southern boundary and roads which run alongside and through land designated as part of the Belclare Turlough.

#### **2.3.8 Killower Turlough 0282**

Four habitat types were observed on the Killower Turlough, freshwater, woodland, peatland and grassland. Freshwater habitat consisted drainage ditches (FW4), Office of Public Works drainage channels C1 and SG 42/1. Peatland, namely rich fen and flush (PF1) was the

dominant habitat adjoining Office of Public Works channel C1. To the north of Killower Turlough at Office of Public Works channel SG 42/1 improved agricultural grassland was dominant.

Agricultural activity was dominated by cattle and sheep grazing land to the north west of Killower Turlough. Areas of improved grassland may have been cut for early silage making, but this has not been confirmed. Post and wire fencing denoted field boundaries. Some houses were observed along the edge of the Turlough while roads ran along the Turlough boundary and one across the Turlough in north east to south west direction.

### **2.3.9 Rosstaff Turlough 0385**

Habitat types associated with Rosstaff Turlough were grassland, freshwater, and woodland habitat. Freshwater habitats included eroding / upland rivers (FW1) the Black river, drainage ditches (FW4) namely Office of Public Works channels C4/4/1, C4/4/2, C4/5, C4/5/1 and the permanent Turlough aquatic environment, Turlough (FL6). Two types of grassland were observed wet grassland (GS4) to the south of channel C4/4/1 and improved agricultural grassland (GA1), to the north of channel C4/4/1 and adjoining channels C4/4/2, C4/5 and C4/5/1.

The land associated with Rosstaff Turlough is divided by the Black River. Land north and south of the river was grazed by cattle. Some improved grassland may have been reseeded this year. Drainage channels were fenced with post and wire fencing while stone walls denoted field boundaries. The built environment consisted of local access roads, housing adjacent to the Turlough and Ross Friary on higher land within the Turlough site.

## **2.4 Identification of other or linked environmentally sensitive aspects**

The single most influential parameter which is experienced by all the Turloughs is climate. Ireland's climate is dominated by the Atlantic Ocean, consequently the annual average temperature is about 9 °C, average rainfall ranges between 800mm and 2800mm and average wind speed on the northeast coast of 7 m/ sec with strong winds more frequent in winter. As described in section 2.2, a defining characteristic of Turlough habitats is the seasonal flooding of land most notably in winter time and often correlating with times of high rainfall. Rainfall figures for the northwest, west and southwest coast are generally higher than the rest of the country due to the south westerly winds from the Atlantic (Met Éireann website). Table 2 attempts to illustrate the potential impact of increased or decreased rainfall (water volume) on Turlough plant ecology.

Parameter	Impact on Turlough
Increased Water Volume	<ul style="list-style-type: none"> <li>• Increased submergence time, selective for flood tolerant and late flowering plant species.</li> <li>• Increased water depth favour aquatic plants</li> <li>• Reduction in light penetration, reduces plant photosynthesis</li> <li>• Potential for temperature differentials to occur within water bodies, selective pressure on plants.</li> </ul>
Decreased Water Volume	<ul style="list-style-type: none"> <li>• Reduced flooding in winter, drier in summer, selective towards terrestrial plant species</li> <li>• In absence of a critical flooding level, tree growth will proliferate</li> <li>• Reduced flooding time, increased area of land for agricultural use</li> <li>• A severe reduction in rainfall will result in the loss of Turlough flora and would impact negatively on Turlough habitats.</li> </ul>

Table 2 Impact of increased or decreased rainfall on Turlough habitats.

European Directive 2000/60 EC of the European Parliament and of the Council commonly known as the Water Framework Directive requires that all waters reach “good status” by 2015. As part of the Directive European states are obliged to protect all high status waters, prevent further deterioration of waters and restore degraded surface waters to a good status. For Turlough habitats “good water status” is achieved by meeting their Habitat Directive (HD) objective of “favourable conservation status” (National Summary Report (Ireland) 2005). The report identifies phosphorus input and water abstraction as the principle pressures contributing to the water deterioration associated with Turloughs.

Categorised as Ground Water Dependent Terrestrial Ecosystems (GWDTE), the quality of groundwater entering Turlough habitats can impact and ultimately alter Turlough ecology. High inputs of phosphorus can impact on oligotrophic ecosystems by creating nutrient rich or eutrophic habitats leading to a change in Turlough flora. Alternatively, over-abstraction of groundwater may reduce the volume of groundwater available thereby reducing the ecology limit of Turlough habitats. As discussed in a number of reports, delineating the extent of groundwater bodies in Turlough habitats has proved challenging due to the capacity of the limestone bedrock in conveying groundwater over an extensive area.

Other environmentally sensitive aspects are associated with individual Turloughs. At Shrle Turlough, the cessation of water abstraction from the Turlough at Lough Lee will bring about an increase in water volume entering the Turlough system. At Levally Lough drainage of the adjacent peatland for fuel extraction reduces the capacity of the land to hold water therefore increasing the volume of water entering the Turlough. For other Turloughs,



increasing the land availability for agriculture during the early growing season can provide good grazing land for livestock. At the Belclare Turlough infilling of adjacent lands could impact on Turlough dynamics.

### **3.0 Description of the maintenance operations carried out by Office of Public Works**

An ecological survey of Turlough lands adjoining Office of Public Works arterial drainage maintenance and flood relief channels was undertaken to determine the impact of the activities on Turlough habitats. As the summer of 2007 had been particularly wet, a very interesting mix of terrestrial and aquatic flora was observed.

Physical parameters associated with Turlough habitats were noted. Water levels, direction of flow, management of flow and exposed swallow holes were observed. Of interest was that modern buildings were much closer to the water, compared with the location of old ruins.

To understand the impact of arterial drainage maintenance and flood relief measures on Turloughs a knowledge of activities carried out to date is essential. More importantly the history behind the works needs should be considered in relation to Turlough management.

#### **3.1 Monitoring and measurements completed (Methodology)**

Site selection was undertaken by cross referencing Office of Public Works channels with Turlough habitats designated as a conservation sites. A preliminary site investigation of most of the Turloughs was undertaken in association with a member of staff from the Office of Public Works in July 2007, in advance of the ecological survey undertaken in August 2007. The ecological assessment focused on habitats and flora and fauna adjacent to and adjoining Office of Public Works channels and not necessarily the entire Turlough habitat.

Six Turloughs designated as candidate Special Areas of Conservation namely Levally Lough, Lisnageeragh Bog and Ballinastack Turlough, Lough Lurgeen Bog/ Glenamaddy Turlough, Carrowkeel Turlough, Clyard Kettle-Holes (Thomastown Turlough) and Shrulough Turlough correlated with Office of Public Works schemes. Three proposed Natural Heritage Areas were also identified, Belclare Turlough, Killower Turlough and Rosstaff Turlough. The above designations applied to the respective Turlough at the time of the survey.

The ecological survey of the Turloughs was undertaken from the 7<sup>th</sup> August 2007. Each Turlough was assessed in terms of habitats present and flora and fauna observed along Office of Public Work channels. These findings were compared with Goodwillie, 1992. Office of Public Works arterial drainage works, past and present, and proposed activities were also examined. Structures including sluices, grills for trapping debris and overflow pipes were noted and compared with arterial drainage maintenance records for each site.

With the exception of the Glenamaddy Turlough all the Turloughs grassland and wet areas were accessible on foot. The high water level at Glenamaddy restricted access to

Turlough land. The survey was conducted from a number of dry land points on the edge of the Turlough. Changes in water levels at Turlough habitats were observed between the months of July and August, from the initial site investigation to the ecological survey respectively. Rising flood waters, therefore, influenced the flora and fauna observed.

Other information gathered during the course of the ecological survey included the direction of flow within Office of Public Works channels, benefiting lands, land management of Turloughs, landuse in the immediate vicinity of the Turlough and knowledge from landowners. Flood relief measures carried out by Local Authorities were identified as part of the site survey.

### **3.2 Ecology and habitats associated with arterial drainage maintenance activities**

A comprehensive list of habitats and flora and fauna recorded on each Turlough is listed in Appendix III. Tabulated below is a list of priority habitats and species of ecological importance associated with each Turlough. The list has been compiled based on observations during the site survey and data sourced from literature (Goodwillie, 1992; National Parks and Wildlife Service, Teagasc website) and personal communication.

<b>Turlough Name</b>	<b>Priority habitat</b>	<b>Adjoining priority habitat</b>
Levally Lough	Turlough	
Ballinastack	Turlough	Raised Bog (Active)
Glenamaddy	Turlough	Raised Bog (Active)
Carrowkeel	Turlough	
Thomastown	Turlough	
Shrule	Turlough	
Belclare	Turlough	
Killower	Turlough	
Rosstaff	Turlough	

Table 3 Priority habitats associated with each site surveyed.

For birds, Annex I status refers to those birds provided protection under the Birds Directive. Flora and fauna is protected in accordance with the Habitats Directive. Specific Irish designations provided legal protection under Irish law is also detailed.

<b>Turlough</b>	<b>Protected species</b>	<b>Type</b>	<b>Annex</b>	<b>Irish status</b>
Levally Lough	Lapwing (NPWS, 2007 landowner) Wigeon (NPWS) Teal (NPWS) Pochard (NPWS) Black-headed gull (NPWS) Golden Plover (NPWS, 2007) Coot (NPWS) Tufted duck (NPWS)	Bird Bird Bird Bird Bird Bird Bird Bird	Annex 1	Red listed Amber listed Amber listed Amber listed Amber listed Amber listed Amber listed Amber listed
Ballinastack	Whooper Swan (NPWS) Greenland White-fronted Goose (NPWS) Golden Plover (NPWS) Wigeon (NPWS)	Bird Bird Bird Bird	Annex 1 Annex 1 Annex 1	Amber listed Amber listed Amber listed Amber listed
Carrowkeel	Lapwing (NPWS, 2007 landowner) Snipe (NPWS) Coot (NPWS) Water rail (NPWS) Frog (2007)	Bird Bird Bird Bird Amphibian	Annex IV	Red listed Amber listed Amber listed Amber listed Protected
Glenamaddy	Whooper Swan (NPWS) Bewick's Swan (NPWS) Great Crested Grebe (2007) Wigeon (NPWS) Teal (NPWS) Pochard (NPWS) Golden Plover (NPWS) Lapwing (NPWS) Snipe (NPWS) Redshank (NPWS) Cormorant (NPWS) Dunlin (NPWS) Greenland White-fronted Goose (NPWS)	Bird Bird Bird Bird Bird Bird Bird Bird Bird Bird Bird Bird Bird	Annex 1 Annex 1     Annex 1     Annex 1	Amber listed Amber listed Amber listed Amber listed Amber listed Amber listed Amber listed Red listed Amber listed Amber listed Amber listed Amber listed Amber listed
Shrule	Frog (2007) Newt (2007 landowner) Kingfisher (2007) Water Rail (2007) Yellowhammer (2007 landowner) Snipe (NPWS) Lapwing (NPWS) Irish Hare (2007)	Amphibian Amphibian Bird Bird Bird Bird Bird Mammal	Annex IV  Annex 1	Protected Protected Amber listed Amber listed Red listed Amber listed Red listed Protected
Belclare	Irish Hare (2007) Wigeon (NPWS) Teal (NPWS) Lapwing (NPWS) Golden Plover (NPWS) Dunlin (NPWS) Greenland White-fronted Goose (NPWS)	Mammal Bird Bird Bird Bird Bird Bird	   Annex 1  Annex 1	Protected Amber listed Amber listed Red listed Amber listed Amber listed Amber listed
Killower	Whooper Swan (NPWS) Greenland White-fronted Goose (NPWS)	Bird Bird	Annex 1 Annex 1	Amber listed Amber listed
Rosstaff	Cormorant (2007) Greenland White-fronted Goose (NPWS) Golden Plover (NPWS)	Bird Bird Bird	 Annex 1 Annex 1	Amber – listed Amber – listed Amber - listed
Thomastown	Frog (2007)	Amphibian	Annex IV	Protected

Table 4 Protected fauna of surveyed Turloughs. Information based on ecological survey 2007 (2007), National Parks and Wildlife Service / Natura Notes (NPWS) and personal communication with land owners (2007 landowners).

### **3.3 Physical parameters recorded during the course of the survey**

The exceptionally wet summer of 2007 provided an insight into Turlough dynamics. The presence of water was recorded at each site. Although no exact measurements recorded the extent, level and change in Turlough, an increase in water levels was visually observed between the months of July and August. Other physical parameters taken into consideration were the flood relief measures undertaken by Local Authorities (Galway and Mayo County Council), were evident around the edge of certain Turloughs.

Water levels varied between sites and within sites between the months of July and August 2007. Between the initial site investigation and the site survey the volume of water in the Shrile and Thomastown Turloughs had increased. For Levally Lough and Carrowkeel Turloughs changes in water levels were not as obvious due to the nature of vegetation colonising the water zone. Glenamaddy Turlough however remained at its winter level with little or no change in water volume.

During the course of the survey evidence of flood relief measures undertaken by Local Authorities were observed. On the north eastern side of the Carrowkeel Turlough a return gully in the road allows a return flow for flood water. At Glenamaddy the exposed road fill on the R362 regional road would suggest that the height of the road has been raised to prevent flooding of the road. For the Thomastown Turlough the presence of a pipe on the N84 national route allows excess water to flow away from the Turlough area.

### **3.4 Details of arterial drainage maintenance and flood relief measure within Turloughs**

Similar to arterial drainage maintenance of rivers and channels, channels within or adjoining Turlough environments are generally maintained on a three, four or five year cycle. The timeframe between drainage maintenance activities is dependent upon access to channels, rate of sediment deposition, impact of vegetation on channel dynamics and the assessment of the perceived risk of flooding to human safety. Removal of silt deposition and bush cutting is on a three year or more cycle.

Drainage maintenance of Turlough channels is largely confined to silt removal and bush cutting. However, the unpredictable seasonal flooding of Turlough habitats, the proximity of built environment and the demand for good agricultural land has necessitated the undertaking of Flood Relief measures to alleviate winter flooding in particular. As Turlough differs from each other, each flooding incident needs to be assessed separately.

In Turlough habitats arterial drainage maintenance activities to assist in flood relief require site specific flood control mechanisms. Work undertaken by the Office of Public

Works has included the addition of a sluice, installation of a grill, increase in swallow hole basin size and the use of overflow pipes. All arterial drainage maintenance works are discussed below .

#### **3.4.1 Levally Lough Turlough**

The flow direction of the Office of Public Works Channel at Levally Lough is into the Turlough from the surrounding peatland to the north east. Arterial drainage maintenance activity on the channel is of silt deposition removal and bush cutting. The Office of Public Works flood mapping website shows the peatland upstream of the drainage channel and the edges of the Turlough as benefitting lands. Drainage of the bog enables turf to be harvested by local people.

