Heritage Surveys of Vulnerable Landscape 2006

Turlough at Bealnalicka

Report commissioned by Clare County Council in association with the Heritage Council, Rural Resource Development Group (Leader Company) and Clare Biodiversity Group, Clare Heritage Forum

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Final Draft

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Executive Summary

Clare County Council in association with the Heritage Council, Rural Resource Development and Clare Biodiversity commissioned Mary Tubridy and Associates to carry out a study of heritage resources in the countryside around Ennis and the Fergus Estuary in 2006. The area studied comprised 212km2 and included all the rural areas covered by the Ennis and Environs Development Plan. It excluded sites already designated for nature conservation, towns and villages.

The principal aim of the study is to describe and review the heritage resources of a landscape, which will be considered for development over the next five years. The heritage resources, which are the focus of this study, include archaeology, geodiversity (which describes geology and landscape features) and habitats. Archaeology and geodiversity were evaluated using existing information together with limited fieldwork of the area north and northeast of Ennis. Information on habitats was gathered through a comprehensive field survey during which all parts of the study area were visited. Habitats were mapped to Level 3 followed the habitat identification and mapping system promoted by the Heritage Council (Fossitt 2000) and the Draft Habitat Mapping Guidelines (2005).

Study outputs include this report; a Geographic Information System (GIS) with habitat mapping, hardcopies of large scale habitat maps (of Ennis, Quin and Shannon estuary areas) and a set of 6"Ordnance Survey maps covering the entire area annotated with information about karst features.

The study revealed the following important features:

A diversity of habitats, including forty-four different types.

The presence of habitats of high value which are sensitive to development. Important and vulnerable habitats cover 21% (3,081 ha) of the rural parts of the Ennis and Environs Development Plan area.

They include ten types listed in the EU Habitats Directive-those that are considered under threat and in danger of disappearance within the EU. These habitats are in addition to the valuable and vulnerable habitats present in the existing network of eighteen sites with nature conservation designations.

Valuable habitats are found throughout the area. They are well represented in the countryside north of Ennis where they are associated with a unique landscape which demonstrates the interface between karstic limestone bedrock and deep glacial sediments. Three rare and valuable types are common there: semi-natural woodland dominated by hazel, exposed limestone rock (limestone pavement) and turloughs. The latter two habitats require protection under the EU Habitats Directive.

> The archaeological heritage of the area, which covers all known periods of habitation is greater than existing records suggest. There is tentative evidence for the presence of landscape areas of particular significance.

An evaluation of the relative sensitivity of the Ennis and Environs Development Plan area (and adjacent land) based on habitat mapping was carried out. Land was categorized as either Highly Sensitive, Very Sensitive, Sensitive, Robust or Very Robust depending on the presence of particular habitats. This revealed that Highly sensitive areas cover 153ha (1.0%), Very Sensitive Areas 1,460ha (10.0%), Sensitive Areas (9.0%), Robust Areas (1.2%) and Very Robust Areas (78%). Very Sensitive areas contained habitats listed in the Habitats Directive. Robust and Very Robust areas contain less valuable and common habitats. Land which had been mapped from field studies and results digitized in 2006 was ascribed to one of these categories.

This evaluation has the following implications for spatial planning, environmental education and further studies:

- The preparation of all development plans, proposals for development, including applications for waste permits should be informed by an awareness of the location of land identified as Highly Sensitive, Very Sensitive and Sensitive Areas on the basis of the habitats which it supports.

- Revision of the Ennis and Environs Development Plan should involve:
    - An examination of the impact of policies on habitats considered Highly Sensitive, Very Sensitive or Sensitive to development, particularly turloughs, fens and semi-natural woodlands.
    - Specification of measures which could mitigate or compensate for impacts to these habitats.
    - The development of policies to minimize the impact of development in the area of high geodiversity value.

- The plan should contain an explicit objective to reduce development pressure in land categorized as Sensitive (21%) and increase it in Robust areas (79%). Major changes should not be encouraged in areas categorized as either Highly Sensitive, Very Sensitive or Sensitive, or those with functional linkages to sites with nature conservation designations. Within Sensitive Areas the priority should be to retain and enhance existing biodiversity. Within Robust Areas the priority should be to promote development and restore biodiversity values.

- Lists and boundaries of important heritage features and habitat types revealed by this study (all ranked as either Highly Sensitive, Very Sensitive or Sensitive) should be included in the plan. The plan should highlight the Habitat Map as a map of green infrastructure which needs management in the same way that society's "grey infrastructure" of roads and buildings is managed. It should refer to the importance not only of individual sites but

of "linkages" and "corridors". Linkages could include those between monuments, between monuments and their landscape, between habitats, between sites with nature conservation designations and certain habitats outside them, and different types of habitats used by important species such as bats.

- The area of geodiversity interest north of Ennis should be recognised as requiring particular policies to protect sub surface water quality. Development Plans should include a policy requesting the submission of a detailed map and photograph of karst features within a 250m radius of all development sites or areas proposed to receive landfill. Spot checks of percolation tests should take place in this region at a higher percentage level than elsewhere in the county and a database should be set up to record the photographed and mapped karst features.

- Areas with Sensitive (Highly Sensitive, Very Sensitive and Sensitive) habitats should be recognised as requiring particular policies to maintain (or enhance) their value, area and connectivity. The Ennis and Environs Development Plan should include a policy to request information on the nature of the habitats directly and indirectly affected by development in these areas and measures proposed to avoid or mitigate for negative impacts.

- The habitat map should be used to inform the Strategic Environmental Assessment of the Ennis and Environs Development Plan. Change in the cover of certain habitats should be used as an indicator to measure the impact of spatial planning. Targets should be set and a policy should be inserted stating that habitats will be resurveyed in 2011.

- Clare County Council in association with Clare Biodiversity and the Heritage Forum should ensure that the results of the study and habitat map are made available to landowners, developers and all interested members of the public.

- Training should be available to planners to enable them to utilise the results of the heritage survey. In the medium term an ecologist and archaeologist should be recruited by the County Council to support local strategies to integrate heritage conservation and development.

- Future survey work should prioritise turloughs (geodiversity and biodiversity) and the area of high geodiversity interest north of Ennis.

1 Introduction

1.1 The brief

According to the brief the principal objective of the study titled *Heritage Surveys of a Vulnerable Landscape*, is to survey an area around Ennis which will be considered for development over the next five years. The surveys should help to integrate development with recognised heritage values and inform actions to manage biodiversity.

Tasks required to achieve this objective were set out in the brief as follows:

a) A habitat survey following the Heritage Council's Draft Habitat Mapping Guidelines.

b) Reviews of the features of archaeological, geological or cultural heritage interest.

c) The compilation of a database with all the information collected in the survey being fully integrated with the Council's Geographical Information System.

d) An assessment of the likely impacts of development upon the heritage features having regard to current and future planning policies.

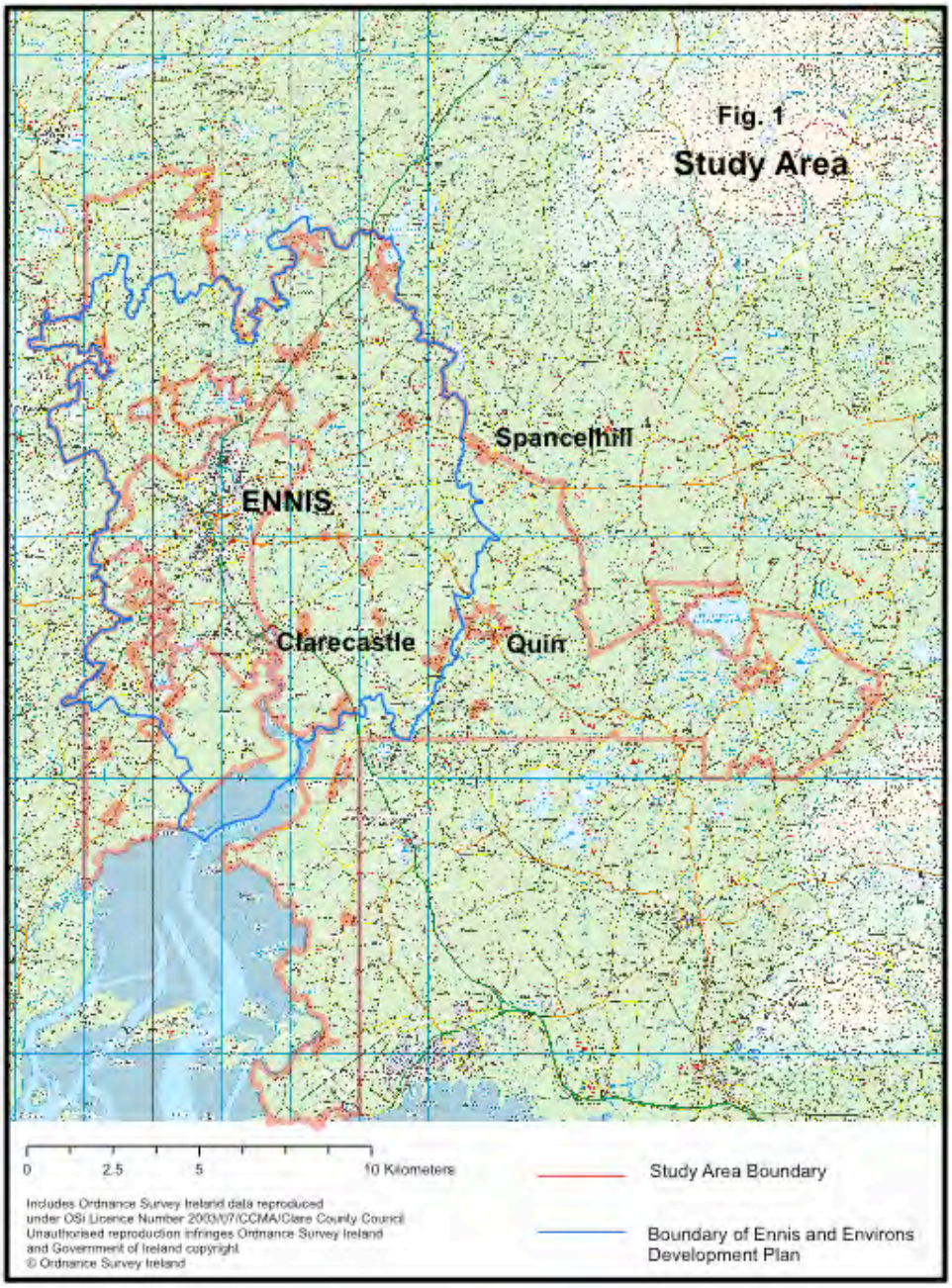
e) Provision of management guidelines for the conservation and enhancement of heritage features both at a local area level and on a generic basis.

f) A public awareness programme involving key stakeholders.