#### **3.4.2 Ballinastack Turlough**

Although a channel is marked on Office of Public Works maps up to the edge of the Lisnageeragh Bog and Ballinastack candidate Special Area of Conservation arterial drainage maintenance is not undertaken on the entire channel length. Arterial drainage maintenance is undertaken between the R364 and the bridge on the track leading to the bog. Arterial drainage maintenance activity on the SG18/2 channel is that of bush cutting and silt removal. Maintenance is scheduled on a three to four year basis (as detailed in the Appendix I). This channel may have been included in a drainage scheme as a result of flooding in the townlands of Clooncon and Mountkelly (Dáil Éireann, 1961).

#### **3.4.3 Glenamaddy Turlough**

In the Dáil Éireann debates of November 1961, the Minister for Finance was asked to confirm whether the drainage of the Glenamaddy Lake would be undertaken as part of the Corrib – Clare Catchment Drainage Scheme.

Office of Public Works scheme maps show that arterial drainage works were proposed for the watercourses that cross the Turlough floor, but these appear to have been omitted from this scheme. A photograph taken at the swallow hole of Glenamaddy Turlough by the Western Regional Fisheries Board in the summer of 2006 (personal communication Rodgers, K.), show a manhole cover in close proximity to the swallow hole.

#### **3.4.4 Carrowkeel Turlough**

During the Dáil Éireann debates of 1938 a question was raised with respect to the Carrowkeel tributary of the River Robe which would involve the drainage of land from Carrowkeel lake through Carrowkeel, Caher and Derrymore. In response it was stated that the proposed work was unfeasible due to unforeseen circumstances. In 1986 the Forest and Wildlife Service of the Department of Fisheries and Forestry expressed concern that the proposed work on the Hollymount sub-catchment would impact on the ecology of the surrounding area.

The Office of Public drainage channel SM 111/1 crossing the Carrowkeel Turlough was deemed to be uneconomical and ecologically unfeasible (Seanad Éireann, 1986). No arterial drainage work and consequently no arterial drainage maintenance was undertaken on the Turlough. Only drawings of a proposed channel remain.

#### **3.4.5 Thomastown Turlough**

In 2007, flood mitigation works were carried out, which were agreed between the Office of Public Works, the National Parks and Wildlife Services and Mayo County Council. An underground pipe positioned at the same level as an existing County Council pipe on the N84, will convey excess water from the Turlough where it will be discharged into an existing Office of Public Works drainage channel.

#### **3.4.6 Shrule Turlough**

In the mid 1970s an arterial drainage scheme was undertaken to relieve flooding at Shrule Turlough. Work included arterial drainage maintenance channels and modification to the swallow hole basin. No arterial drainage maintenance has been scheduled at Shrule Turlough in excess of twenty years. Evidence of arterial drainage scheme includes:

- a) Drainage channels – SM122/1, SM 122/2. SM122/2/1
- b) Installation of a grill, on the drain identified as SM122/1 adjacent to the swallow hole
- c) Removal of boulders around the mouth of the swallow holes, to increase basin size.

The direction of flow in drainage channels is from a west and north west direction into the swallow hole on the Lough Corrib side to the Turlough. Flow from Lough Lee is from an east to west direction into the swallow hole on the Tuam side of the Turlough.

Another channel is marked on the scheme map at Lough Lee namely C4/10. Channel C4/10 is a proposed drainage channel that has the capacity to direct excess water from Lough Lee, fed by a spring, into the Black River. As the water supply for Shrulue is supplied from the Lough Lee the drainage channel is not operational.

Other arterial drainage activity undertaken in Shrulue include the installation of a grill to prevent debris entering the swallow hole basin which may cause a blockage and the widening of the Turlough swallow hole. This work did not interfere with the mouth of the swallow hole or the associated underground water conveyance network. Benefiting land is confined to the Turlough complex as designated by the National Parks and Wildlife Service.

#### **3.4.7 Belclare Turlough**

Belclare and Killower Turlough are situated beside each other with Killower Turlough to the north and Belclare Turlough to the south. In the Killower Turlough water is conveyed in a south to south west direction. For the Belclare Turlough drainage channels SG 43/1, SG 43/1/1, SG 43/1/2 direct water in a southerly direction towards the Belclare swallow hole. Channel C1 allows flood waters to flow towards Killower Turlough. Arterial drainage maintenance of channels within the Turlough is on a five year schedule.

#### **3.4.8 Killower Turlough**

Arterial drainage maintenance of channels within the Turlough is on a five year schedule. As detailed in section 3.4.7 C1 channel conveys flood waters from the Belclare Turlough to the Killower Turlough.

To manage excess Turlough water in the Killower Turlough a sluice was installed on the SG42/1 channel where it joins the Black River. During flooding the pressure builds on the Turlough side of the sluice causing a reverse flow along the drainage channel SG42/1 forcing the sluice to open, allowing water to discharge to the river. High water in the river cannot flow into the Turlough because of the presence of the sluice.

#### **3.4.9 Rosstaff Turlough**

Although five arterial drainage channels are identified on Office of Public Works maps only four are in existence. Channel CH4/4 was constructed to drain excess water from the Turlough to the Black River in a north to south direction. However, landowners noticed an inflow of water from the River into the Turlough via the drainage channel when the Black River was in flood. Consequently, the channel was infilled and no longer exists. Maintenance



scheduled for the Rosstaff Turlough channels is on a five year rotation. The Black River designated as CH4 is maintained every ten years if maintenance is deemed necessary.

Channel CH4/4/2 extends from the R334 to the Turlough flowing in a North east to south west direction. The channel CH4/4/1 flows from a west to north direction and loops around to a southerly direction into the Turlough. To the south of the Black River the two channels CH4/5 and CH4/5/1 flow directly into the Black River. The channel CH4/5/1 flows in a south to north direction into the CH4/5 channel which discharges to the Black River.

### **3.5 Factors affecting Turloughs from arterial drainage maintenance and other sources**

On completion of the ecological survey of the Turlough sites and based on a literature review a selection of potential impacts on Turlough habitats were observed. These include erosion and deposition of fine sediment, the infilling of a Turlough habitat and the impact of flooding management on the surrounding Turlough environment.

Sand deposition was observed in the swallow hole on the Corrib side of Shrule Turlough. The increase in the size of the swallow hole collecting basin and decreased flow of water within the basin appears to facilitate the deposition of particulate matter. This phenomenon might also be true of other Office of Public Works drainage channels that benefit the drainage of peatlands which flow into Turloughs. Access to swallow hole would be needed to confirm deposition of any external particulate matter.

Private infilling of Turlough land (within the boundary of the Natural Heritage Area), with aggregate material was observed at Belclare. At the south east corner of the Belclare Turlough berms of aggregate material have been stock piled. Reducing the Turlough flood plain will impact negatively on the Natural Heritage Area.

Flood relief measures which manage flood peak have been undertaken to confine Turlough flooding within the Turlough boundaries. Flooding beyond the Turlough can affect road access and private dwellings. Management of peak flood minimises the impact on the ecology of the Turlough by undertaking flood relief work beyond the ecological limit.

#### **4.0 Effects of the maintenance operations**

Arterial drainage activities can be categorised as either schemes or maintenance works. The initial work to develop arterial drainage channels or flood relief measures can be described as schemes. Maintaining channels or structures associated with the initial scheme is referred to as arterial drainage maintenance. Since the mid 70s the approach to arterial drainage maintenance has changed by incorporating a more environmentally sensitive approach to flood relief.

In the past arterial drainage schemes involved large engineering projects which altered the site integrity of Turloughs. In some cases complete drainage of Turlough habitats occurred, for others the swallow hole basin was altered to accommodate larger water volumes. Current flood relief work carried out on Turloughs focuses on managing the flood peak beyond the ecological boundary, thereby minimising the impact upon the Turlough.

For the purpose of this report the effects of arterial maintenance operations will be considered in terms of ecological diversity. Recording habitat types and flora and fauna observed provide an insight into Turlough dynamics. Land management regimes were identified and their associated impacts determined.

#### **4.1 Changes in site integrity on Turloughs**

Arterial drainage maintenance has influenced the Turlough regime. At the Shrile Turlough, the appearance of the swallow hole has changed (Goodwillie, 1992, personal communication from OPW staff). Arterial drainage work has focused on increasing the water storage capacity around the swallow hole rather than interfering with the swallow hole mechanics. Consequently, a rather large hollow identifies the swallow hole to the west. The swallow hole to the east is marked by a debris collection grill and an arc of stones enclosing the swallow hole (which were removed from the swallow hole area).



Fig. 11 Swallow hole to the west of the Shrule Turlough (July 2007).



Fig. 12 Swallow hole to the east of the Shrule Turlough (July 2007).

During the course of the survey arterial drainage channels supported a different flora to that of the surrounding Turlough environment. For the most part this was due to the different land management regime observed. Office of Public Works channels were often protected by fencing preventing livestock from accessing the channel area. As a result the channel banks were colonised by tree and plant species. The drainage channel at Rosstaff Turlough was colonised with Heath Orchids in July and Purple Loosestrife in August, which contrasted with the surrounding grazed agricultural grassland. The slow colonisation of marl at the Belcare Turlough supports insectivorous plants.



Fig. 13 Floral diversity on the banks of an Office of Public Work channel (August 2007).

Channel width and depth within Turlough habitats has an impact on mammals and birds. Fenced sections of arterial drainage channels supporting rushes were often preferred by birds such as mallard ducks and kingfisher. However, channel width and depth can on occasion negatively impact on terrestrial mammals traversing dry Turlough lands.



Fig. 14 A hare burrowed channel cut into the side of a drainage channel (August 2007).



## 4.2 Influence of Turlough maintenance on the surrounding area

Historically arterial drainage maintenance of Turloughs has increased the land available for agricultural use. Arterial drainage maintenance of Turlough systems allows Turlough flooding to be managed thereby reducing the impact on surrounding land. Extreme flooding of Turlough habitats has the capacity to impact negatively on activities on the surrounding land. Between the months of October and May, Turlough flooding reduces the land area available for spring grazing. By controlling flood events the grazing time for livestock, theoretically, can be extended.

In the absence of Turlough flood management, flooding caused by Turloughs has made roads impassable and left communities stranded. A report in a local paper the Western People on the 10<sup>th</sup> October 2007 publicised the flood relief work undertaken at the Thomastown Turlough. According to the article the worst flooding was experienced in the area in late 2006 and early 2007 when four to five houses were cut-off due to flood waters. Similarly, flooding caused by the Shrule, Belclare and Killoower Turloughs has also been reported in local newspapers. In the case of Shrule Turlough, local access roads adjoining the Turlough have been impassable for two to three months at a time.



Fig. 15 The extent of flooding near Shrule November 1999 (courtesy Office Public Works).

In ecological terms arterial drainage maintenance can impact positively and negatively on Turlough habitats. Negative impacts include the reduction in surface water area for migrating wildfowl. As discussed in section 3.2 Turloughs are a valuable habitat for Annex 1 bird species. Increasing the dry season for livestock may lead to overgrazing which can reduce the vegetation available for migratory birds.

Drainage channels (see section 4.1) have increased the habitats of other plant species not traditionally associated with Turlough ecosystems, for example the *Myriophyllum*

*verticillatum* or Whorled Water Milfoil. *M.verticillatum* is associated with floating river vegetation of EU habitat 3260:

“Watercourses of plain to montane levels with the *Ranunculus fluitans* and *Callitriche-Batrachium* vegetation” (Ní Bhroin, 2007).

#### **4.3 Most critical effects of arterial drainage maintenance on Turloughs**

Irreversible damage caused in Turlough habitats are associated with large schemes undertaken in the mid 70s. Engineering works undertaken at Shrle Turlough involved the removal of large sections of limestone rock to enlarge the swallow hole basins. The deposition of fine sediment material in a swallow hole basin at Shrle may need to be assessed in the short to medium term. Whether the deposition of sandy material is a consequence of a larger swallow hole basin is debatable and beyond the scope of this report.

Altering the hydrological regime of a Turlough can impact or influence Turlough ecology. Native Turlough ecology has adapted to seasonal fluctuations. Patterns of plant community zonation has been proposed and described by Goodwillie, 2004. The presence of arterial drainage channels provides linear habitats and may be responsible for attracting opportunistic flora and fauna to Turlough habitats. Kingfisher was observed on a channel at Shrle Turlough, while slow colonising flora was evident on exposed marl surfaces at Belclare Turlough. By managing the peak flood at Thomastown Turlough the creeping buttercup community with modified leaves, evolved as a consequence of repeated flooding (Lynn & Waldren, 2004), remains within the ecological limit.

A localised effect of arterial drainage maintenance and flood management is the containment of Turlough waters within areas supporting Turlough ecology. Where Turlough flood water extends to land not previously associated with seasonal flooding this can impact negatively on local communities. Consequences of excess Turlough flooding include the inundation of agricultural grassland not previously associated with Turlough flooding and restricted access on national primary roads and to private property (Western People).

#### **4.4 Physical, Chemical and Biological Impacts of arterial drainage maintenance**

A physical impact of arterial drainage maintenance on Turlough habitats is the management of flood water levels within Turloughs. In an attempt to manage and reduce the risk of flooding, physical changes have been made to Turlough habitats. The addition of drainage channels and the construction of sluices and debris collection grills are all examples

of physical impact upon Turlough sites. Naturally, arterial drainage channels have the greatest visual impact on Turloughs.

Managing peak flooding may increase land availability for housing, industrial or agricultural activity and could impact negatively on ground water quality and sources. Goodwillie, 2004 has stated that the overwintering of cattle in slatted sheds, the application of fertiliser to fields and the problems associated with septic tanks can impact negatively on groundwater. It has been estimated that only five percent of oligotrophic Turlough sites still exist in Ireland as opposed to eutrophic sites.

Indirectly, groundwater sources may be threatened as a consequence of excessive arterial drainage maintenance. The partial or complete drainage of Turlough systems would reduce or cease Turlough flooding thereby increasing the grazing season for livestock which may lead to a change in land use. The Working Group on Groundwater Sub-committee on Turloughs in 2005 identified phosphorus as a significant threat resulting in the eutrophication of groundwater dependent terrestrial ecosystems. The rapid (up to 100m /h for some Turloughs), dispersal of water through cracks in the limestone provides an easy access point for groundwater pollutants.

## **5.0 Mitigation measures**

Listed on the European University Information Systems (EUNIS website) Ireland lists a total of forty three individual Turlough habitats as Special Areas of Conservation. This contrasts with five similar habitats from Germany and two in the United Kingdom. According to the website the Geographical distributions of Turlough habitats have been found in four biogeographic regions namely Atlantic (Ireland and the United Kingdom), Alpine (Germany and Slovenia), Boreal (Estonia) and Continental (Germany and Slovenia).