1.2 The study area

The study area shown in Fig. 1 covers 212.17 km2. This includes the rural areas (147km2) covered by the Ennis and Environs Development Plan.

It comprises the Fergus estuary and adjacent land to the north, east and west. To the south-east, the edge of the study area is defined by the Fergus estuary and a low-lying lake-studded region. The lower reaches of Maghera Mountain form the north-east boundary, while another area of lakeland, dominated by Muckanagh Lough, lies to the north.



The region of the Burren lies to the north-west, and another area of upland, dominated by Slievecallan, forms the west and south-west limits. The land is generally low lying with occasional elevated points, the ground surface lying between 5m and 110m above Ordnance Datum.

The study area is essentially countryside or rural land in the environs of Ennis. It covers the parishes of Kilnasoolagh, Tomfinlough, Kilfinaghta, Kilmaleery, Kilconry, Templemaley, Kilraghtis, Inchicronan, Cloney, Doora, Quin, Kilmurry, Ruan, Kilnamona, Dysert, Kilkeedy, Drumcliff, Clareabbey, Killone, Clondagad, Clonlea, Kilseily and Tulla. The relevant baronies are Bunratty Lower, Bunratty Upper, Inchiquin, Islands and Tulla Lower.

The area was identified by Clare County Council as an area under pressure from development about which little information was available on biodiversity and heritage. It excludes areas known to be of value for biodiversity (Special Areas of Conservation , Special Protection Areas and Natural Heritage Areas); land which has alredy been developed within the town of Ennis and in large villages such as Kilkishen, Quin and Ruan.

2 Approach

2.1 Key deliverables

Consultations with the Heritage Officer and steeting group for the project clarified, that while all the aspects of the local heritage mentioned in the brief (geology, archaeology and habitats) are all important, the key deliverables are 1) a habitat map to the most detailed level of classification for the entire area and 2) guidance to maximise the value of the heritage information to the Ennis and Environs Development Plan which is being revised in 2007.

The project required a team approach, key members of which were ecologists, a geomorphologist and Geographic Information System (GIS) specialists. A review of archaeology was commissioned from an archaeological consultancy TVAS Ltd., Clare.

2.2 Geological heritage

The term geodiversity expresses the variation in bedrock, subsoils, soils and terrain and all the processes that give landscape its special character. Measures to protect and recognise geodiversity involve landscape sensitivity analysis and specific measures to protect individual examples of geodiversity features.

The use of Landscape Character Assessment has been elaborated to a particular extent in Clare and the results are enshrined in the County Development Plan. The proposed study area falls within five landscape character areas. These are the Fergus loughlands (north of Ennis), Sixmilebridge/Quin farmlands, East Clare loughlands, Ennis drumlin farmland and the Fergus Estuary. Information on the character of each area is contained in Appendix 1. Sixmilebridge/Quin lowlands, east Clare loughlands and the Ennis drumlins are ranked as being of medium sensitivity to development; Fergus loughlands and Fergus estuary were identified as being of high sensitivity.Character assessments and sensitivity

rankings are based on an amalgamation of information on different aspects of local heritage including archaeology, biodiversity and landscape.

Features of national geodiversity interest can be protected under the Wildlife Amendment Act 2000 as Natural Heritage Areas. The Irish Geological Heritage Programme (IGHP), which is a partnership between The Geological Survey of Ireland (GSI) and The National Parks and Wildlife Service, has drawn up lists of sites, which could qualify as geological NHAs. This process involves expert panels drawing up lists of known sites, under sixteen different themes, one of which is karst. This is an indicative list of sites worthy of more detailed assessment. The site lists for karst has been completed, and reports have been written following fieldwork. The lists also include sites of regional value, which could be identified as County Geological Sites. The process, which has been carried out on a national scale, has been complemented in Clare by a desk study commissioned as an action of the Heritage Plan (Parkes *et. al*. 2005). This has identified three sites of geological interest within or immediately adjacent to the study area, which have potential as County Geological Sites

- Kilbreckan Mine (NGR 139900 176300). This site is of international importance for mineralogy and economic geology as it was the first place that 'Kilbreckenite' ore was found.

- Rineanna Point (NGR 134600 159800). While this site is just outside the study boundary it is included as it is of interest as an exposure of the
- Waulsortian limestone sequence.

- Toonagh Quarry near Ennis (NGR 130319 183800) is rated as a County Geological site as it provides an exposure of the 3-D Clare Burren type limestone Formation.

Records from the Geological Survey of Ireland (Karst Database, Groundwater Section) show the presence of one turlough within the study area.

No sites of national geodiversity importance have been officially proposed for designation as pNHAs within this area. Neither have geological NHAs suggested by the IGHP been designated as yet in the country.

2.3 Archaeology/cultural heritage

Within the study area, known sites of archaeological importance are listed in the Record of Monuments and Places for County Clare. These sites have statutory protection under the National Monuments Act 1930 (as amended), are available as a digital data base and are also listed in the County Development Plan. The list is being updated by field survey by the Archaeological Survey of Ireland (part of the Office of Public Works) and it is likely that some monuments will be removed from the list and others will be added. Outside the study area, in West Clare, a Fields Monuments Advisory Pilot Scheme is being implemented to

provide information on the status of known sites, guidance to landowners on whose land these sites occur and examine the potential for further sites of archaeological interest to be discovered.

2.4 Habitat mapping

2.4.1 Introduction

Habitat mapping is an important tool to identify areas of biodiversity interest. The Guide to Habitats in Ireland (Fossitt 2000) defines a habitat as "an area in which an organism or group of organisms lives, and is defined by the living (biotic) and non biotic (abiotic) components of the environment". By mapping habitats, information can be gathered about natural and semi-natural places in the landscape and the organisms, common or rare, which use them. Habitats vary in value for biodiversity depending on factors such as naturalness and habitat and species rarity. Habitats of high value are usually less modified by development. They may be associated with land, freshwaters or marine environments. The system promoted by the Heritage Council allows for a hierarchal classification of habitats in all these landscapes, from Level One to Three.

- Level One classification differentiates eleven habitats. These are Freshwater, Grassland and Marsh, Heath and Dense Bracken, Peatlands, Woodland and Scrub, Exposed Rock and Disturbed Ground, Cultivated and Built Land, Coastland, Littoral, Sub littoral and Marine Water Body.

- At Level Two, a more detailed classification is possible for the Level One types. For example Level One Freshwater habitats can be distinguished as either lakes, ponds, watercourses, springs or swamps.

- Level Three allows for further differentiation of these five types. There may be one of eight different lake habitats; four watercourses, two springs and two different kinds of swamps.

This approach allows for habitat mapping at different levels of differentiation depending on resources available and survey aims.

2.4.2 Current practice in habitat and species protection

Identification of habitats supports the implementation of the most important piece of wildlife legislation which applies in Ireland; The Habitats Directive 92/43/EEC (CEC, 1992), which was brought into force through the European Communities (Natural Habitats) Regulations 1997 (SI /97/094) and the Planning and Development Regulations 2001 (S.I. 600 of 2001) made under the Planning and Development Act, 2000.

Under this Directive there is a legal obligation on Ireland to protect fifty-nine habitats and twenty-five species, which are considered rare and threatened in Europe (see Appendix 2 for a list of relevant habitats and species contained in annexes to this Directive so called "annexed habitats and species").

According to Article 1 of the Habitats Directive the listed habitats are in danger of disappearance in their natural range, have a small range or are outstanding examples of typical habitats found in the biogeographic region. The Habitats Directive distinguishes priority and non-priority type habitats. Priority type habitats are listed in Annex I of the Directive and fulfill the three criteria above. They are given priority for designation as Special Areas of Conservation (SACs). Other "annexed" habitats are non-priority types. These could also be protected within SACs. The designation of areas with these types of habitats is of lesser priority. The two types are distinguished in Appendix 2.

The EU has produced brief descriptive accounts of annexed habitats (European Commission 1996, updated in 2003). Appendix 1 in Fossitt (2000) relates these to habitats mapped at Level 3 in Ireland.