Often described as uniquely Irish landscape Turloughs are concentrated in the west of Ireland in counties Clare, Galway and Mayo, with some in County Roscommon. Designated as a priority habitat Turloughs have been recognised as internationally important habitats. A comprehensive survey conducted by Goodwillie, 1992 proposed that forty five Turloughs be designated as candidate Special Areas of Conservation and a further thirty four as proposed Natural Heritage Area status.

The flora associated with Turlough habitats has evolved to tolerate fluctuating water levels. Patterns of plant colonisation are often associated with the length and duration of flooding. Summer grazing by livestock is the principle form of land management. Although low level grazing is considered beneficial for Turlough flora and fauna, changes in livestock grazing and the application of fertiliser have been found to impact negatively on Turlough habitats (Burren beo website).

### **5.1 Identify avoidance measures for arterial drainage maintenance**

As highlighted in section 4.1 drainage channels which are wide, deep and steep create a barrier to movement of wildlife. For aquatic plant species colonising drainage channels, water depth is the determining factor. When designing or maintaining drainage channels within Turlough systems, winter and summer function should be taken into consideration. In winter drainage channels convey water but in summer drainage channels may be ecologically significant for aquatic plants but pose a negative impact for other wildlife such as terrestrial mammals.

As mentioned in section 3.4 some arterial drainage channels although marked on Office of Public Works maps do not exist. The Office of Public Works needs to review and update all scheme maps associated with Turlough habitats.

- For the Carrowkeel Turlough the marked channel was a proposed drainage channel which was found to be “not cost beneficial” and therefore not undertaken.



- At the Rosstaff Turlough channel CH4/4 was infilled and no longer exists.
- Based on maintenance details supplied by the Office of Public Works the channel SG18/2 associated with the Lisnageeragh Bog and Ballinastack Turlough candidate Special Area of Conservation has only been maintained over a limited distance from Glenamaddy village to the bridge upstream. There is no record of scheduled maintenance for the section of channel that extends from the candidate Special Area of Conservation to the bridge.
- Glenamaddy Turlough map also requires updating as no arterial drainage maintenance has been undertaken or scheduled.

Although channel CH4/10 in Shrle was proposed but not used, the future upgrading of Shrle village to mains drinking water, may lead to pressure for the channel to be brought in to use for flood mitigation. An appropriate environmental assessment may be required in due course.

## **5.2 Influence of Environmental Drainage Maintenance work practices**

The policy of the Office of Public Works with respect to Turloughs is to reduce flood peak. In doing so, excess flood water is removed thereby maintaining Turlough ecology. Currently, only flood relief measures are undertaken by the Office of Public Works in Turlough habitats.

Arterial Drainage Maintenance channels entering Turlough habitats are maintained in accordance with the Environmental Drainage Maintenance work practices. The Environmental Drainage Maintenance Programme steps described below are those which are implemented.

Step 1 Protect bank slopes – the marl component of the Turloughs is slow to colonise and readily dissolves in water. Retaining vegetation and minimising scraping of banks will reduce channel infilling due to bank erosion. Fencing will also reduce the incidence of animals trampling in the banks.

Step 2 Restrict maintenance to channel – primarily applies to the removal of excess instream vegetation where applicable.

Step 3 Deposit spoil on bank full - spoil deposition should be confined to spoil banks where these exist.

Step 4 Selective vegetation removal – applies to the removal of Bulrush or Rush

Step 5 Leave sections untouched – is probably the most important of all the steps

“if channel capacity is not affected leave intact”.

Step 6 Management of trees – this will become progressively more important as time goes on. Depending on the volume of water seasonally flooding, change in landuse and prevention of access by livestock to the channel edge native trees will develop. Trees such as willow, buckthorn and hawthorn will form a riparian strip along drainage channels.

Although Turlough habitats are classified as freshwater environments not all Turloughs surveyed would be capable of supporting fish populations during summer months. However, Turlough habitats fed by large streams can support fish populations. Photographed below are two different types of deflectors which have been installed in an Office of Public Works drainage channel at the edge of a Turlough habitat. This is in compliance with Step 10 of the Environmental Drainage Maintenance Programme and undertaken in consultation with the Western Regional Fisheries Board.



Fig. 16 Deflectors placed at the base of a bridge of the Clyard Turlough complex (July 2007).



Fig. 17 Alternating deflector series on the Clyard Turlough complex (July 2007).

### 5.3 Specific extra mitigation measures identified

The length of Turlough flooding can be crucial for ecological diversity. According to local knowledge the Carrowkeel Turlough retains water even in the driest of summers, while the Turlough at Levally Lough remained damp and slightly wet in the centre but was passable with wellingtons (summer 2006). In the summer of 2007 both Turloughs retained a quantity of water. For Carrowkeel Turlough the extended flooding period in May 2007, allowed eight to nine cygnets to successfully hatch, unlike previous years where the retreating waters made the nest vulnerable to attack from dogs and foxes. Flood relief schemes should always ensure appropriate water levels are maintained annually.

The unpredictable nature of Turloughs requires a strategic approach to be taken to manage flooding caused by Turloughs. There is a need to develop a flood risk strategy for each Turlough system identifying the causes of flooding, area under flood, frequency of flooding and the effect of flooding. Flood relief measures undertaken in response to flooding should be designed to cause minimum impact on the ecology of the Turlough habitat. As a general rule flood management should not compromise Turlough ecology. Of all flood relief works that can be undertaken the complete drainage of Turlough habitats is ecologically the most damaging. Seasonal fluctuation in water levels is critical to maintaining Turlough ecology.

Currently the Office of Public Works is focusing on non-structural approaches to flood risk reduction and management. Initiatives such as National Flood Hazard Maps ([www.floodmaps.ie](http://www.floodmaps.ie)), recommendations on living with floods, ([www.flooding.ie](http://www.flooding.ie)) and the development of planning and development guidance for flood risk management (Office of Public Works, 2007) are in progress. Planning and development guidance will focus on floodplain awareness. Inclusion of Turloughs in this category will provide added protection for Turlough habitats.

Where infrastructure and centres of populations are affected by Turlough flooding, a suite of flood warning systems may need to be developed. Correlation between climate parameters such as rainfall should be undertaken in association with Met Éireann environmental observatories to predict climatic factors which impact on Turlough water dynamics namely rainfall. Met Éireann described the summer of 2007 as:

“The wettest summer for fifty years in the east of the country with temperature and sunshine a little above average”. This contrasted with the summer of 2006 which was recorded as:

“The warmest, driest and sunniest summer since 1995”, see Appendix IV for rainfall and temperature data.

#### **5.4 Opportunities for enhancement or compensatory measures**

The Office of Public Works should engage with the relevant Local Authorities to ensure that appropriate planning strategies are adopted as part of County Development Plans so that good practice is applied to planning management for the areas prone to flooding near Turloughs. Planners must be made aware of the hydrometric data, flood mapping tools and flood prevention strategies being developed by the Office of Public Works.

In cases where extreme Turlough flooding has a negative impact on the surrounding built environment, flood mitigation measures may be an appropriate response to relieve the threat of flooding. In certain cases it may be more appropriate to reverse the development.

As a future measure the Office of Public Works needs to monitor land management practices of Turlough habitats. Current plans to connect the village of Shrile to a mains water supply will discontinue water abstraction at Lough Lee. Reduced extraction will therefore increase water volume entering the Turlough. It may be necessary to divert some of the water via channel C4/10 directly into the Black River.

## **Conclusion**

A total of nine Turloughs were surveyed to determine the ecological impact assessment of arterial drainage maintenance on each habitat. Six of the Turloughs are designated as candidate Special Areas of Conservation and a further three are designated as proposed Natural Heritage Areas.

The survey findings were as follows:

### **Levally Lough 00295**

Arterial drainage channel SG30/3 is located to the east of the Turlough and drains surrounding peat land. The drainage maintenance activity undertaken at the channel is of silt management and bush cutting. Based on the ecological survey of the Levally Lough Turlough the current arterial drainage maintenance regime should pose no ecological threat. The removal of silt deposits especially those of peat origin will reduce the volume of peat particles entering the Turlough system.

### **Lisnageeragh Bog and Ballinastack Turlough 00296**

A single arterial drainage channel from Glenamaddy touches the edge of the candidate Special Area of Conservation Lisnageeragh Bog and Ballinastack Turlough. The Ballinastack Turlough is situated to the north of the cSAC approximately 2 km north of the marked Office of Public Works drainage channel. A study of the maintenance schedule reveals that arterial drainage maintenance is only carried out between Glenamaddy village and the bridge upstream. No arterial drainage maintenance has been undertaken between the bridge and the edge of the candidate Special Area of Conservation. Arterial drainage maintenance activity, therefore, on the channel SG 18/2 does not ecologically impact on the Ballinastack Turlough.

### **Lough Lurgen Bog/ Glenamaddy Turlough 00301**

Office of Public Works scheme maps show four arterial drainage channels crossing the Glenamaddy Turlough. Although, walk over surveys have been undertaken by staff of the Office of Public Works no arterial drainage work was carried out at the Glenamaddy Turlough. The drainage channels identified as SG 18/4, SG 18/4/1, SG 18/4/2, SG 18/4/2/1 and SG 18/4/3 are only proposed channels and exist on scheme maps only. Consequently the Office of Public Works arterial drainage maintenance activity does not impact on the ecology of the Glenamaddy Turlough.

### **Carrowkeel Turlough 00475**

Although a drainage scheme was sought for the Carrowkeel Turlough drainage of the Turlough was deemed to be “not cost beneficial”. Consequently, the proposed scheme was never undertaken and the only reference to the drainage channel is on Office of Public Works scheme maps. As no drainage scheme exists at Carrowkeel Turlough, Office of Public Works arterial drainage maintenance activity does not impact on the Turlough.

### **Thomastown Turlough (Clyard Kettle-Holes) 00480**

In September 2007 flood relief measures were completed for the Thomastown Turlough. A pipe was installed to convey peak flood water from the Turlough site to a drainage channel east of the Turlough. The Office of Public Works pipe was placed at the same level as the Local Authority overflow pipe on the national Galway to Castlebar road, N84. A survey of the site revealed that the pipe is situated at the ecological limit of the Turlough. This does not affect the integrity of the site.

### **Shrule Turlough 00525**

Arterial drainage scheme activities at the Shrule Turlough have included the enlargement of the swallow hole basins and increased drainage capacity of channels across the Turlough. Although efforts have been made to manage water levels in the Turlough, flooding of adjoining land frequently occurs. Ecologically, Shrule Turlough was found to be quite diverse and compared favourably with previously documented plant species. Ecologically arterial drainage channels supported atypical Turlough species. The presence of a Kingfisher, an Annex I bird species, along an arterial drainage channel would be uncharacteristic of Turlough habitats.

This study noted the deposition of fine sediment at the western Turlough swallow hole. Removal of some of the fine sediment may be a future concern because of a threat of blockage. Concern was expressed by the National Parks and Wildlife Service (personal communication J. Ryan) to any work being undertaken at Shrule Turlough. Following the cessations of water abstraction at Lough Lee, localised flood relief works will be considered under a separate study.



### **Belclare Turlough 00234**

Belclare Turlough is a heavily grazed Turlough which appears to be under constant pressure from agriculture and the built environment. Two arterial drainage channels cross the Belclare Turlough the SG 43/1/1 and the SG 43/1. Increasing channel capacity has had an impact on the Turlough ecology by providing aquatic plant species with a suitable habitat. If further arterial drainage works need to be undertaken for flood relief or flood management reasons it is very likely that such work will have a negative impact on the Turlough habitat and ecology. Additional drainage channels will reduce the total land area available for terrestrial Turlough flora and consequently bird and animal populations.

### **Killower Turlough 00282**

Flooding at the Killower Turlough is controlled by a sluice system on the channel SG 42/1. As the water level rises in the Turlough the water is conveyed in the direction of the swallow hole. Excess flooding in the Turlough area reverses the flow in the channel exerting a pressure on the sluice gates to facilitate management of peak flood water by discharging to the Black River. In terms of site integrity arterial drainage maintenance channels were found to be deep and wide. The exposed marl at the side of the channels was slow to colonise but has provided orchids and insectivorous plants with a suitable habitat.

### **Rosstaff Turlough 00385**

A total of five arterial drainage channels are marked on scheme maps within the boundary of the Rosstaff Turlough, however only four exist. Channel C4/4 which conveyed flood water from the Turlough to the Black River was infilled as the direction of flow in the channel was reversed when the river was in flood. The ecological survey of the Rosstaff Turlough details flora frequently associated with Turloughs. Areas of improved grassland had reduced floral diversity. Arterial drainage maintenance has had a minimal impact on Turlough flora but has created alternative habitat types within the channels.



## **General conclusion**

Arterial drainage maintenance activity is confined to six of the nine Turlough sites investigated. The site integrity of each Turlough basin was found to compare favourably with the species diversity recorded by Goodwillie, 1992.

By managing the flooding peak of Turloughs the Office of Public Works can alleviate flooding while minimising the impact on Turlough ecology. Although arterial drainage schemes have had an impact on Turloughs in the past, modern flood relief schemes undertake flood peak management at the ecological limit of Turlough habitats.

A future concern is that further flood relief works on the Belclare and Killower Turlough will impact negatively on the Turlough ecosystems. Increasing the number of channels crossing the Turloughs will reduce the land available for terrestrial flora during summer months.

## **Further studies**

Mapping of flood extent and seasonal occurrence of flooding associated with the Turloughs surveyed.

Identification of changes in land management practice and settlement patterns within Turlough catchments, using aerial photographs.

Develop an ecological database of Groundwater Dependent Plant species associated with Turlough ecosystems in conjunction with other Groundwater Terrestrial Ecosystem research.