Not all examples of annexed habitats or populations of annexed species require protection. Annex III of the Habitats Directive contains the following broad criteria against which sites and populations of species should be evaluated. These include

- Degree of representativity of the habitat
- Area
- Management potential
- Overall global assessment

Implementation of this Directive, through the identification of sites, which qualify, has been a priority of The National Parks and Wildlife Service. At an early stage in the process these sites are known as pcSAC potential candidate Special Areas of Conservation or Special Protection Areas (SPAs). When these sites have been investigated thoroughly, consultations have taken place with landowners, and details submitted to the EU the sites have the status of cSACs, (candidate SACs). Once confirmed by the EU they are known as Natura 2000 sites. Sites identified under an earlier EU Directive, the Birds Directive 79/409/EEC (CEC, 1979), can also qualify as Natura 2000 sites.

Habitat and species protection also occurs under the Wildlife Amendment Act 2000. Sites designated under this legislation are known as proposed Natural Heritage Areas. Sites with these designations support habitats and species of national importance. The process of designation is similar to Special Areas of Conservation. Once landowners have been contacted and an adequate time for consultations have been allowed the sites can be designated as Natural Heritage Areas. Protection of these sites is also provided for from the time of proposal.

Sites with nature conservation designations protect important species which require protection under the Wildlife (Amendment) Act 2000, are listed in the

Irish Red Data Books (Curtis and McGough 1988); Whilde, (1993); (Stewart and Church, 1993) or under the Flora Protection Order (S.I. No 94 of 1999) made under the Wildlife Act 1976. Evaluations for particular groups either on a national, regional and local basis can be used to distinguish areas of value for species. Of particular importance is a list of threatened birds drawn up by BirdWatch Ireland (Newton *et. al.* 1999).

While surveys have taken place for particular species or habitats in particular areas, comprehensive surveys have not taken place nationally to locate areas of high biodiversity value which should be protected under the Habitats and Birds Directive. The identification of cSACs, SPAs and NHAs has principally taken place through the redesignation of sites identified as Areas of Scientific Interest in the 1970's and 1980's. While these include important areas of biodiversity value it is likely that other sites supporting valuable habitats and rare species have been missed.

2.4.3 Sites with nature conservations designations within and adjacent to the study area

An examination of the range of designated sites within and adjacent to the study area provides an indication of the nature and importance of the natural biodiversity in this area. Eighteen sites with nature conservation designations are found within or adjacent to the study area. These are shown on Fig. 2.

Appendix 3 provides summary accounts of these sites based on an examination of files held by the National Parks and Wildlife Service in Dublin.

They reveal the following characteristics of biodiversity in the study area:

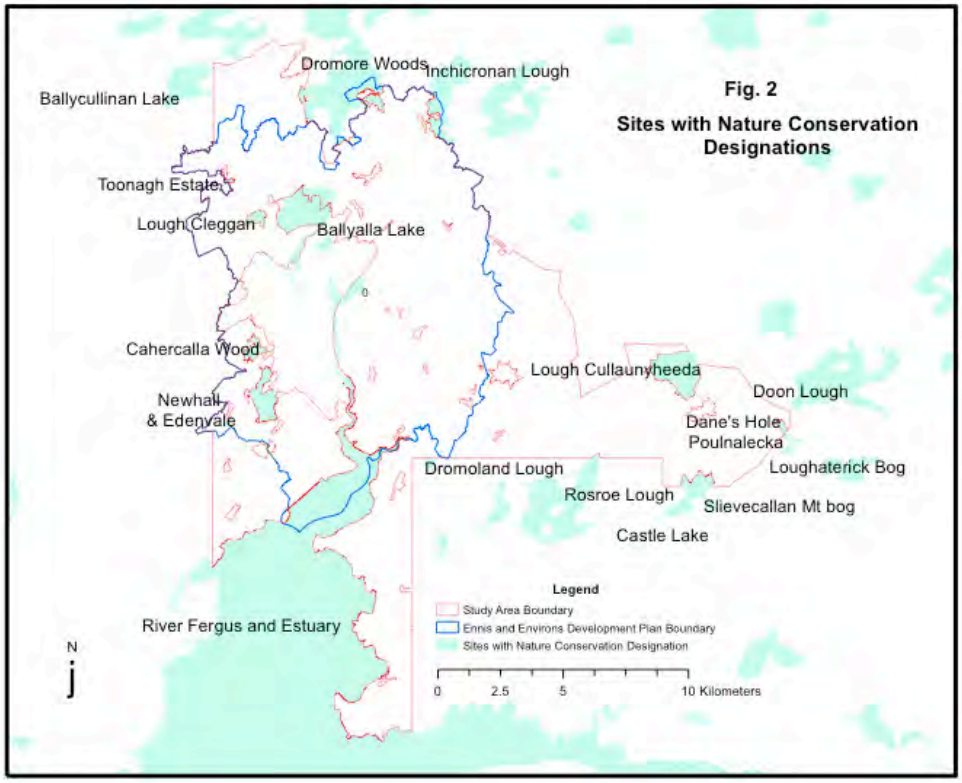
- Areas of high biodiversity value are found throughout the study area but principally to the south (Fergus Estuary, River Fergus and its tributaries) and to the north (The Burren).

- Areas of high value are mainly wetlands (lakes and estuary) dominated by open water habitats, which are important for birds.

- One turlough has been identified in the network of designated sites.

- Some areas of high biodiversity value are very close to or are even within the environs of Ennis. These include the Fergus Estuary and River Fergus, Ballyallia Lake and Cahercallia Woods.

- Some of the habitats present in these sites are listed in the Habitats Directive. As habitat maps have only been prepared for two sites (using a classification system which predates Fossitt 2000) detailed records do not exist of habitat diversity in most areas of high biodiversity value.



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- With the exception of species such as lesser horsehoe bat, otter and crayfish, systematic information or records are not available on the status of other annexed species.

- The network of designated sites within or adjacent to the study area includes a large number which are important for lesser horseshoe bats. They include Toonagh Estate, Dane's Hole, Poulnalecka, Dromore Woods and Newhall and Edenvale Complex. This species is protected under the Habitats Directive and designated sites include roosting sites in buildings or caves, and habitats which function as commuting routes to feeding areas. Detailed records for this species are available in Clare due to research work carried out in University College Galway and the efforts of the National Parks and Wildlife Service in the locality. The lesser horseshoe bat is the only member of the horseshoe bat family to occur in Ireland where it is confined to the six counties of Mayo, Galway, Clare, Cork, Limerick, and Kerry. Twenty cSACs have been identified for this species in Clare (Biggane, 2005). A breeding colony of female lesser horseshoe bats totaling more than 100 individuals and/or a winter site of more than 50 are the criteria used to identify qualifying sites.

Reviews of the network have taken place infrequently due to lack of resources. They result from research on the status of particular species, such as the horseshoe bat, suggestions from non-governmental organizations and awareness of the importance of linkages between sites. However no systematic survey work has taken place in Clare to discover the status of all the habitats and species protected by EU Directives. Throughout the county the process of communicating with owners, mapping habitats and putting in place management plans for sites with nature conservation designations is proceeding at a slow pace.

The identification of areas of high biodiversity value has significant implications for land management and spatial planning. Once informed of the status of their land, landowners are required to consult with the NPWS if planning any practices which might affect its value. Local authorities are required to recognise the status of these sites in development plans and development control. Under Article 6 of the Habitats Directive an environmental assessment is required for any development which threatens an annexed habitat or species.

While the emphasis in the Habitats Directive is on specific habitats and species it also recognises the need for management of the wider countryside. The preamble states "land use planning and development policies should encourage the management of features of the landscape which are of major importance to flora and fauna".

Article 3 of the Habitats Directive states that there are obligations on member states to maintain features of the landscape which will improve the ecological coherence of the NATURA 2000 network. The obligations and the type of features are highlighted in Article 10 as follows:

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

While the Directive does not imply that features such as hedgerows are designated, it states that their value to particular annexed species, such as bats, which use them as commuting routes, should be recognized.

2.4.4 Biodiversity and spatial planning

The traditional emphasis on habitat and species protection, which is enshrined in legislation, is increasingly being complemented by an approach which reflects the principle of sustainable development. The concept of sustainable use was

initially elaborated in the Convention on Biodiversity, which was drawn up at Rio in 1992.

The approach recognizes that greater efforts must be made to decrease the pressures which have caused the decline in biodiversity, to inform and educate stakeholders and to provide for a greater variety of responses for the management of biodiversity. The implication of this approach to biodiversity management is that policies and actions should be informed by an awareness of the biodiversity value of all areas, not just at designated sites.

New tools have been developed to integrate biodiversity and spatial planning. One such tool is ecological networks (Tubridy and O'Riain, 2001), which works at various scales including the landscape. It is based on awareness that the enclave approach to biodiversity management has limitations, and that some types of development can lead to a decline of biodiversity by fragmenting habitats and isolating populations of species. Using this approach the landscape is differentiated as having 1) core areas of high value for habitats and species; 2) nature development (rehabilitation) areas where its value has declined; and 3) ecological corridors or buffer zones which link and improve the status of high value areas. In the context of lesser horseshoe bats, roosting sites and feeding areas are "core areas" which may require buffers for protection. Corridors comprise the hedgerows which provide a link between a roosting and feeding area and rehabilitation areas are places that no longer offer adequate feeding or transport routes because their habitats have been damaged. This concept has been elaborated nationally using land use (not habitat) data.

Increasing awareness of the deteriorating condition of biodiversity nationally and internationally has led to the EU and Irish government to announce their intention to halt the loss of biodiversity by 2010. The National Biodiversity Plan (2002) has the overall goal of securing the conservation, and wherever possible the enhancement and sustainable use of biological diversity in Ireland and of contributing to biodiversity globally. One of its objectives is to strengthen the role of local authorities in managing local biodiversity, through the designation of an official with responsibility for biodiversity and the preparation of Local Biodiversity Plans.