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## Appendix I– Details of maintenance schedule for Turloughs

### Levally Lough SAC 0295

Drainage scheme	Channel Ref.	Year of last maintenance
Corrib Clare	SG 30/3	06/11/1998

### Lisnageeragh Bog and Ballinastack Turlough SAC 0296

Drainage scheme	Channel Ref.	Year of last maintenance
Corrib Clare	SG 18/2	11/05/1984
Corrib Clare	SG 18/2	18/03/1991
Corrib Clare	SG 18/2	25/09/1998
Corrib Clare	SG 18/2	23/01/2002
Corrib Clare	SG18/2	14/08/2002
Corrib Clare	SG 18/2	14/08/2002
Corrib Clare	SG 18/2	21/08/2002
Corrib Clare	SG 18/2	21/08/2002
Corrib Clare	SG 18/2	05/01/2005
Corrib Clare	SG 18/2	12/01/2005

### Lough Lurgen Bog/ Glenamaddy Turlough SAC 301

Drainage scheme	Channel Ref.	Year of last maintenance
Corrib Clare	SG 18/4	<u>No works have ever taken place</u> <u>on these channels</u>
Corrib Clare	SG 18/4/1	
Corrib Clare	SG 18/4/1/1	
Corrib Clare	SG 18/4/2	
Corrib Clare	SG 18/4/2/1	
Corrib Clare	SG18/4/3	

### Carrowkeel Turlough SAC 0475

Drainage scheme	Channel Ref.	Year of last maintenance
Corrib Mask	SM 111/1	<u>No works have ever taken place</u> <u>on this channel</u>

**Thomastown Turlough (Clyard Kettle-Holes) SAC 0480**

<b>Drainage scheme</b>	<b>Channel Ref.</b>	<b>Year of last maintenance</b>
Corrib Clare	Localised flood relief works	2007, overflow mechanism on to reduce peak flood

**Shrule Turlough SAC 0525**

<b>Drainage scheme</b>	<b>Channel Ref.</b>	<b>Year of last maintenance</b>
Corrib Headford	SM 122/1	08/10/1982
Corrib Headford	SM 122/2	12/02/1982
Corrib Headford	SM 122/2/1	05/03/1982
Corrib Headford	SM 122/2/1	21/08/1992
Corrib Headford	SM 122/2	31/07/1992

**Belclare Turlough NHA 0234**

<b>Drainage scheme</b>	<b>Channel Ref.</b>	<b>Year of last maintenance</b>
Corrib Headford	SG43/1	15/05/1987
Corrib Headford	SG43/1	08/07/1994
Corrib Headford	SG43/1	16/04/2003
Corrib Headford	SG43/1	23/04/2003
Corrib Headford	SG43/1	30/04/2003
Corrib Headford	SG43/1/1	29/05/1987
Corrib Headford	SG43/1/1	27/07/1994
Corrib Headford	SG43/1/1	30/04/2003
Corrib Headford	SG43/1/1	07/05/2003

**Killower Turlough NHA 0282**

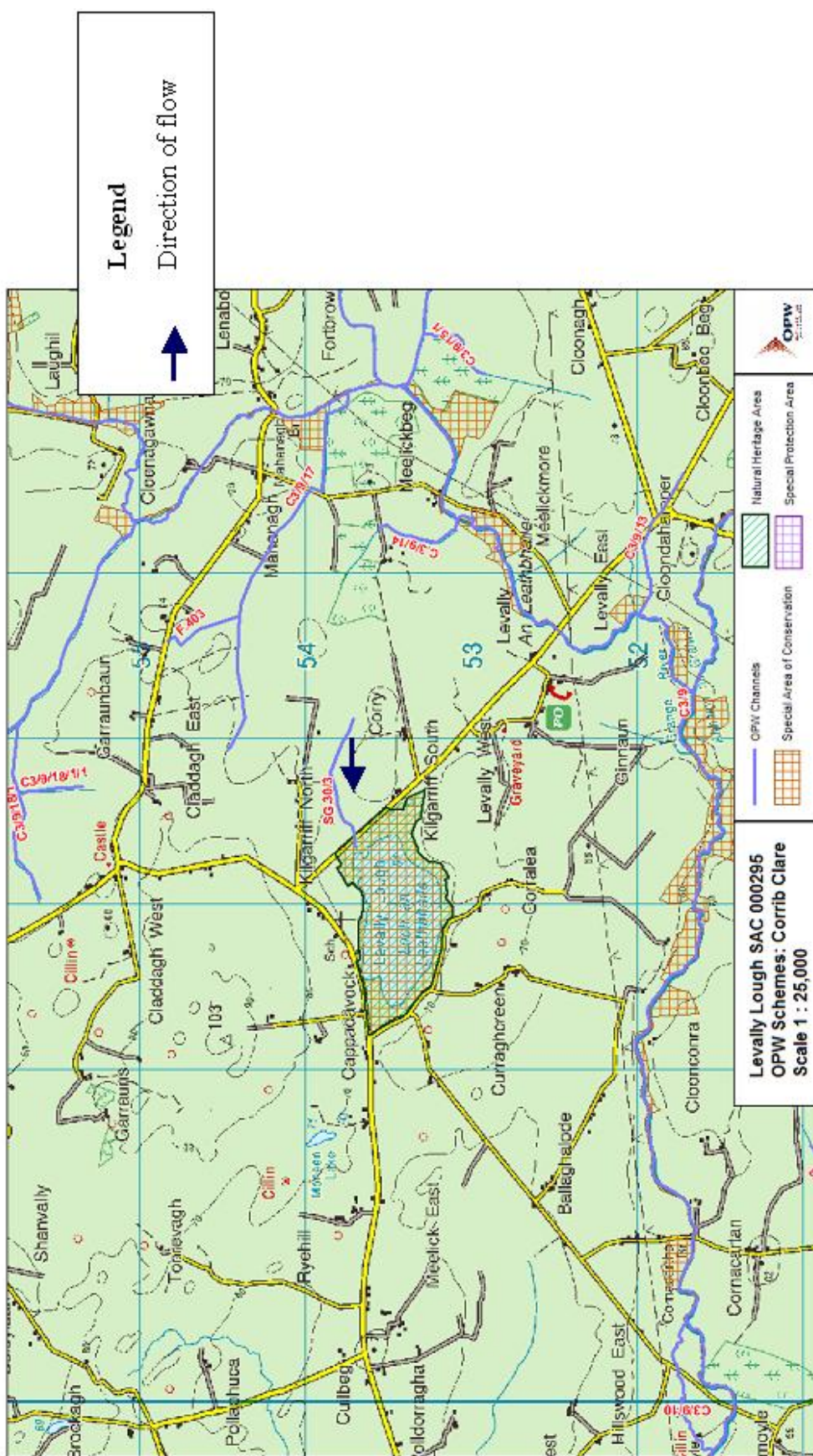
<b>Drainage scheme</b>	<b>Channel Ref.</b>	<b>Year of last maintenance</b>
Corrib Headford	CH4/13/6 – SG42/1	16/03/1995
Corrib Headford	CH4/13/6 – SG42/1	29/09/1995
Corrib Headford	CH4/13/6 – SG42/1	02/05/2006
Corrib Headford	CH4/13/6 – SG42/1	26/07/2006
Corrib Headford	CH4/13/6 – SG42/1	09/08/2006
Corrib Headford	CH4/13/6 – SG42/1	16/08/2006
Corrib Headford	C1	Belclare Flood Relief Scheme

**Rosstaff Turlough NHA 0385**

<b>Drainage scheme</b>	<b>Channel Ref.</b>	<b>Year of last maintenance</b>
Corrib Headford	CH4/4/21	Maintenance is on a five year cycle
Corrib Headford	CH4/4/2	
Corrib Headford	CH4/4	No longer in existence
Corrib Headford	CH4	Maintenance is on a five year cycle
Corrib Headford	CH4/5	
Corrib Headford	CH4/5/1	



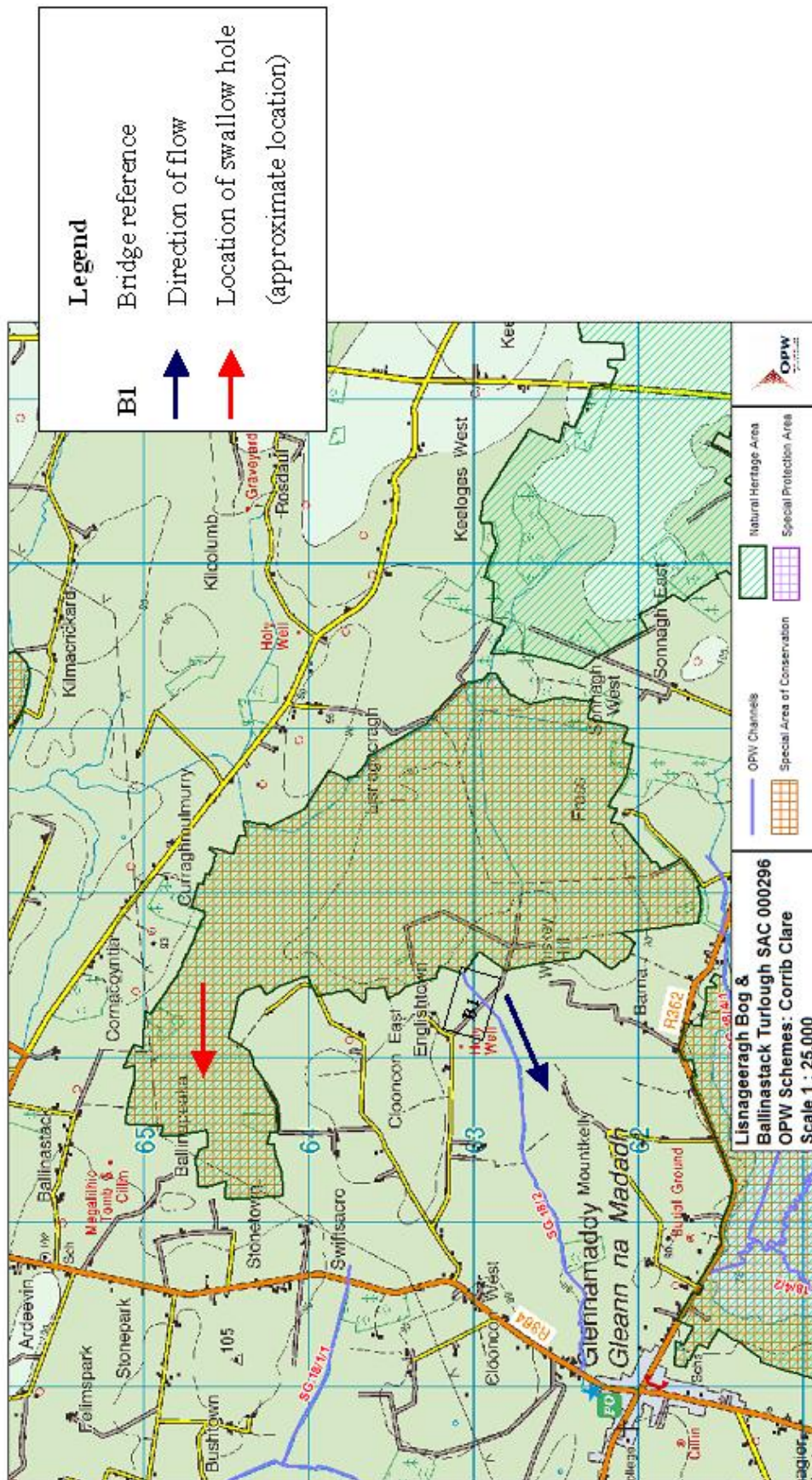
## Appendix II– Physical characteristics of Turloughs



Levally Lough Turlough and Office of Public Works channel SG 18/2

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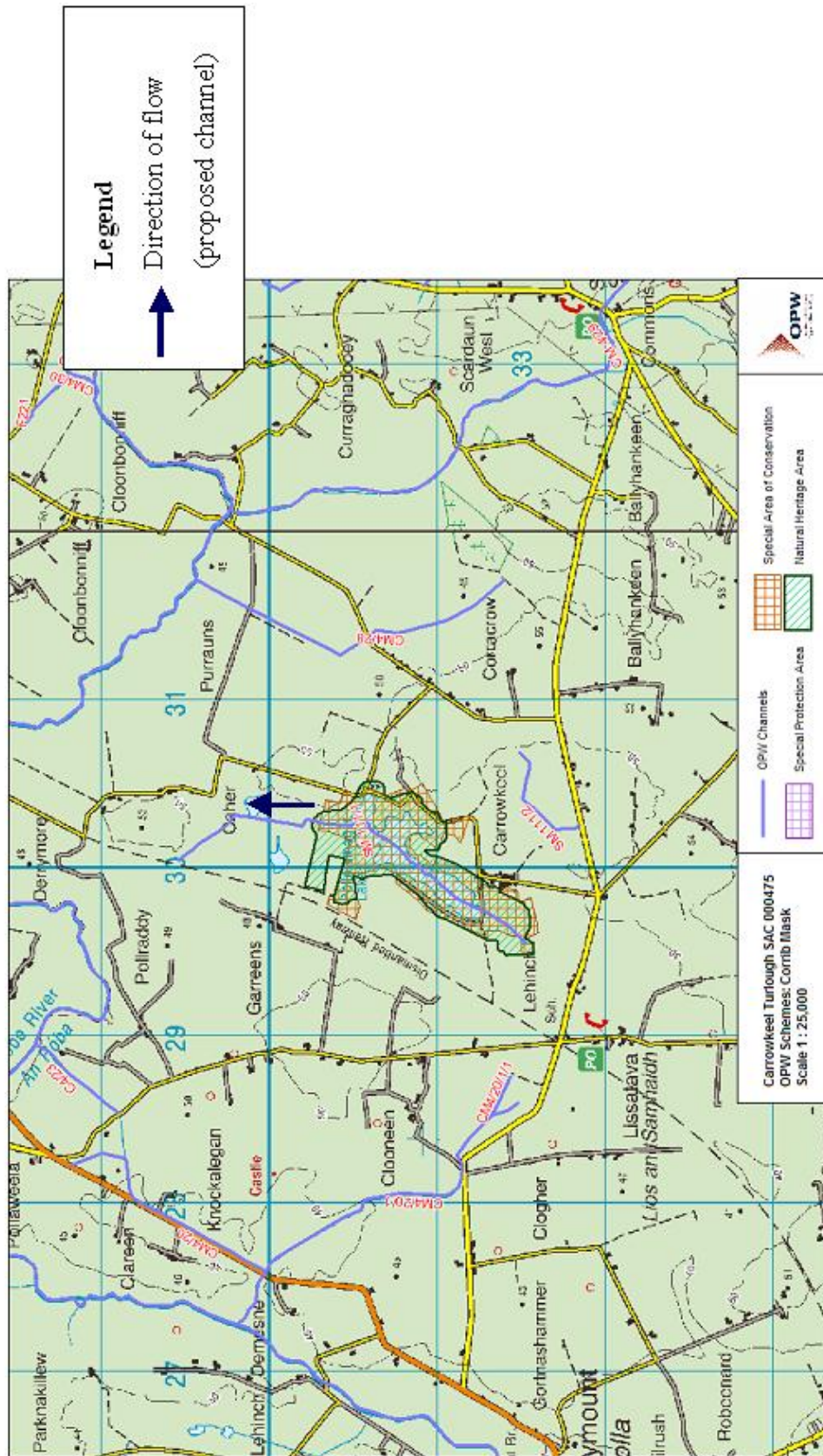
Ballinastack Turlough and Office of Public Works channel SG 18/2