Certain local authorities have responded to the challenge by becoming involved in initiatives in conjunction with stakeholder fora, to research local biodiversity, provide local records, support environmental education, and to commission studies to support spatial planning.

Habitat mapping exercises have been stimulated by the existence of the habitat classification and methodology promoted by the Heritage Council. Work has been carried under the auspices of Heritage fora in rural parts of Carlow (Hickey, 2002, 2003, 2004), rural Fingal (by Fingal County Council); rural and urban Laois (Tubridy and Hickey 2004); Dublin City (Tubridy and Compass Informatics 2004) and Galway City (Natura 2004). Within Fingal large scale habitat mapping is being carried out in its rural areas in 2006 (Deborah Tiernan, pers.comm.). This will be informed principally by aerial photography. Fieldwork is only occurring

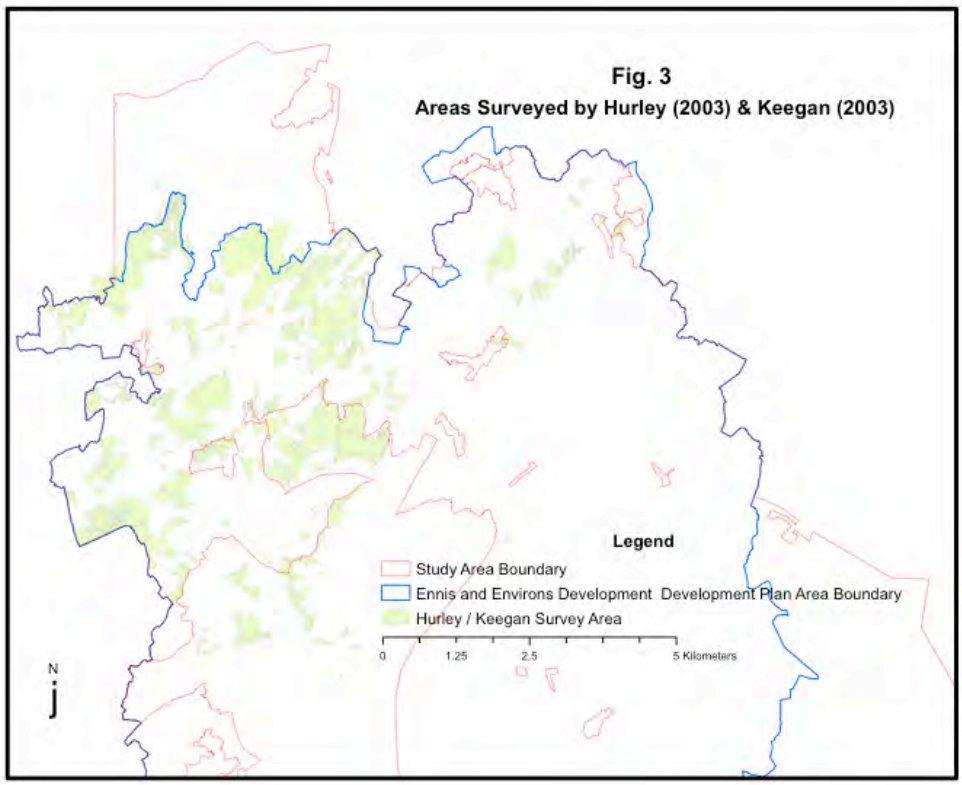
in areas highlighted by informants as being of importance for semi-natural habitats and rare plant species. In other counties efforts have focused on mapping habitats associated with particular landscape features, such as fens or eskers, which are vulnerable to exploitation. Esker studies carried out in Offaly (Tubridy 2006) Westmeath (Tubridy, 2005) and 2006) and Laois (Muyllaert and Tubridy 2005) were directly linked to local authority efforts to protect these types of sites from exploitation for sand and gravel. In Westmeath studies resulted in a ranking of all esker systems in the county based on geodiversity and biodiversity, their listing in the Draft County Development Plan and their use in the elaboration of policies to guide spatial planning.

While the principal objective of these studies is to provide comprehensive maps of habitats, which will assist in the identification of areas which are important for biodiversity, results have also been disseminated through local conferences, field trips, the web and local libraries to support local environmental education.

Habitat mapping for this study follows a tradition of natural heritage recording and heritage awareness initiatives in Clare. The first published habitat map in Ireland covered part of the Burren (Moles and Travers, 1981). A large scale habitat mapping study using satellite imagery was carried out more recently in the Burren (Parr et al, 2006) to map habitats on farms. The results are being actively utilised by the Burren LIFE project (www.burrenlife. ie). Habitat mapping commissioned by Clare County Council was recently completed around Newmarket on Fergus and Shannon (Fuller and Conaghan 2004). Postgraduate research included habitat mapping in an area north of Ennis. (Keegan 2003) and Hurley (2003). The areas mapped by Hurley and Keegan within the study area are shown on Fig. 3.

The principal objectives of the Shannon Habitats study, referred to above, were to provide a comprehensive map and relative evaluation of the habitats. Habitats were mapped to Level 3 and each type was ranked on a four point scale, to indicate its value relative to other types. Hurley's and Keegan's studies focussed on the identification of woodlands and grasslands requiring special protection either because they were intrinsically interesting or because they were linked to other sites of value, particularly sites with nature conservation designations.

Assessment procedures have been elaborated in other studies to describe the relative value of a wide range of habitats. Guidelines produced by the National Roads Authority (NRA, 2004) allow for the ranking of areas potentially impacted by road schemes. This system uses habitat and fisheries information and is contained in Appendix 4. The assessment section of the Environmental Impact Study for the Ennis by pass (Babtie Pettit 2000) rated areas of ecological interest as being of Local, District or County Importance.



The NRA guidelines give their highest ranking (international importance) to the following sites:

- Undesignated sites containing good examples of Annex I priority habitats listed in the EU Habitats Directive.
- Sites designated (or qualifying for designation) under the EU Habitats or Birds Directives.
- Major salmon river fisheries.
- Major salmonid (salmon, trout or char) lake fisheries.
- Habitats and species protected by European legislation.

The lowest ranking (low value, locally important) is given to the following areas:

- Artificial or highly modified habitats with low species diversity and low wildlife value.
- Water bodies with no current fisheries value and no significant potential fisheries value

2.5 Conclusions

Spatial planning in Clare is associated with initiatives to recognise heritage and landscape values. Local development plans give protection through policy statements and listing to a variety of heritage sites designated under international and national legislation. The Landscape Character Assessment is

used to inform development control. The habitat map for the Shannon study is currently used by the Heritage Officer who refers to it when asked by the Council to comment on the impact of planning applications on biodiversity.

Habitat mapping is similarly needed to inform spatial planning in other parts of the county, particularly the vicinity of Ennis which is under pressure from development. The designation of sites of biodiversity importance has not been based on comprehensive field studies. Therefore it can be assumed that important sites have been missed. As wall as identifying key sites of importance, fieldwork will identify all habitats, some of which act as "stepping stones" or linking features or corridors which are necessary to maintain the condition of the key sites within and outside designated areas.

Local habitat mapping has the potential to inform the Strategic Environmental Assessment associated with the Ennis and Environs Development Plan. The SEA requires the careful identification of features of value and a close evaluation of the impact of plans and policies particularly on sites of European importance. As habitats will be identified to Level 3, EU listed habitats will be identified. Changes in biodiversity values resulting from different policy choices can be measured by examining its impact on these habitats. Geographic Information Systems (GIS) can be used in this analysis as the habitat data will be available digitally.

Habitat mapping can also be used to refine the definition and sensitivity ratings for Landscape Character Areas which are currently based on land use characteristics.

As the study is an action of the Heritage and Biodiversity Action Plans the results could be used for local environmental education. There are regular biodiversity awareness campaigns in Clare and a web site has been set up to publicise information on local biodiversity (www.clarebiodiversity.ie) An environmental education strategy for the county has been prepared as an Action of the Heritage Plan (Tubridy et al, 2003). The Heritage Forum has published a set of guidelines on development in the countryside (County Clare Heritage Forum 2006). Fieldwork for this study which will be carried out in co-operation with landowners and residents has the potential to directly inform them about the biodiversity value of their land.

3 Methodology

3.1 Project set up

The project was initiated in May 2006 at meetings with Congella McGuire, Heritage Officer; Dr Julie Fossitt, NPWS; Martin McKeown, Clare Biodiversity; and planners involved in strategic planning and development control, the manager of the Clare Biological Records Centre and staff from the information technology section of Clare County Council. These meetings clarified study outputs, discussed sources of data and allowed for agreement on a revised study area boundary. Soon after licences were signed and arrangements started to be made for access to digital data held by the council (vector mapping, 6" mapping, 2000 aerial photography, Ennis and Environs Development Plan boundary, route of Ennis bypass and 1: 50,000 Discovery maps). Ancillary data sources were researched locally and nationally.

The process of sourcing ancillary digital data was started by drafting letters (signed by Heritage Officer) to the following sources: Environmental Protection Agency (Forest Inventory Parcel System/EPA datasets), GSI (Geological data); Coillte (Forest type and biodiversity areas); OPW (Ennis Floodplain Study in prep).

3.2 Review of archaeology/cultural heritage

The review of archaeology/cultural heritage was carried out by TVAS Ltd, a Clare based archaeological consultancy through consultations and examination of published and unpublished reports. No fieldwork took place. Principal published and unpublished sources include:

- The Sites and Monuments Record for County Clare.
- The Record of Monuments and Places for County Clare. These sites have statutory protection under the National Monuments Act 1930 (as amended).
- The *Excavations* database – A listing, with summary results, of all licensed archaeological work in the state.
- Published and unpublished archaeological excavation reports.
- Topographical files of the National Museum of Ireland.

Discussions were held with heritage specialists in Clare.

The results of the cultural survey are contained in a report produced for this study (TVAS 2006) the contents of which are incorporated in this document. References are contained in the review are in Appendix 5.

3.3 Geological heritage

This aspect of local heritage was researched by Dr Robbie Meehan, Consultant Geologist, and principally involved desk research using published information and digital data sets. Appendix 6 contains a list of sources. Initial familiarisation with the area occurred through an inspection of 1) the Geological Survey of Ireland publication "Geology of the Shannon Estuary' (Sleeman and Pracht, 1999) and 2) digital mapping of subsoils and glacial geology (Teagasc/Environmental Protection Agency Subsoils Map (2005)) and 3) geological data from the Geological Survey of Ireland including Parkes et al, 2005). An examination of some of these digital data sets was carried out in association with Dr Mary Tubridy in order to reveal the principal landscape units within the study area and the location of landscape features, which could provide orientation to ecologists carrying out field mapping.

Examination of digital mapping of subsoils and glacial geology in the Teagasc/Environmental Protection Agency Subsoils Map (2005) allowed for the identification of drumlins, which are important landscape features and also indicate the presence of improved land. Based on 6" Ordnance Survey mapping calcareous springs and turloughs were identified as both of these features of geodiversity interest are listed as annexed habitats under the Habitats Directive. Springs were noted where they were indicated on 6"maps. The identification of turloughs used an innovative approach as follows:

Paper copies of the six inch sheets (1920) were scanned, and any probable turlough area marked with highlighter pen. Probable turlough areas include areas of marshy ground, especially close to bedrock outcrop ('rough ground'), rounded areas marked as open water, and some extensive flats with a dense drainage network. Aerial photography (dated 2000) was later used to add to this number.

The turlough areas were digitised as points using the 1841 Ordnance Survey six inch sheets as a backdrop. These points were then geo-corrected from Cassini Projection to Irish National Grid by using the colour orthophotographs as a backdrop.

The points were then cross checked with the Teagasc/EPA subsoils map and the aerial photographs. Some features that did not look like turloughs were omitted (no poorly drained vegetation, no sign of seasonal flooding, absence of karstic rock, extensive peat), but some new features were added (presence of signs of seasonal flooding, poorly drained vegetation). This led to a reduction of the final number of turloughs identified within the study area.

Each individual hollow that floods has been identified as a point location. Some areas may have several adjacent hollows that flood to the same level; others may not really be hollows at all, but wide, expensive flats still fed by groundwater from the karst system or a component of the karst system in winter. It should also be noted that some turloughs are floored by peat of varying thicknesses,

others by marl, others by mineral lake clay, others by till derived from limestone. Some are just hollows in limestone pavement. The common characteristic is the 'hollow', which floods seasonally. As these sites have not been ground truthed they have been called "Probable Turloughs".

Other karst features highlighted on the 1920 six inch sheets (springs, caves, pavement) were not digitised due to resource constraints. They are shown on marked up paper copy 6" maps.

Fieldwork took place in the east of the study area to investigate landscape features and patterns highlighted on the 6" maps. As it was impossible to visit the location of all features of geodiversity interest within the resources of this project pilot level survey work took place assisted by Martin McKeown, consultant Geologist and member of Clare Biodiversity. Robbie Meehan and Martin McKeown visited and photographed karstic sites, north and west of Ennis. This confirmed the value of desk research and indicated the presence of other karst features.

3.4 Habitat mapping

3.4.1 Introduction

Habitats were mapped to Level 3 according to the 2005 version of the Draft Habitat Mapping Guidelines.

3.4.2 Ancillary Data

Sources of data which informed habitat mapping are listed in Table 1.

Table 1 Source and usefulness of data which assisted habitat mapping

Source	Nature of Data	Usefulness
Coillte	Coillte (2003) Management plan for Biodiversity Areas. Unpublished Internal Report.	General accounts of woodland habitats in Lough Cullaunyheeda, near Craggaunowen, and Ballygriffy Wood.
Coillte	Digital mapping of forest type	Reference data set
Keegan (2003)	M.Sc thesis and associated digital map	Digital mapping to Level 3 for woodlands in part of the study area. Mapping of other habitats to Level 2
Hurley (2003)	M.Sc thesis and associated digital map	Digital mapping to Level 3 for grasslands in part of the study area.Mapping of other habitats to Level 2.
Babtie Pettit on behalf of Clare County Council and the National Roads Authority (no date)	EIS for N18 Road Improvements (Dromoland to Crusheen) including Ennis bypass	Reference data set. Habitat mapping classification pre Fossitt. Background information for certain habitats within 100m of the route near Ennis.
Botanical Society of the British Isles (c/o Catriona Brady, former county recorder)	While recording done at 10km, a list of sites (4) supporting rare species of plants provided	Data useful as a quality indicator for four examples of particular wetland habitats

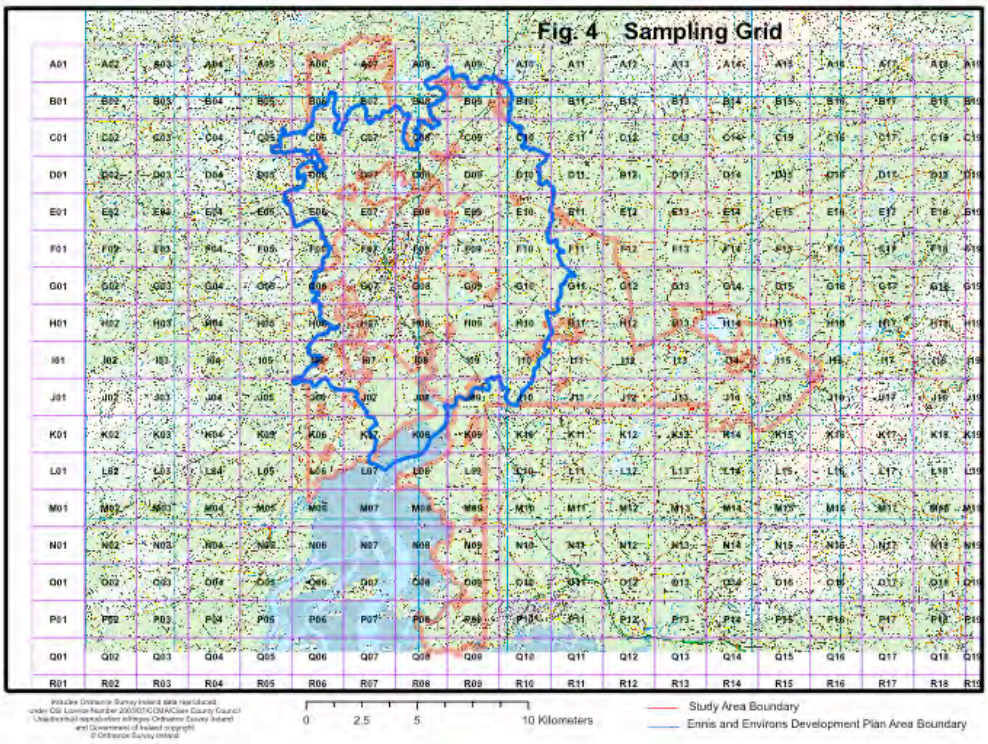
Table 1 (contd) Source and usefulness of data which assisted habitat mapping.

Source	Data	Usefulness
Natura Ecological Consultants and White Young Green (OPW study of Ennis Floodplain in prep for Ennis Urban District Council)	Habitat mapping in the vicinity of the Fergus to inform Floodplain Study	Reference data set.Mapping already carried out by the time data arrived.
Micheline Sheehy Skeffington UCG (Pers.comm)	List of turloughs (in press)	Reference data set. Cross checked with those identified by this study. Only one in common!
NPWS	Lists of rare flora and fauna in study area (NK) Habitat maps for Newhall/Edenvale SAC (outside study area) (RJ) List of indicator species for priority type grassland (GS1) (MD)	Result from review of site files and review of species data base in Appendix 3. Habitat maps for Ballyallia Lake for reference

3.4.3 Fieldwork

The study area was divided into a large number (83) of squares measuring 2km X 2km (Fig. 4). A pilot habitat mapping exercise was carried out by ecologists and Geographic Information System specialist in early June 2006. This exercise had the following objectives 1) reconnaissance of different landscape types, 2) ensuring compatability in interpretation between field surveyors involved in this study and recent habitat mapping exercises (Conaghan and Fuller (2004), Keegan (2004) and Hurley (2003) in adjacent areas and 3) clarification of mapping needs in the field.

Following this trial, map packs (83) were prepared to inform fieldwork. For each square they contained an aerial photograph, blank vector map, 1st ed Ordnance Survey map and vector maps showing location of karst, peat and landuse (from FIPS/EPA Soils and Subsoils Digital Data Base). These maps were produced at a Scale of 1:10,000.



Aerial photography was flown either in January or May 2000. The latter photographs were easily identifiable by the appearance of flowering thorn bushes. Where habitat mapping generated by Keegan (2003) and Hurley (2003) was available it was added to map packs. Boundaries of the study area, designated areas (NHAs and SACs) and drumlins (taken from FIPS/EPA data sets) were shown on all aerial photographs. The grid and study area boundary were shown on all field maps and the 1:50,000 Discovery Map.