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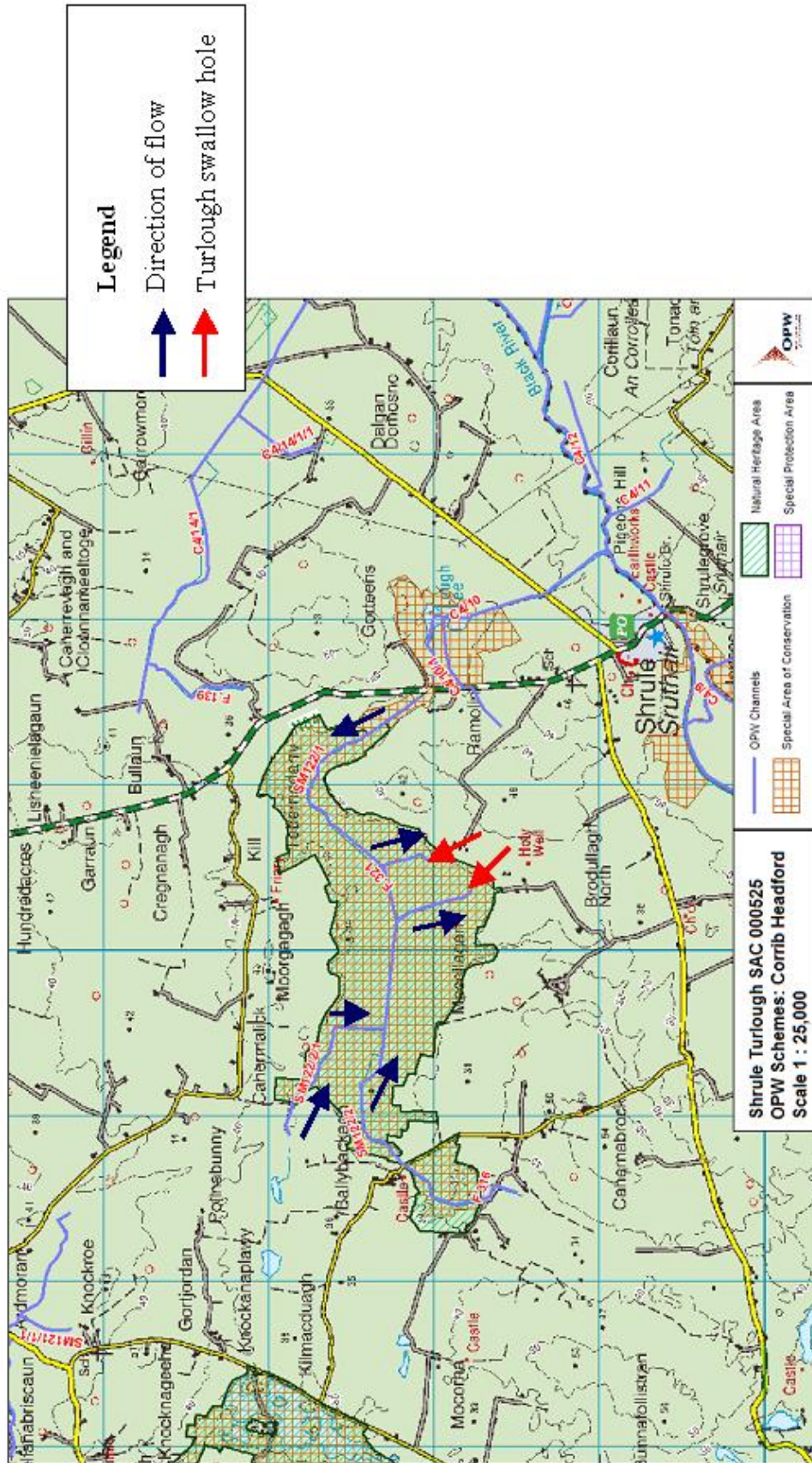
Carrowkeel Turlough and proposed Office of Public Works channel SM111/1.

Drainage channel DOES NOT exist

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Shrule Turlough and Office of Public Works channels:

F316, F321, SM 122/2, SM 122/2/1, SM 122/1, C4/10, C4/10/1. Drainage channel C4/10 DOES NOT exist.

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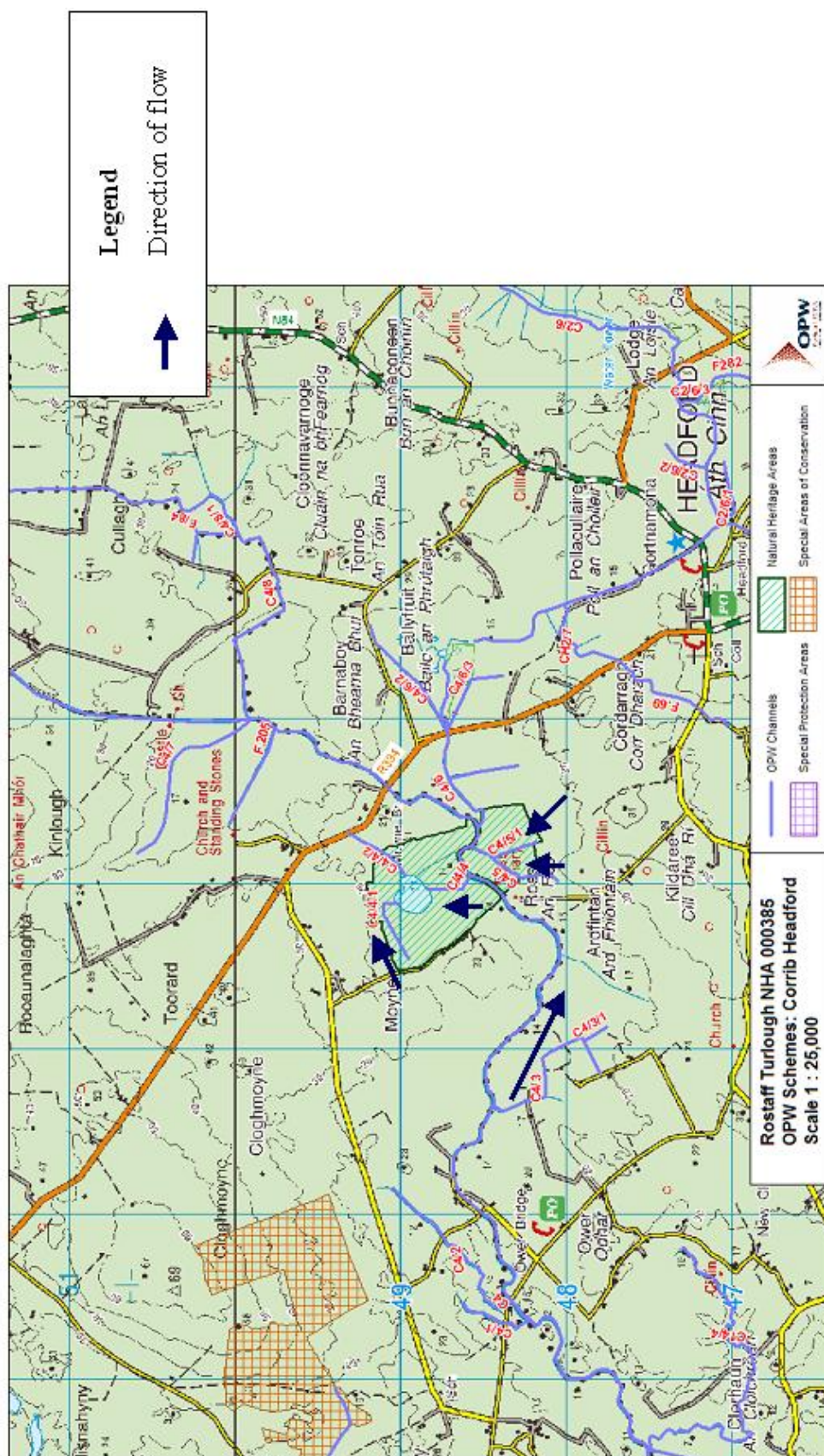












Rosstaff TurloughTurlough and Office of Public Works channels:

C4/4/1, C4/4/2, C4/5 C4/5/1, C4/4, C4/4/1 C4/6. Drainage channels C4/4 NO LONGER exists.

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## Appendix III – Turlough Flora and Fauna

### Levally Lough SAC 0295

Common Name	Latin name	Habitat	Year
<b>Trees</b>			
Gorse	<i>Ulex europaeus</i>	FW4	2007
Hawthorn	<i>Crataegus monogyna</i>	FW4	2007
Willow	<i>Salix</i> sp.	FW4	2007
<b>Herbaceous plants and shrubs</b>			
Birds foot trefoil	<i>Lotus corniculatus</i>	GA1	2007
Brambles	<i>Rubus fruticosus</i>	FW4	2007
Cat's ear	<i>Hypochaeris radicata</i>	GA1, FW4	2007
Common knapweed	<i>Centaurea nigra</i>	FW4	2007
Dropwort	<i>Filipendula vulgaris</i>	GA1	2007
Lesser spearwort	<i>Ranunculus flammula</i>	GA1	2007
Marsh pennywort	<i>Hydrocotyle vulgaris</i>	GA1	2007
Marsh thistle	<i>Cirsium palustre</i>	GA1, FW4	2007
Marsh woundwort	<i>Stachys palustre</i>	GA1	2007
Ox eye daisy	<i>Leucanthemum vulgare</i>	FW4	2007
Pale persicaria	<i>Persicaria lapathifolia</i>	FL6	2007
Red clover	<i>Trifolium pratense</i>	GA1	2007
Redleg	<i>Polygonum persicaria</i> ( <i>Persicaria maculosa</i> )	GA1	2007
Silverweed	<i>Potentilla anserina</i>	GA1	2007
Tufted vetch	<i>Vicia cracca</i>	FW4	2007
Water mint	<i>Mentha aquatica</i>	GA1, FL6	2007
Yellow loosestrife	<i>Lysimachia vulgaris</i>	GA1	2007
<b>Aquatic plants</b>			
Amphibious bistort	<i>Polygonum amphibium</i> ( <i>persicaria amphibia</i> )	FL6	2007
Water forget-me-not	<i>Myosotis scorpioides</i>	FL6	2007
Water speedwell	<i>Veronica anagallis-aquatica</i>	FL6	2007
Greater bladderwort	<i>Utricularia vulgaris</i>	FL6	2007
<b>Grasses</b>			
Creeping bent	<i>Agrostis stolonifera</i>	GA1	2007
Crested dogtail	<i>Cynosurus cristatus</i>	GA1	2007
Floating sweet grass	<i>Glyceria fluitans</i>	GA1	2007
<b>Sedges, rushes, reeds</b>			
Blunt-flowered rush	<i>Juncus subnodulosus</i>	GA1	2007
Common club rush	<i>Scirpus lacustris</i> ( <i>Schoenoplectus lacustris</i> )	FL6	2007
Common sedge	<i>Carex nigra</i>	GA1	2007
Common spike rush	<i>Eleocharis palustris</i>	GA1	2007
Great fen sedge	<i>Cladium mariscus</i>	FL6	2007
Yellow sedge	<i>Carex lepidocarpa</i>		2007
<b>Birds</b>			
Moor hen	<i>Gallinula chloropus</i>	FL6	2007
Plover	<i>Pluvialis apricaria</i>	FL6	2007
White fronted goose	<i>Anser albifrons</i>	FL6	2007

## Lisnageeragh Bog and Ballinastack Turlough SAC 0296

Common Name	Latin name	Habitat	Year
<b>Trees</b>			
Ash	<i>Fraxinus excelsior</i>	WL1	2007
Blackthorn	<i>Prunus spinosa</i>	WL1	2007
Gorse	<i>Ulex europaeus</i>	WL1	2007
Hawthorn	<i>Crataegus monogyna</i>	WL1	2007
Willow	<i>Salix</i> sp.	FW4	2007
<b>Herbaceous plants and shrubs</b>			
Brambles	<i>Rubus fruticosus</i>	WL1	2007
Broadleaved dock	<i>Rumex obtusifolius</i>	GS4	2007
Cats ear	<i>Hypochaeris radicata</i>	GS4	2007
Common chickweed	<i>Stellaria media</i>	GS4	2007
Common knapweed	<i>Centaurea nigra</i>	WL1	2007
Common mouse ear	<i>Cerastium fontanum</i>	WL1, GS4	2007
Common sorrel	<i>Rumex acetosa</i>	GS4	2007
Creeping buttercup	<i>Ranunculus repens</i>	GS4	2007
Creeping yellow cress	<i>Rorippa sylvestris</i>	GS4	2007
Daisy	<i>Bellis perennis</i>	GS4, WL1	2007
Field veronica	<i>Veronica persica</i>	GS4	2007
Goose grass	<i>Galium aparine</i>	WL1	2007
Grass of Parnassus	<i>Parnassia palustris</i>	GS4	2007
Great yellow cress	<i>Rorippa amphibia</i>	FW4	2007
Greater plantain	<i>Plantago major</i>	GS4	2007
Greater spearwort	<i>Ranunculus lingua</i>	GS4	2007
Knotgrass	<i>Polygonum aviculare</i> ( <i>Persicaria heterophyllum</i> )	GS4	2007
Lesser spearwort	<i>Ranunculus flammula</i>	GS4	2007
Marsh cinquefoil	<i>Potentilla palustris</i>	GS4	2007
Marsh marigold	<i>Caltha</i> ( <i>Caltha palustris</i> )	FW4, GS4	2007
Marsh pennywort	<i>Hydrocotyle vulgaris</i>	GS4	2007
Marsh ragwort	<i>Senecio aquatica</i>	GS4	2007
Marsh thistle	<i>Cirsium palustre</i>	GS4, WL1	2007
Marsh yellow-cress	<i>Porippa palustre</i>	GS4	2007
Meadowsweet	<i>Filipendula ulmaria</i>	GS4	2007
Northern bedstraw	<i>Galium boreale</i>	FW4, GS4	2007
Pineapple weed	<i>Matricaria discoidea</i>	FL6, GS4	2007
Redleg	<i>Polygonum persicaria</i> ( <i>Persicaria maculosa</i> )	GS4	2007
Ribwort plantain	<i>Plantago lanceolata</i>	GS4	2007
Selfheal	<i>Prunella vulgaris</i>	GS4	2007
Shepherds purse	<i>Capsella bursa-pastoris</i>	GS4	2007
Silverweed	<i>Potentilla anserina</i>	GS4, FL6	2007
Trifid bur-marigold	<i>Bidens tripartite</i>	FW4, GS4	2007
Tufted vetch	<i>Vicia cracca</i>	WL1	2007
Water mint	<i>Mentha aquatica</i>	FW4	2007
White clover	<i>Trifolium repens</i>	GS4	2007
Yellow loosestrife	<i>Lysimachia vulgaris</i>	GS4	2007
<b>Aquatic plants</b>			
Amphibious bistort	<i>Polygonum amphibium</i> ( <i>Persicaria amphibia</i> )	GS4	2007
Bogbean	<i>Menyanthes</i> ( <i>Menyanthes trifoliata</i> )	FW4	2007
Broad leaved pondweed	<i>Potamogeton natans</i>	FW4	2007
Common water starwort	<i>Callitriche stagnalis</i>	FW4, GS4	2007
Least Bur-reed	<i>Sparganium minimum</i> ( <i>Sparganium natans</i> )	FW4	2007
Thread-leaved Water Crowfoot	<i>Ranunculus trichophyllus</i>	FW4	2007
Thread-leaved Water Crowfoot	<i>Ranunculus trichophyllus</i>	FW4	2007
Unbranched bur-reed	<i>Sparangium emersum</i>	FW4	2007
Water dock	<i>Rumex obtusifolius</i>	FL6	2007