Habitats to Level 3 (Fossitt 2000) were identified using a combination of aerial photographic interpretation and fieldwork by ecologists Dr Mary Tubridy, Dr Betsy Hickey and Mieke Muyllaert. All sample squares were examined directly. Before fieldwork occurred the location of certain habitats and areas of potential interest were identified. Homogenous dark green fields particularly on drumlins were identified as (probable) improved grassland (GA1) of lesser priority for field examination. Woodland and scrub on the 1st ed map which appeared to be present on modern vector maps were considered high priority for field examination. The presence of 1) peat or karst in soils and sub soils (Teagasc/EPA maps), and 2) water bodies in aerials were interpreted as indicating the presence of high value habitats which required direct examination.

Before starting fieldwork landowners were located and asked for permission to survey their land. If time allowed they were engaged in a discussion on land

management practices. If the landowner could not be located, or if they refused permission, their land was not surveyed unless it was easily visible from an adjacent public road. In practise, almost all land was surveyed directly and only two landowners refused access.

On inspecting the land, all Level 3 habitats with the exception of GA1 (Improved Grassland), WL1 (Hedgerows) and WL2 (Treelines), BL3 (Buildings and Artificial Surfaces) and FW (Watercourses) were coded onto the relevant field/ area on the vector map.

These habitats were not mapped directly for the following reasons:

- The presence of Hedgerows/Treelines can be assumed bounding a field. However not all linear features were hedgerows/treelines. Stone walls were also present.
- Buildings and built surfaces were not mapped as these habitats are not of high biodiversity value.They can be easily identified using aerial photography and research to inform the Ennis and Environs Plan will involve fieldwork to map the location of buildings in 2006/2007.
- Watercourses were not mapped to Level 3 as drainage ditches and large rivers are shown as linear features on vector maps.
- Improved grassland was not mapped in the field as this is the commonest habitat in rural areas and is relatively low biodiversity value compared to other types of grassland.

Once the nature of the habitat was identified its extent was mapped on the aerial photograph and code added to corresponding area in the vector map. Where an example of good quality habitat was encountered, this was noted on the aerial photograph (marked as N1, N2 etc) and a plant species list was compiled. Photographs were taken occasionally to record habitats. Species identification and nomenclature was based on Hubbard (1984), (Jermyn *et al* 1982), Mitchell (1978), Rose (1991), Rose (1989) and Webb *et al* (1996).

The survey proceeded by mapping habitats field-by-field and square-by-square until all squares were examined and mapped. Despite the brief and time constraints, some mapping occurred outside the study area boundary in order to include adjacent and contiguous areas of habitat.

A limited amount of onscreeen interpretation occurred where the codes on the marked up vector maps were unclear. Notes describing particular sites were transcribed for later insertion into a database. Once digitised, printed copies of habitat maps were returned to ecologists for checking.

Table 2 lists features used to identify habitats using aerials and through fieldwork.

Table 2 Habitat indicators used in the field and remotely

Habitat	Field Identification	Remote identification
Lakes FL , FL2/7/8	Open water (but not always seen in the field due to season) Origins (whether man made or natural). As trophic status of water bodies could not be definitively determined on the ground on the day, the lakes were categorised by examining surrounding drainage topography and geology, the presence of a 'buffer' of semi-natural habitats between improved land and the water's edge, and the characteristics in Fossitt (2000)	Areas dominated by water have a uniform black colour. Boundary on vector map. As water not always seen on aerials field checking needed
Turloughs	Sites with wet grassland or fen, which showed evidence of extensive flooding. Limestone outcrop nearby	See notes on turlough identification in section on geodiversity.
FS1 swamp	Identified by the presence of stands of *Typha* or *Scirpus* or *Phragmites* Peat present according to Teagasc/EPS Soils and Subsoils Mapping Project	Fringing vegetation directly adjacent to open water on lakes. Colour depends on time of photograph. Light brown in winter. Issues of scale where present in a narrow band.
FS2	Species more diverse in comparison to FS1.	Difficult to identify as it grades into other habitats.

Table 2 (contd). Habitat indicators used in the field and remotely

Habitat	**Field Identification**	**Remote identification**
GA1 Agricultural type	Presence of more rye grass relative to GS. Evidence of potential for fertilisation (access and size, low cover of clover, presence of thistles and docks) Information from landowner on management regime. Closed off or cut for silage. Signs of silage Mostly on drumlins	Even green colour/regular topography, no bushes in field. Nearer to a farmhouse. Probably not underlain by peat but this is not always the situation.
Amenity Grassland GA2	Species poor (even relative to GA1).	Even green colour near houses, in parks, golf courses and football pitches.
GS1 Semi-natural grassland (all types)	Species diversity high and includes clover (cover high) and numerous grass species Topography and position does not allow fertilisation because it is too steep, too stony and field has high bush cover. Farmer states that land not fertilised. Priority type has higher species diversity, Briza and orchids and farmer confirms absence of fertilising over a very long period (c 30-40 years)	Uneven green tussocky appearance on aerials. Karst below. No peat. Cannot be distinguished from GA1 accurately without field inspection.
GS2	In fields with usual GA1 species but signs of increasing dominance of tussock formers due to lack of cutting or management	Not possible to identify remotely. Rarely mapped in verge due to scale.

Table 2 (contd). Habitat indicators used in the field and remotely

Habitat	**Field Identification**	**Remote identification**
GS3	Found in revegetated cutover bog with acid peat and *Calluna* nearby. Grasses dominated by bents and herbs such as tormentil and sweet vernal grass common	Not possible to identify remotely
Wet grassland GS4	Presence of rush sp Very species rich type around turloughs Cover of grasses >50% Reeds less than 50%.	Purple hue on aerials. Uneven tussocky appearance. Possibly near drainage ditch/river, underlain by peat?
Freshwater marsh GM1	High diversity of broadleaved herbs. Band around lake dryer than reed swamp	Difficult to identify remotely
Raised bog (PB1)	Sphagnum and typical raised bog species	Peat soil
Cutover Bog (PB4)	Mosaic of various habitats none big enough to map individually	ditto
Rich fen (PF1)	Characterised by Schoenus, large and small sedge species, occasional Cladium. Priority type has high cover of Cladium	Underlain by peat. Local drainage. Identified in FIPS.
Oak ash hazel wood WN2	Hazel >4-5m, occasional ash tree. Difficult to access. As aerial dates from 2000 what was scrub then may be woodland now. Unlikely to be on limestone pavement Scrub has scattered small bushes. >5m wide	Scrub areas with signs of tree canopy. Karst always underneath.
Wet willow alder wood WN6	Tree species	Not possible to identify remotely. Should be adjacent to open water.

Table 2 (contd). Habitat indicators used in the field and remotely

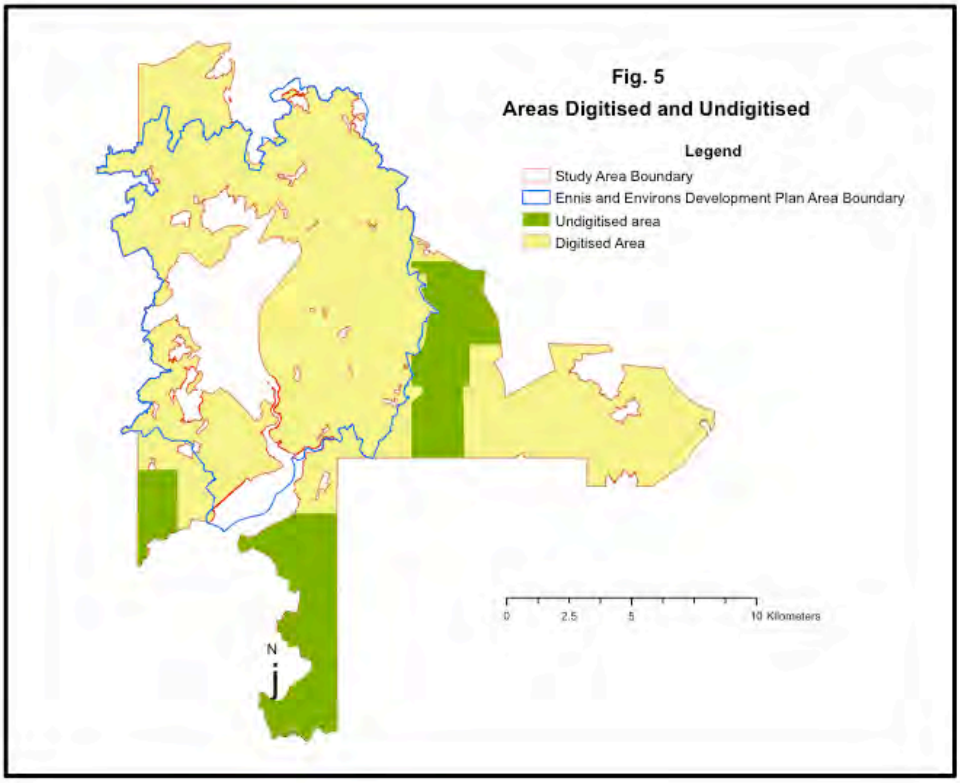
Habitat	**Field Identification**	**Remote identification**
Mixed broadleaved wood WD1	Presence of non-native broadleaves	Trees easily visible. Outline sometimes indicates plantation
Broadleaved conifer wood WD2	Mix of broadleaves and conifers	Colour/ texture of tree canopy
Coniferous plantation WD4	Tree species	Colour/pattern of tree canopy
Scrub WS1	Gorse, blackthorn, hazel dominated. Hazel stunted <4m high Scattered bushes Gorse or hawthorn obvious Hazel scrub difficult to distinguish from oak ash hazel woodland.	Yellow of gorse depending on time of photo, on fringe of dry land, or wet land or on land with little soil cover. Scatter of bushes
Immature woodland WS2	Recently planted woodland. If WS2 on 2000 photo then different category in 2006	Evidence of lines of drains and other possible habitat type. No tree canopy.
Disturbed ground ED	Natural topography disturbed, quarried or dumped on. Quarry extent (ED4) difficult to map as aerials out of date. Areas where building is occurring were mapped as ED3	Various textures which contrast with nearby vegetation.
Built up land BL3	Buildings, roads and hard surfaces As mapping and photography out of date and some sites too small, no priority was assigned to recording this habitat.	Outlined in vector mapping. Obvious on aerials.
Salt marsh CM	Typical salt marsh species	

3.4.4 Habitat data management

Data on habitats was processed as follows:

Marked up vector maps were delivered to Compass Informatics for digitising. All mapped habitats were digitised. Hard copy maps were produced using a new colour coding system as that contained in the Habitat Council Draft Habitat Mapping Guidelines was unsuitable.