Common Name	Latin name	Habitat	Year
<b>Aquatic plants</b>			
Water forget-me-not	<i>Myosotis scorpioides</i>	FW4, GS4	2007
Water pepper	<i>Persicaria minor</i>	GS4	2007
Water plantain family	<i>Alisma</i>	FW4	2007
Water-plantain	<i>Alisma plantago-aquatica</i>	FW4	2007
<b>Grasses</b>			
Creeping bent	<i>Agrostis stolonifera</i>	GS4	2007
Floating sweet grass	<i>Glyceria fluitans</i>	FW4	2007
Marsh foxtail	<i>Alopecurus geniculatus</i>	GS4	2007
Rye grass	<i>Lolium perenne</i>	GS4	2007
Wavy hair grass	<i>Deschampsia flexuosa</i>	GS4	2007
Yorkshire fog	<i>Holcus lanatus</i>	GS4	2007
<b>Mosses, Ferns and lichens</b>			
Turlough moss	<i>Cinclidotus fontinaloides</i>	FL6	2007
Male fern	<i>Dryopteris filix-mas</i>	WL1	2007
<b>Sedges, rushes, reeds</b>			
Blunt-flowered rush	<i>Juncus subnodulosus</i>	GS4	2007
Common sedge	<i>Carex nigra</i>	GS4	2007
Common spike rush	<i>Eleocharis palustris</i>	GS4	2007
Soft rush	<i>Juncus effuses</i>	GS4	2007
Tawny sedge	<i>Carex hostiana</i>	GS4	2007
<b>Birds</b>			
Swallow	<i>Hirundo rustica</i>	FL6	2007
<b>Mammals and amphibians</b>			
Rabbit burrow		WL1	2007
<b>Butterflies, moths and insects</b>			
Small white	<i>Pieris rapae</i>	FW4	2007
Cinnabar moth	<i>Tyria jacobaeae</i>	GS4	2007
Large red damselfly	<i>Pyrrhosoma nymphula</i>	WL1	2007
Buff-tailed bumble bee	<i>Bombus terrestris</i>	GS4	2007
Red admiral caterpillar	<i>Vanessa atalanta</i>	GS4	2007



### Lough Lurgreen Bog/ Glenamaddy Turlough SAC 301

Common Name	Latin name	Habitat	Year
<b>Trees</b>			
Alder	<i>Alnus glutinosa</i>	WS1	2007
Bog myrtle	<i>Myrica gale</i>	PF1	2007
Creeping willow	<i>Salix repens</i>	WS1, PF1	2007
Gorse	<i>Ulex europaeus</i>	WS1	2007
Hawthorn	<i>Crataegus monogyna</i>	WS1	2007
Willow	<i>Salix</i> sp.	PF1	2007
<b>Herbaceous plants and shrubs,</b>			
Birdsfoot trefoil	<i>Lotus corniculatus</i>	PF1	2007
Brambles	<i>Rubus fruticosus</i>	WS1	2007
Bulrush	<i>Typha latifolia</i>	PF1	2007
Common knapweed	<i>Centaurea nigra</i>	WS1	2007
Common ragwort	<i>Senecio jacobaea</i>	WS1	2007
Devil's bit scabious	<i>Succisa pratensis</i>	PF1	2007
Eyebright	<i>Euphrasia</i>	PF1	2007
Grass of Parnassus	<i>Parnassia palustris</i>	PF1	2007
Great yellow cress	<i>Rorippa amphibia</i>	PF1	2007
Hedge bindweed	<i>Calystegia sepium</i>	WS1	2007
Hogweed	<i>Heracleum sphondylium</i>	WS1	2007
Marsh bedstraw	<i>Galium palustre</i>	PF1	2007
Marsh pennywort	<i>Hydrocotyle vulgaris</i>	PF1	2007
Meadowsweet	<i>Filipendula ulmaria</i>	PF1	2007
Oilseed rape	<i>Brassica napus</i> var. <i>oleifera</i>	WS1	2007
Oxeye daisy	<i>Leucanthemum vulgare</i>	WS1	2007
Red clover	<i>Trifolium pratense</i>	WS1	2007
Silverweed	<i>Potentilla anserina</i>	WS1, PF1	2007
Smooth hawsbeard	<i>Crepis capillaris</i>	PF1	2007
Tormentil	<i>Potentilla erecta</i>	PF1	2007
Water mint	<i>Mentha aquatica</i>	PF1	2007
Yarrow	<i>Achillea millefolium</i>	WS1	2007
Yellow rattle	<i>Rhinanthus minor</i>	WS1	2007
<b>Aquatic plants</b>			
Amphibious bistort	<i>Polygonum amphibium</i> ( <i>persicaria amphibia</i> )	FL6	2007
Bogbean	<i>Menyanthes</i> ( <i>Menyanthes trifoliata</i> )	PF1	2007
Broad leaved pondweed	<i>Potamogeton natans</i>	PF1	2007
<b>Grasses</b>			
Floating sweet grass	<i>Glyceria fluitans</i>	FL6	2007
Purple Moor grass	<i>Molinia caerulea</i>	PF1	2007
<b>Sedges, rushes, reeds</b>			
Compact rush	<i>Juncus conglomeratus</i>	GS4	2007
Soft rush	<i>Juncus effusus</i>	GS4	2007
<b>Mosses, Ferns and lichens</b>			
Male fern	<i>Dryopteris filix-mas</i>	PF1	2007
Royal fern	<i>Osmunda regalis</i>	PF1	2007
<b>Birds</b>			
Great crested grebe	<i>Podiceps cristatus</i>	FL6	2007
Swan	<i>Cygnus</i> sp.	FL6	2007
<b>Fish</b>			
*Brown trout	<i>Salmo trutta</i>	FL6	2007

\*Great crested grebe observed with a fish possible brown trout.

## Carrowkeel Turlough SAC 0475

Common Name	Latin name	Habitat	Year
<b>Trees</b>			
Alder	<i>Alnus glutinosa</i>	WL1	2007
Ash	<i>Fraxinus excelsior</i>	WL1	2007
Blackthorn	<i>Prunus spinosa</i>	WL1	2007
Hawthorn	<i>Crataegus monogyna</i>	WL1	2007
<b>Herbaceous plants and shrubs</b>			
Birdsfoot trefoil	<i>Lotus corniculatus</i>	GS3	2007
Bush vetch	<i>Vicia sepium</i>	GS3	2007
Cat's ear	<i>Hypochaeris radicata</i>	GS3	2007
Common chickweed	<i>Stellaria media</i>	GS3	2007
Common knapweed	<i>Centaurea nigra</i>	GS3	2007
Creeping buttercup	<i>Ranunculus repens</i>	GS3	2007
Creeping thistle	<i>Cirsium arvense</i>	GS3	2007
Creeping yellow cress	<i>Rorippa sylvestris (Nastrurtium sylvestre)</i>	FL6	2007
Devil's bit scabious	<i>Succisa pratensis</i>	GS3	2007
Eyebright	<i>Euphrasia</i>	GS3	2007
Lesser spearwort	<i>Ranunculus flammula</i>	FL6	2007
Marsh marigold	<i>Caltha palustris</i>	FL6	2007
Marsh pennywort	<i>Hydrocotyle vulgaris</i>	GS3	2007
Marsh stitchwort	<i>Stellaria palustris</i>	FL6	2007
Meadowsweet	<i>Filipendula ulmaria</i>	GS3	2007
Mint	<i>Mentha sp.</i>	GS3	2007
Nettles	<i>Urtica dioica</i>	GS3	2007
Northern bedstraw	<i>Galium boreale</i>	FL6	2007
Oxeye daisy	<i>Leucanthemum vulgare</i>	GS3	2007
Pignut	<i>Conopodium majus</i>	GS3	2007
Ribwort plantain	<i>Plantago lanceolata</i>	GS3	2007
Self heal	<i>Prunella vulgaris</i>	GS3	2007
Silverweed	<i>Potentilla anserina</i>	GS3	2007
Stinging nettle	<i>Urtica dioica</i>	GS3	2007
White clover	<i>Trifolium repens</i>	GS3	2007
Yarrow	<i>Achillea millefolium</i>	GS3	2007
Yellow rattle	<i>Rhinanthus minor</i>	GS3	2007
<b>Aquatic plants</b>			
Amphibious bistort	<i>Polygonum amphibium (Persicaria amphibia)</i>	FL6	2007
Broad leaved pondweed	<i>Potamogeton natans</i>	FL6	2007
Fine-leaved water dropwort	<i>Oenanthe aquatica</i>	FL6	2007
Narrow-leaved water plantain	<i>Alisma lanceolatum</i>	FL6	2007
Water horsetail	<i>Equisetum fluviatile</i>	FL6	2007
<b>Grasses</b>			
Cocksfoot grass	<i>Dactylis glomerata</i>	GS1 / GS3	2007
Floating sweet grass	<i>Glyceria fluitans</i>	FL6	2007
Giant fescue	<i>Festuca gigantea</i>	WL1	2007
Quaking grass	<i>Briza (Briza media)</i>		2007
Ryegrass	<i>Lolium</i>	GS1 / GS3	2007
Timothy	<i>Phleum pratense</i>	GS1 / GS3	2007
<b>Sedges, rushes, reeds</b>			
Bladder sedge	<i>Carex vesicaria</i>	FL6	2007
Blunt flowered rush	<i>Juncus subnodosus</i>	FL6	2007
Common Club-rush	<i>Scirpus lacustris (Schoenoplectus lacustris)</i>	FL6	2007
<b>Birds</b>			
Mallard	<i>Anas platyrhynchos</i>	FL6	2007*
Moor hen	<i>Gallinula chloropus</i>	FL6	2007
Mute swan	<i>Cynus olor</i>	FL6	2007*

Common Name	Latin name	Habitat	Year
<b>Birds</b>			
Robin	<i>Erithacus rubecula</i>	WL1	2007
Swallow	<i>Hirundo daurica</i>	GS1 / GS3	2007
<b>Mammals and amphibians</b>			
Frog	<i>Rana temporaria</i>	GS1 / GS3	2007
<b>Butterflies, moths and insects</b>			
Peacock butterfly	<i>Inachis io</i>	GS1 / GS3	2007
Common darter	<i>Sympetrum striolatum</i>	FL6	2007

2007\* Local Knowledge / Local observations personal communication with landowner

## Thomastown Turlough (Clyard Kettle-Holes) SAC 0480

Common Name	Latin name	Habitat	Year
<b>Trees</b>			
Ash	<i>Fraxinus excelsior</i>	WL1	2007
Blackthorn	<i>Prunus spinosa</i>	WL1	2007
Buckthorn	<i>Rhamnus cathartica</i>	WL1	2007
Damson	<i>Prunus domestica</i>	WL1	2007
Guelder rose	<i>Viburnum opulus</i>	WL1	2007
Hawthorn	<i>Crataegus monogyna</i>	WL1	2007
Spindle	<i>Euonymus europaeus</i>	WL1	2007
Sycamore	<i>Acer</i>	WL1	2007
<b>Herbaceous plants and shrubs</b>			
Birdsfoot trefoil	<i>Lotus corniculatus</i>	GA1	2007
Brambles	<i>Rubus fruticosus</i>	WL1	2007
Broadleaved dock	<i>Rumex obtusifolius</i>	GA1	2007
Bush vetch	<i>Vicia sepium</i>	GA1	2007
Cat's ear	<i>Hypochaeris radicata</i>	GA1	2007
Common chickweed	<i>Stellaria media</i>	GA1	2007
Common knapweed	<i>Centaurea nigra</i>	GA1	2007
Creeping buttercup	<i>Ranunculus repens</i>	GA1	2007
Devil's bit scabious	<i>Succisa pratensis</i>	GA1	2007
Great yellow cress	<i>Rorippa amphibia</i>	GA1	2007
Ivy	<i>Hedera helix</i>	WL1	2007
Ladys bedstraw	<i>Galium verum</i>	GA1	2007
Lesser spearwort	<i>Ranunculus flammula</i>	GA1	2007
Marsh bedstraw	<i>Galium palustre</i>	FL6	2007
Marsh pennywort	<i>Hydrocotyle vulgaris</i>	GA1	2007
Marsh ragwort	<i>Senecio aquaticus</i>	GA1	2007
Meadowsweet	<i>Filipendula ulmaria</i>	GA1	2007
Nettle	<i>Urtica dioica</i>	GA1	2007
Pink bedstraw	<i>Unidentified</i>	FL6	2007
Red clover	<i>Trifolium pratense</i>	GA1	2007
Ribwort plantain	<i>Plantago lanceolata</i>	GA1	2007
Self heal	<i>Prunella vulgaris</i>	GA1	2007
Silverweed	<i>Potentilla anserina</i>	GA1, FL6	2007
Tormentil	<i>Potentilla erecta</i>	GA1	2007
Tufted vetch	<i>Vicia cracca</i>	GA1	2007
Water mint	<i>Mentha aquatica</i>	GA1, FL6	2007
White clover	<i>Trifolium repens</i>	GA1	2007
Yarrow	<i>Achillea millefolium</i>	GA1	2007
Yellow loosestrife	<i>Lysimachia vulgaris</i>	GA1	2007
Yellow rattle	<i>Rhinanthus minor</i>	GA1	2007
<b>Aquatic plants</b>			
Amphibious bistort	<i>Polygonum amphibium (persicaria amphibia)</i>	FL6	2007
Least water pepper	<i>Persicaria minor</i>	GA1	2007
Lesser water plantain	<i>Baldellia ranunculoides</i>	GA1	2007
Thread-leaved Water Crowfoot	<i>Ranunculus trichophyllus</i>	FL6	2007
Water forget-me-not	<i>Myosotis scorpioides</i>	GA1, FL6	2007
Water horsetail	<i>Equisetum fluviatile</i>	FL6	2007
<b>Grasses</b>			
Floating sweet grass	<i>Glyceria fluitans</i>	GA1	2007
Timothy	<i>Phleum pratense</i>	GA1	2007
Purple moor grass	<i>Molinia caerulea</i>	GA1	2007
<b>Mosses, Ferns and lichens</b>			
Turlough moss	<i>Cinclidotus fontinaloides</i>	FL6	2007