Accounts were prepared of habitats within the area digitised in 2006 (Fig.5). It includes all the surveyed land within the boundary of the Ennis and Environs Development Plan area and countryside to the east of Ennis. GIS allowed for the calculation of the areas covered by habitats in this area.



3.5 Public awareness

Stakeholder engagement took place through direct contacts with landowners who were given an information leaflet. Approximately 250 copies were produced and c. 220 distributed. Copies were also available in Clare County Council offices. In association with Clare County Council an article was published in the Clare Champion which referred to the study and its relevance to research on global warming being carried out in the University of Maynooth.

During Heritage Week 2006 preliminary results from the project were presented at a lunchtime lecture. Meetings (2) were held with planning staff in Clare County Council to consider the outcomes of this study, one of which was informed by a briefing note prepared by the consultants on the relevance of the results to spatial planning.

4 Results

4.1 Geological heritage

4.1.1 Description

Pure bedded limestone much of which is extensively karstified underlies most of the study area. Other rock types outcrop around the edges; sandstones and shales at the west, unbedded limestones and impure limestones at the east and northeast of the study area. The bedrock is often exposed, with outcrop covering about 33% of the land surface (Teagasc/EPA Subsoils Map for Clare, 2005). As this figure includes rock just under the surface (50cm) its distribution cannot be used as an indicator of exposed limestone and less so of limestone pavement, a habitat type listed in the Habitats Directive.

The landscape of the study area is best described as the southwestern portion of the mid-Clare drumlin belt (broadly equivalent to the 'Gort Lowlands' peneplain), which grades into wide, flat areas of karstified bedrock outcrop and estuarine sediments around, south and southeast of Ennis town. The Gort Lowlands type area has a large number of classical turloughs and shallow permanent lakes that appear to be interconnected as they have a common rest water level. Within the northern portion of the study area, however, the edge of this flat area is a shallow scarp, which degrades south of Ruan into a mixed complex of geomorphological features.

Examination of OS mapping revealed the presence of a large number of karst features. These include eighty-four 'probable turloughs" and almost three hundred other karst features including springs, pouls, swallow holes, dolines, estavelles and caves. While these were found throughout the study area they were concentrated north of Ennis. When turlough distribution was later reviewed with the aid of aerial photography this led to an increase in their number to 117. Fig. 6 indicates their distribution. Plate 1 shows a small turlough at Drumcliff.

The turlough-like lakes in the Ennis area are much more complex than those of the "Gort Lowlands" area, with edges of fen and peat and marl in their bases. Some of these are classical turloughs by definition, while others are not. Within this area, many flooded areas in winter become dry pasture in summer, but with complex and distinct geological geometry within each feature.

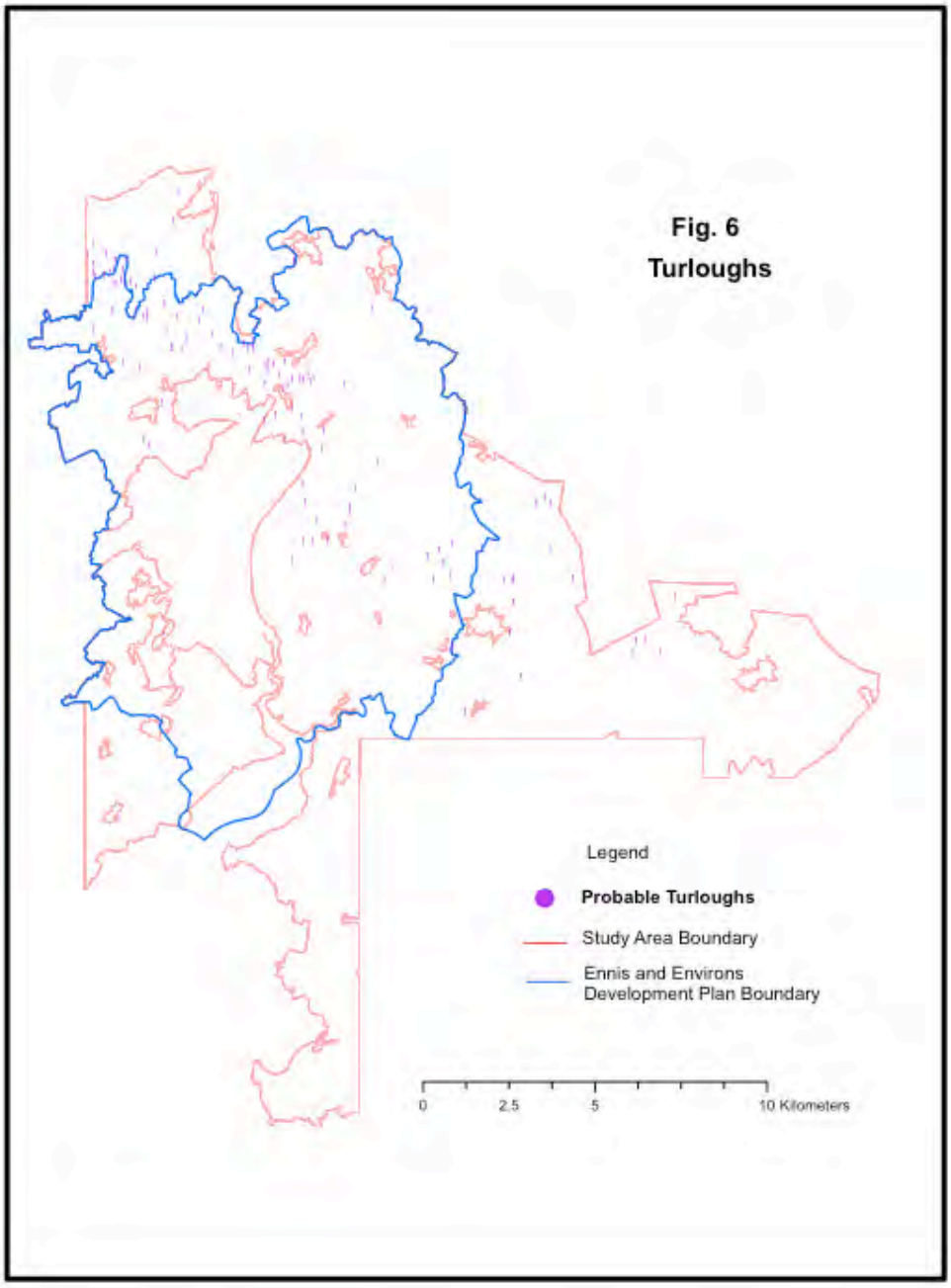
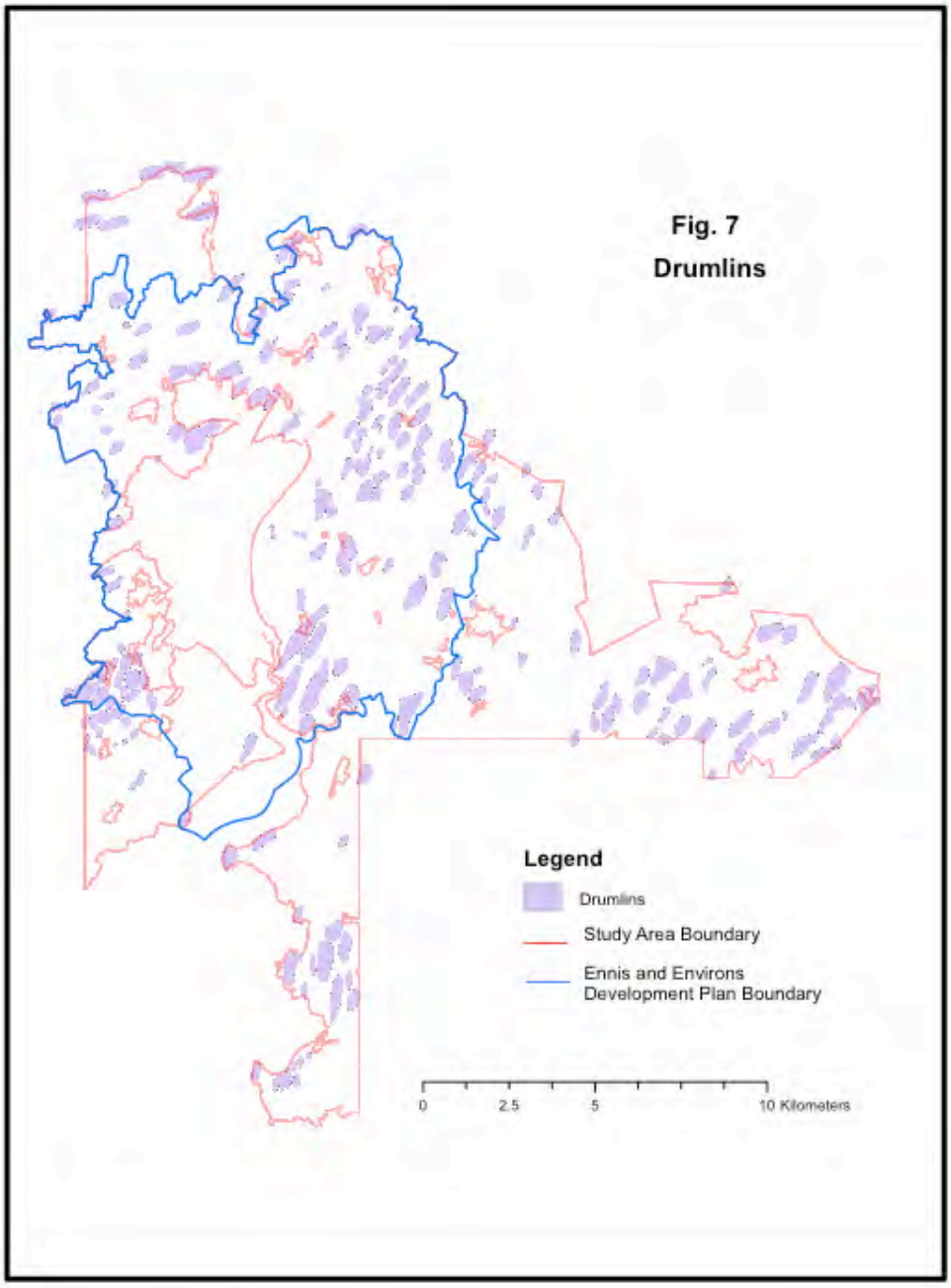