Common Name	Latin name	Habitat	Year
<b>Sedges, rushes, reeds</b>			
Blunt flowered rush	<i>Juncus subnodulosus</i>	GA1	2007
Common club rush	<i>Schoenoplectus lacustris</i>	GA1	2007
Common sedge	<i>Carex nigra</i>	GA1	2007
Tawny sedge	<i>Carex hostiana</i>	GA1	2007
<b>Birds</b>			
Wigeon	<i>Anas penelope</i>	FL6	2007
Wren	<i>Troglodytes troglodytes</i>	WL1	2007
Blackbird	<i>Turdus merula</i>	WL1	2007
Robin	<i>Erithacus rubecula</i>	WL1	2007
<b>Mammals and amphibians</b>			
Frog	<i>Rana temporaria</i>	GA1	2007
<b>Butterflies, moths and invertebrates</b>			
Blue tailed damselfly	<i>Ischnura elegans</i>	FL6	2007
Buff-tailed bumble bee	<i>Bombus terrestris</i>	GA1	2007
Crane fly	<i>Tipula maxima</i>	GA1	2007
Large red damselfly	<i>Pyrrhosoma nymphula</i>	FL6	2007
Small heath	<i>Coenonympha pamphilus</i>	FL6	2007
Small tortoiseshell	<i>Nymphalis urticae</i>	FL6	2007
Small white	<i>Pieris rape</i>	GA1	2007

## Shrule Turlough SAC 0525

Common Name	Latin name	Habitat	Year
<b>Trees</b>			
Buckthorn	<i>Rhamus cathartica</i>	FW4	2007
Damson	<i>Prunus domestica</i>	FW4	2007
Creeping willow	<i>Salix repens</i>	FW4	2007
Grey willow	<i>Salix cinerea</i>	FW4	2007
Hawthorn	<i>Crataegus monogyna</i>	FW4, GA1, WS1	2007
Ash	<i>Fraxinus excelsior</i>	FW4	2007
Sycamore	<i>Acer</i> sp.	GA1	2007
<b>Herbaceous, shrubs, aquatic plants</b>			
Birdsfoot trefoil	<i>Lotus corniculatus</i>	GS3, PF1	2007
Bramble	<i>Rubus fruticosus</i>	FW4	2007
Broadleaved dock	<i>Rumex obtusifolius</i>	GS3	2007
Cat's ear	<i>Hypochaeris radicata</i>	GA1, GS3	2007
Common duckweed	<i>Lemna minor</i>	FW4	2007
Common knapweed	<i>Centaurea nigra</i>	GA1	2007
Creeping buttercup	<i>Ranunculus repens</i>	GA1	2007
Creeping thistle	<i>Cirsium arvense</i>	GA1	2007
Creeping yellow cress	<i>Rorippa sylvestris (Nastrurtium sylvestre)</i>	FW4	2007
Dandelion	<i>Taraxacum officinale</i>	GA1	2007
Devils bit scabious	<i>Succisa pratensis</i>	GS3, PF1	2007
Dropwort	<i>Filipendula vulgaris</i>	PF1, GS3	2007
Great fen sedge	<i>Cladium mariscus</i>	PF1	2007
Great knapweed	<i>Centaurea scabiosa</i>	PF1	2007
Great willowherb	<i>Epilobium</i>	GA1	2007
Hedge bindweed	<i>Calystegia sepium</i>	GA1	2007
Ladys bedstraw	<i>Galium verum</i>	GA1	2007
Lesser meadow rue	<i>Thalictrum flavum</i>	GS3	2007
Lesser spearwort	<i>Ranunculus flammula</i>	GS3	2007
Marsh bedstraw	<i>Galium palustre</i>	GS3	2007
Marsh marigold	<i>Caltha palustris</i>	PF1, GS3	2007
Marsh pennywort	<i>Hydrocotyle vulgaris</i>	GS3	2007
Marsh ragwort	<i>Senecio aquatica</i>	FW4	2007
Marsh thistle	<i>Cirsium palustre</i>	GA1, GS3	2007
Marsh woundwort	<i>Stachys palustris</i>	FW4	2007
Meadowsweet	<i>Filipendula ulmaria</i>	GA1, GS4, FS1, FL7 PF1	2007
Nettle	<i>Urtica dioica</i>	GA1	2007
Northern bedstraw	<i>Galium boreale</i>	GS3	2007
Pale persicaria	<i>Persicaria lapathifolia</i>	GA1	2007
Purple loosestrife	<i>Lythrum salicaria</i>	GS3	2007
Ragged robin	<i>Lychnis flos-cuculi</i>	GS4	2007
Red barista	<i>Odontites vernus</i>	GA1, GS3	2007
Red clover	<i>Trifolium pratense</i>	GA1, GS3	2007
Ribwort plantain	<i>Plantago lanceolata</i>	PF1, GS3	2007
Sea plantain	<i>Plantago maritima</i>	PF1	2007
Self heal	<i>Prunella vulgaris</i>	GS3	2007
Silverweed	<i>Potentilla anserina</i>	GS3	2007
Sneezewort	<i>Achillea ptarmica</i>	PF1	2007
Tormentil	<i>Potentilla erecta</i>	GA1, PF1	2007
Trifid Bur-marigold	<i>Bidens tripartita</i>	FW4	2007
Tufted vetch	<i>Vicia cracca</i>	FW4	2007
Water mint	<i>Mentha aquatica</i>	GA1, FW4, GS3	2007
Wild thyme	<i>Thymus polytrichus</i>	GA1	2007
Yellow iris	<i>Iris pseudacorus</i>	GS4, FW4	2007
Yellow loosestrife	<i>Lysimachia vulgaris</i>	GS3, FW4	2007

Common Name	Latin name	Habitat	Year
<b>Aquatic plants</b>			
Amphibious bistort	<i>Polygonum amphibium (Persicaria amphibia)</i>	FL7	2007
Bogbean	<i>Menyanthes trifoliata</i>	FW4	2007
Broad leaved pondweed	<i>Potamogeton natans</i>	FW4	2007
Brooklime	<i>Veronica beccabunga</i>	FW4	2007
Common water starwort	<i>Callitriche stagnalis</i>	FW4	2007
Fool's watercress	<i>Apium nodiflorum</i>	FW4	2007
Horned pondweed	<i>Zannichellia palustris</i>	FW4	2007
Least Bur-reed	<i>Sparganium minimum (Sparganium natans)</i>	FW4	2007
Marestail	<i>Hippuris vulgaris</i>	FW4	2007
Speedwell (unknown details)	<i>Veronica (unusual hybrid)</i>	FW4	2007
Spiked water milfoil	<i>Myriophyllum spicatum</i>	FW4	2007
Unbranched bur-reed	<i>Sparangium emersum</i>	FW4	2007
Various-leaved pondweed	<i>Potamogeton gramineus</i>	FW4	2007
Water forget-me-not	<i>Myosotis scorpioides</i>	FW4	2007
Water horsetail	<i>Equisetum fluviatile</i>	FW4	2007
Water plantain	<i>Alisma plantago-aquatica</i>	FW4	2007
Water speedwell	<i>Veronica anagallis-aquatica</i>	FW4	2007
Watercress	<i>Rorippa nasturtium-aquaticum</i>	FW4	2007
<b>Grasses</b>			
Creeping bent	<i>Agrostis stolonifera</i>	GS3	2007
Crested dogstail	<i>Cynosurus cristatus</i>	GS3	2007
Floating sweet grass	<i>Glyceria fluitans</i>	FW4	2007
Quaking grass	<i>Briza (Briza media)</i>	GS3	2007
Tall fescue	<i>Fescue arundinacea</i>	GS3	2007
<b>Sedges, rushes, reeds</b>			
Black Bog-rush	<i>Schoenus nigricans</i>	PF1	2007
Blunt-flowered rush	<i>Juncus subnodulosus</i>	PF1	2007
Bulrush	<i>Typha latifolia</i>	FW4	2007
Common club rush	<i>Schoenplectus lacustris</i>	FL7, FW4	2007
Common reed	<i>Phragmites australis</i>	FL7, FW4, FS1	2007
Common sedge	<i>Carex nigra</i>	GS3	2007
Great fen sedge	<i>Cladium mariscus</i>	GS3	2007
Jointed rush	<i>Juncus articulatus</i>	GS4	2007
Purple moor grass	<i>Molinia caerulea</i>	PF1	2007
Spiked sedge	<i>Carex sicata</i>	GS4	2007
<b>Mosses, Ferns and lichens</b>			
Turlough moss	<i>Cinclidotus fontinaloides</i>	FL6	2007
<b>Mammals and Amphibian</b>			
Common Frog	<i>Rana temporaria</i>	GA1, GS3	2007
Fox	<i>Vulpes vulpes</i>	FW4	2007
Hare	<i>Lepus timidus hibernicus</i>	GS3	2007
Smooth Newt	<i>Triturus vulgaris</i>	PF1	2007*
<b>Birds</b>			
Grey Heron	<i>Ardea cinerea</i>	FL6	2007*
Kingfisher	<i>Alcedo atthis</i>	FW4	2007
Lapwing	<i>Vanellus vanellus</i>	FL6	2007*
Malard	<i>Anas platyrhynchos</i>	FW4	2007
Snipe	<i>Gallinago gallinago</i>	FL6	2007*
Stonechat	<i>Saxicola torquata</i>	FW4	2007
Water Rail	<i>Rallus aquaticus</i>	FW4	2007
Wren	<i>Troglodytes troglodytes</i>	FW4	2007
Yellowhammer	<i>Emberiza citrinella</i>	FL6	2007*



Common Name	Latin name	Habitat	Year
<b>Butterflies, moths and insects</b>			
Banded demoiselle	<i>Calopteryx splendens</i>	FW4	2007
Grasshopper	<i>Chorthippus</i> sp.	GS3	2007
Great pond snail	<i>Lymnaea stagnalis</i>	FW4	2007
<b>Butterflies, moths and insects</b>			
Large red damselfly	<i>Pyrrhosoma nymphula</i>	FW4	2007
Peacock butterfly	<i>Inachis io</i>	GA1	2007
Red admiral caterpillar	<i>Vanessa atalanta</i>	GA1	2007
Ruddy darter	<i>Sympetrum sanguineum</i>	FW4	2007
Small white	<i>Pieris rapae</i>	GS3	2007

2007\* Local Knowledge / Local observations personal communication with landowner

## Belclare Turlough NHA 0234

Common Name	Latin name	Habitat	Year
<b>Trees</b>			
Buckthorn	<i>Rhamus cathartica</i>	FW4, GA1	2007
Hawthorn	<i>Crataegus monogyna</i>	FW4, GA1	2007
Willow	<i>Salix</i> sp.	GA1, FW4	2007
<b>Herbaceous flora and shrubs</b>			
Birdsfoot trefoil	<i>Lotus corniculatus</i>	GA1	2007
Broadleaved dock	<i>Rumex obtusifolius</i>	FW4, GA1	2007
Cat's ear	<i>Hypochaeris radicata</i>	FW4, GA1	2007
Creeping buttercup	<i>Ranunculus repens</i>	GA1	2007
Creeping thistle	<i>Cirsium arvense</i>	FW4, GA1	2007
Dropwort	<i>Filipendula vulgaris</i>	GA1	2007
Goose grass	<i>Galium aparine</i>	GA1	2007
Grass of Parnassus	<i>Parnassia palustre</i>	FW4, GA1	2007
Greater spearwort	<i>Ranunculus lingua</i>	GA1	2007
Hedge mustard	<i>Sisymbrium officinale</i>	GA1	2007
Ladys bedstraw	<i>Galium verum</i>	GA1	2007
Marsh bedstraw	<i>Galium palustre</i>	FW4, GA1	2007
Marsh marigold	<i>Caltha palustris</i>	FW4, GA1	2007
Marsh pennywort	<i>Hydrocotyle vulgaris</i>	FW4, GA1	2007
Marsh ragwort	<i>Senecio aquaticus</i>	GA1	2007
Marsh woundwort	<i>Stachys palustre</i>	FW4, GA14	2007
Meadowsweet	<i>Filipendula ulmaria</i>	GA1	2007
Ox eye daisy	<i>Leucanthemum vulgare</i>	GA1	2007
Pineapple weed	<i>Matricaria discoidea</i>	GA1	2007
Red clover	<i>Trifolium pratense</i>	GA1	2007
Redleg	<i>Persicaria maculosa</i>	GA1	2007
Self heal	<i>Prunella vulgaris</i>	FW4, GA1	2007
Silverweed	<i>Potentilla anserina</i>	GA1	2007
Trifid Bur-Marigold	<i>Bidens tripartita</i>	FW4, GA1	2007
Water mint	<i>Mentha aquatica</i>	FW4, GA1	2007
White clover	<i>Trifolium repens</i>	GA1	2007
Yellow loosestrife	<i>Lysimachia vulgaris</i>	GA1	2007
Yellow rattle	<i>Rhinanthus minor</i>	FW4, GA1	2007
Yellow rattle (variegated)			
<b>Aquatic plants</b>			
Amphibious bistort	<i>Polygonum amphibium</i> ( <i>Persicaria amphibia</i> )	FW4	2007
Common Water Starwort	<i>Callitriche stagnalis</i>	FW4	2007
Duckweed	<i>Lemna minor</i>	FW4	2007
Floating sweet grass	<i>Glyceria fluitans</i>	GA1	2007
Fools watercress	<i>Apium nodiflorum</i>	FW4, GA1	2007
Greater bladderwort	<i>Utricularia vulgaris</i>	FW4, GA1	2007
Lesser water parsnip	<i>Berula erecta</i>	FW4	2007
Martestail	<i>Hippuris vulgaris</i>	FW4, GA1	2007
Spiked water milfoil	<i>Myriophyllum spicatum</i>	FW4	2007
Unbranched bur-reed	<i>Sparganium emersum</i>	FW4	2007
Various leaved water starwort	<i>Callitriche platycarpa</i>	FW4	2007
Water forget- me-not	<i>Myosotis scorpioides</i>	FW4, GA1	2007
Water horsetail	<i>Equisetum fluviatile</i>	FW4	2007
Water plantain	<i>Alisma plantago-aquatica</i>	FW4, GA1	2007
<b>Grasses</b>			
Timothy	<i>Phleum pratense</i>	GA1	2007
<b>Mosses, Ferns and lichens</b>			
Turlough moss	<i>Cinclidotus fontinaloides</i>	FL6	2007

Common Name	Latin name	Habitat	Year
<b>Sedges, rushes, reeds</b>			
Black bog-rush	<i>Schoenus nigricans</i>	GA1	2007
Bulrush	<i>Typha latifolia</i>	FW4	2007
Common reed	<i>Phragmites australis</i>	FW4	2007
Common sedge	<i>Carex nigra</i>	FW4	2007
<b>Mammals and amphibians</b>			
Hare	<i>Lepus timidus hibernicus</i>	GA1	2007

# Killower Turlough NHA 0282

Common Name	Latin name	Habitat	Year
<b>Trees</b>			
Alder	<i>Alnus glutinosa</i>	WL1	2007
Ash	<i>Fraxinus excelsior</i>	WL1 FW4	2007
Buckthorn	<i>Rhamnus cathartica</i>	FW4	2007
Gorse	<i>Ulex europaeus</i>	PF1, FW4	2007
Hawthorn	<i>Crataegus monogyna</i>	WL1, PF1	2007
Snowberry	<i>Symphoricarpos albus</i>	FW4	2007
Sycamore	<i>Acer sp.</i>	WL1	2007
Willow	<i>Salix sp.</i>	FW4	2007
<b>Herbaceous plants and shrubs</b>			
Angelica	<i>Angelica sylvestris</i>	FW4, PF1	2007
Beaked hawksbeard	<i>Crepis vesicaria</i>	PF1	2007
Birdsfoot trefoil	<i>Lotus corniculatus</i>	PF1	2007
Brambles	<i>Rubus fruticosus</i>	WL1, PF1, FW4	2007
Cat's ear	<i>Hypochaeris radicata</i>	PF1	2007
Coltfoot	<i>Tussilago farfara</i>	PF1	2007
Common butterwort	<i>Pinguicula vulgaris</i>	PF1	2007
Common knapweed	<i>Centaurea nigra</i>	PF1, FW4	2007
Common milkwort	<i>Polygala vulgaris</i>	PF1	2007
Common spotted orchid	<i>Dactylorhiza fuchsii</i>	PF1	2007
Daisy	<i>Bellis perennis</i>	PF1	2007
Devil's bit scabious	<i>Succisa pratensis</i>	PF1	2007
Dog rose	<i>Rosa sp.</i>	PF1	2007
Dropwort	<i>Filipendula vulgaris</i>	FW4	2007
Dropwort	<i>Filipendula vulgaris</i>	PF1	2007
Grass of Parnassus	<i>Parnassia palustre</i>	PF1	2007
Great willow herb	<i>Epilobium hirsutum</i>	FW4	2007
Great yellow cress	<i>Rorippa amphibia</i>	PF1	2007
Harebell	<i>Campanula rotundifolia</i>	PF1	2007
Heath spotted orchid	<i>Dactylorhiza maculata</i>	PF1	2007
Hedge bindweed	<i>Calystegia sepium</i>	FW4	2007
Lesser spearwort	<i>Ranunculus flammula</i>	PF1	2007
Lesser Twayblade orchid	<i>Listera cordata</i>	PF1	2007
Lesser water parsnip	<i>Berula erecta</i>	FW4	2007
Marsh bedstraw	<i>Galium palustre</i>	PF1	2007
Marsh cinquefoil	<i>Potentilla palustris</i>	PF1	2007
Marsh marigold	<i>Caltha palustris</i>	FW4	2007
Marsh pennywort	<i>Hydrocotyle vulgaris</i>	PF1	2007
Marsh St. Johns wort	<i>Hypericum elodes</i>	PF1	2007
Marsh thistle	<i>Cirsium palustre</i>	PF1	2007
Marsh woundwort	<i>Stachys palustre</i>	FW4	2007
Meadowsweet	<i>Filipendula ulmaria</i>	FW4, PF1	2007
Nettle	<i>Urtica dioica</i>	PF1	2007
Ox eye daisy	<i>Leucanthemum vulgare</i>	PF1	2007
Pyramidal orchid	<i>Anacamptis pyramidalis</i>	PF1	2007
Red clover	<i>Trifolium pratense</i>	PF1	2007
Sea plantain	<i>Plantago maritima</i>	PF1	2007
Self heal	<i>Prunella vulgaris</i>	PF1	2007
Silverweed	<i>Potentilla anserina</i>	PF1	2007
Spear thistle	<i>Cirsium vulgare</i>	PF1	2007
Trifid Bur-Marigold	<i>Bidens tripartita</i>	FW4	2007
Water mint	<i>Mentha aquatica</i>	FW4, PF1	2007
Common Name	Latin name	Habitat	Year

<b>Herbaceous plants and shrubs</b>			
White clover	<i>Trifolium repens</i>	PF1	2007
Wild thyme	<i>Thymus polytrichus</i>	PF1	2007
Yarrow	<i>Achillea millefolium</i>	PF1	2007
Yellow rattle	<i>Rhinanthus minor</i>	PF1	2007
<b>Aquatic plants</b>			
Broad leaved pondweed	<i>Potamogeton natans</i>	FW4	2007
Common water Starwort	<i>Callitriche stagnalis</i>	FW4	2007
Duckweed	<i>Lemna minor</i>	FW4	2007
Floating sweet grass	<i>Glyceria fluitans</i>	PF1, FW4	2007
Fools watercress	<i>Apium nodiflorum</i>	FW4	2007
Martestail	<i>Hippuris vulgaris</i>	FW4	2007
Spiked water milfoil	<i>Myriophyllum spicatum</i>	FW4	2007
Unbranched bur-reed	<i>Sparganium emersum</i>	FW4	
Water forget- me-not	<i>Myosotis scorpioides</i>	FW4	2007
Water horsetail	<i>Equisetum fluviatile</i>	FW4	2007
Water plantain	<i>Alisma plantago-aquatica</i>	FW4	2007
<b>Grass</b>			
Purple moor grass	<i>Molinia caerulea</i>	PF1	2007
Quaking grass	<i>Briza media</i>	PF1	2007
<b>Mosses, Ferns and lichens</b>			
Turlough moss	<i>Cinclidotus fontinaloides</i>	FL6	2007
<b>Sedges, rushes, reeds</b>			
Black bog-rush	<i>Schoenus nigricans</i>	FW4, PF1	2007
Bulrush	<i>Typha latifolia</i>	FW4	2007
Common sedge	<i>Carex nigra</i>	FW4	2007
Jointed rush	<i>Juncus acutiflorus</i>	FW4	2007

### Rosstaff Turlough NHA 0385

Common Name	Latin name	Habitat	Year
<b>Trees</b>			
Ash	<i>Fraxinus excelsior</i>	FW4	2007
Blackthorn	<i>Prunus spinosa</i>	WL1	2007
Hawthorn	<i>Crataegus monogyna</i>	WL1	2007
Willow	<i>Salix</i> sp.	FW4	2007
<b>Herbaceous plants and shrubs</b>			
Angelica	<i>Angelica sylvestris</i>	FW1, FW4	2007
Birdsfoot trefoil	<i>Lotus corniculatus</i>	GA1	2007
Brambles	<i>Rubus fruticosus</i>	FW4	2007
Broadleaved dock	<i>Rumex obtusifolius</i>	GA1	2007
Bush vetch	<i>Vicia sepium</i>	FW4	2007
Cat's ear	<i>Hypochaeris radicata</i>	GA1, GS4	2007
Common chickweed	<i>Stellaria media</i>	GA1	2007
Common knapweed	<i>Centaurea nigra</i>	FW4, GA1, GS4	2007
Common spotted orchid	<i>Dactylorhiza fuchsii</i>	FW4	2007
Common valerian	<i>Valeriana officinalis</i>	FW4	2007
Creeping buttercup	<i>Ranunculus repens</i>	GA1	2007
Creeping thistle	<i>Cirsium arvense</i>	GA1, FW4	2007
Daisy	<i>Bellis perennis</i>	GA1	2007
Dropwort	<i>Filipendula vulgaris</i>	GS4	2007
Great yellow cress	<i>Rorippa amphibia</i>	GA1	2007
Herb Robert	<i>Geranium robertianum</i>	FW4	2007
Marsh bedstraw	<i>Galium palustre</i>	GA1	2007
Marsh pennywort	<i>Hydrocotyle vulgaris</i>	GA1, GS4	2007
Marsh ragwort	<i>Serecio aquaticus</i>	GA1	2007
Marsh thistle	<i>Cirsium palustre</i>	GA1	2007
Marsh woundwort	<i>Stachys palustre</i>	GA1, FW4	2007
Meadowsweet	<i>Filipendula ulmaria</i>	FW4, GA1, GS4	2007
Nettle	<i>Urtica dioica</i>	GA1, FW4	2007
Pineapple weed	<i>Matricaria discoidea</i>	GA1	2007
Purple loosestrife	<i>Lythrum salicaria</i>	FW4	2007
Red clover	<i>Trifolium pratense</i>	GS4	2007
Ribwort plantain	<i>Plantago lanceolata</i>	GA1, GS4	2007
Self heal	<i>Prunella vulgaris</i>	GA1, GS4	2007
Silverweed	<i>Potentilla anserina</i>	GA1	2007
Smooth hawkbeard	<i>Crepis capillaris</i>	FW4	2007
Spear thistle	<i>Cirsium vulgare</i>	GA1	2007
Trifid Bur-Marigold	<i>Bidens tripartita</i>	GA1	2007
Unbranched bur-reed	<i>Sparganium emersum</i>	FW1	2007
Water mint	<i>Mentha aquatica</i>	FW4, GA1	2007
White clover	<i>Trifolium repens</i>	GA1	2007
Yarrow	<i>Achillea millefolium</i>	FW4	2007
Yellow iris	<i>Iris pseudacorus</i>	FW4	2007
Yellow loosestrife	<i>Lysimachia vulgaris</i>	GS4	2007
<b>Aquatic plants</b>			
Brooklime	<i>Veronica beccabunga</i>	FW4	2007
Common water starwort	<i>Callitriche stagnalis</i>	FW4	2007
Duckweed	<i>Lemna minor</i>	FW4	2007
Floating sweet grass	<i>Glyceria fluitans</i>	FW1	2007
Fools watercress	<i>Apium nodiflorum</i>	FW4	2007
Perfoliate pondweed	<i>Potamogeton perfoliatus</i>	FW1	2007
Water forget- me-not	<i>Myosotis scorpioides</i>	FW1, FW4	2007
Water horsetail	<i>Equisetum fluviatile</i>	FW4	2007
Watercress	<i>Rorippa nasturtium-aquaticum</i>	FW4	2007

Common Name	Latin name	Habitat	Year
<b>Grasses</b>			
Annual meadow grass	<i>Poa annua</i>	GS4	2007
Crested dogs tail	<i>Cynosurus cristatus</i>	GS4	2007
Perennial rye grass	<i>Lolium perenne</i>	GS4	2007
Quaking grass	<i>Briza media</i>	GS4	2007
Timothy	<i>Phleum pratense</i>	GS4	2007
<b>Mosses, Ferns and lichens</b>			
Turlough moss	<i>Cinclidotus fontinaloides</i>	FL6	2007
<b>Sedges, rushes, reeds</b>			
Blunt flowered rush	<i>Juncus subnodulosus</i>	GA1	2007
Bulrush	<i>Typha latifolia</i>	FW4	2007
Common club rush	<i>Schoenoplectus lacustris</i>	FW1	2007
Common sedge	<i>Carex nigra</i>	FW4, GA1	2007
Compact rush	<i>Juncus conglomeratus</i>	GA1, GS4	2007
Soft rush	<i>Juncus effusus</i>	GS4, GA1	2007
<b>Birds</b>			
Comorant	<i>Phalacrocorax carbo</i>	FL6	2007
Curlew	<i>Numenius arquata</i>	FL6	2007
Robin	<i>Erithacus rubecula</i>	FW4	2007
Starling	<i>Sturnus vulgaris</i>	WL1	2007
Stonechat	<i>Saxicola torquata</i>	FW4	2007
Wren	<i>Troglodytes troglodytes</i>	FW4	2007
<b>Butterflies, moths</b>			
Peacock caterpillar	<i>Inachis io</i>	BL3	2007
Small white	<i>Pieris rape</i>	GA1	2007



## Appendix IV Met Éireann Climatic Data for 2006 and 2007

Total rainfall (mm) for 2006 and 2007 at the Claremorris weather station

Year	Month											
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
2007	132.2	102.0	95.4	22.8	70.5	100.2	127.9	78.9	60.9	91.1	80.0	165.0
2006	74.1	49.6	106.7	53.5		39.1	47.9	53.3	162.2	123.5	141.7	199.2
Mean	121.1	82.9	95.8	61.7	77.5	71.7	63.4	96.9	104.2	125.9	111.8	123.5

Temperature ( $^{\circ}\text{C}$ ) for 2006 and 2007 at the Claremorris weather station

Year	Month											
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
2007	6.5	5.6	6.7	10.1	10.7	14.0	14.2	14.5	12.8	11.3	8.9	6.5
2006	5.2	5.2	5.7	7.9	10.7	14.2	16.5	14.7	14.4	11.3	7.2	6.3
Mean	4.3	4.5	5.9	7.6	10.0	12.6	14.3	14.0	12.1	9.8	6.2	5.1

Soil temperature ( $^{\circ}\text{C}$ ) for 2006 and 2007 at the Claremorris weather station

Year	Month											
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
2007	5.7	5.1	7.0	11.6	13.7	16.8	17.2	16.9	14.9	12.1	9.3	6.1
2006	5.3	4.9	6.1	9.9	13.5	17.0	18.6	16.7	15.4	11.9	7.0	6.1
Mean	3.8	4.1	5.9	8.6	11.9	15.1	16.5	15.8	13.3	10.2	6.4	4.8

Season and year	Met Éireann comment
Autumn 2007	Warm and dry everywhere; sunshine totals near normal
Summer 2007	Wettest summer for 50 years in east; temperature and sunshine a little above normal
Spring 2007	Warmest and sunniest on record in places; dry except in northwest
Winter 2006 / 2007	Warmer, wetter and mostly sunnier than normal
Autumn 2006	Warmest Autumn on record in many places; wetter, sunnier than normal everywhere
Summer 2006	Warmest, driest and sunniest summer since 1995
Spring 2006	Very wet in many places; warmer, sunnier than normal generally
Winter 2005/ 2006	Very dry in many places; milder and sunnier than normal

Met Éireann seasonal weather summary for 2006 and 2007.