Fig. 6
Turloughs
Legend
Probable Turloughs
Study Area Boundary
Ennis and Environs
Development Plan Boundary
0
2.5
5
10 Kilometers

Plate 1 Small turlough at Drumcliff

Drumlins and ribbed moraines at locations shown on Fig. 7 characterize the topography at higher elevations in the study area.

Drumlins are streamlined hills which are deposited parallel to ice flow. They form the landscape's major features northeast of Ennis, where they occur in a swarm, and also occur sporadically as discrete, lone drumlins in the karstified area east of the town. They are generally asymmetrical, with a high, blunt stoss (up-ice, northeast) end and a lower, tapering lee (down-ice, southwest) end. Crag-and-tail features occur on Cairn Hill at the western extreme of the study area. These are streamlined glacial lineations with a bedrock stoss end (the 'crag') and a lee end composed of boulder clay or till (the 'tail').



Ribbed moraines comprising chains of drumlins are found around Drummeen and Newhall crossroads. These glacial deposits consist of numerous parallel, closely spaced ridges, which were formed transverse to ice flow in a sub glacial position.

Plate 2 Cutting through till in drumlin at Drumcliff

The landscape around the Fergus is characterized by a wide alluvial floodplain. which was drained and reclaimed in modern times. Recent archaeological excavations have revealed the former existence of an underlying natural layer of orangish brown glacial till and alluvium overlying limestone outcrop (Hull 2006a, Hull 2006b).

Alluvial deposits are also being built up between drumlins. Here lakes lay shortly after deglaciation. But these have been in filled with the build up of basin peat and/or fen peat.

Soils reflect their parent material and history of formation. The tills, and therefore the drumlins, are dominated by well drained limestone and limestone soils for the most part, but in the northeastern portion of the study area sandstone tills have been carried over from the Slieve Aughty Mountains and veneer the drumlins, giving soils of often poorly drained, acidic reaction. In the extreme west of the study area, shale tills also host poorly drained, clayey, acidic soils. Peat is concentrated in the northeast and east of the study area between drumlins. Estuarine sediments form silts and clays along the Fergus Estuary.

Small areas of alluvium occur along rivers in valleys. Areas with no soil cover and which comprise outcropping rock or karstified limestone host springs, swallow holes, turloughs and sinking streams in localized zones of surface water-groundwater-rock substrate interaction. These features are most abundant north of Ennis.

4.1.2 Evaluation

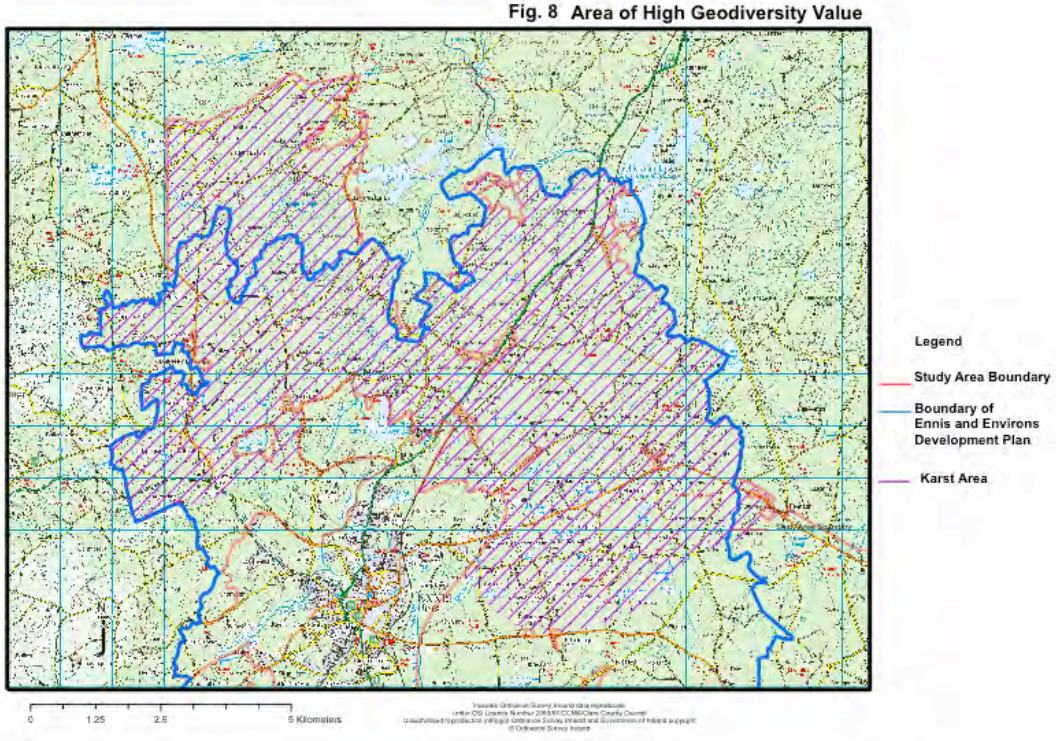
The GSI study had identified only three sites of County Geological Interest in the study area and one turlough. This study provides new evidence for the presence of important karst features and a unique landscape north of Ennis. Fig. 8 indicates the area of particular value.

It has a myriad of classical karst features and demonstrates a transition between karstified rock and deep glacial sediments. Features of interest are concentrated in the vicinity of Fountain Cross-Drumcliff-Ballymaley-Barefield-Inchicronan Lough. Within this area, desk research revealed over 375 probable-karst features. Field survey in a small portion of this area illustrated that even more features exist. This is a world-class example of the interaction between glacial sediments of varying depths and a karst environment, and has a myriad of extraordinary karst-glacial features rarely found in such concentrations.

Turloughs are particular features of both geodiversity and biodiversity interest. The IGHP is developing a list of important turlough sites based on desk research. Turloughs are also listed as habitats the Habitats Directive. This study identified 117 probable turloughs. The majority of these, 83, are within the Ennis and Environs Development Plan area. Therefore, this area has numerous sites which have potential to be recognized under the Habitats Directive.

The geodiversity and potential biodiversity interest of the area north of Ennis has significant implications for the management of landscape values, biodiversity and water quality. Turloughs have a unique biodiversity due to the impact of flooding with lime rich waters. As bedrock is close to the surface there is an extremely high risk of contamination of groundwater resources from intensive farming and the development of septic tanks. Conditions may vary over short distances and depth to bedrock will be difficult to predict.

Fig. 8 Area of High Geodiversity Value



4.2 Archaeology

4.2.1 Description

Site diversity

The County Clare Sites and Monuments Record revealed a total of 719 monument entries in the study area. All of these sites are listed on the Records of Monuments and Places. A breakdown of these sites by type is given in Table 3 and a detailed listing is given in TVAS Ltd (2006).

Table 3: Archaeological site types

Site Type	**Number**
Archaeological Complex	5
Architectural Fragments (s)	1
Battlefield	2
Bridge Possible	1
Bullaun Stone	3
Burial Ground	17
Cairn	2

Table 3 (contd): Archaeological site types

Cashel	43
Castle	8
Castle Possible Site	1
Castle Site	2
Cave	1
Cemetery Cairn Possible	1
Church	12
Church Possible Site	1
Church Site	1
Clochan (s)	1
Crannog	1
Date Stone	1
Dwelling (s) Possible	1
Earthwork	15
Earthwork Complex	2
Ecclesiastical Remains	4
Enclosure	372
Enclosure Complex	1
Enclosure Conjoined	4
Enclosure Possible	13
Enclosure Site	4
Field System	2
Field System Possible	1
Fortified House	1
Fulacht Fiadh	38
Fulachta Fiadh	11
Fulachta Fiadh Possible	1
Graveyard	14
Henge	1
Holy Well	19
House - 17th Century	5
House - 17th Century Possible	2
Hut Site Possible	1
Inauguration Site	1
Linear Earthwork Possible	1
Megalithic Structure	6
Megalithic Structure Possible	2
Megalithic Structure Site	1
Megalithic Tomb Unclassified	3
Mound	1
Potential Site - Aerial Photo	5
Potential Site - Documentation	1
Potential Site - Name	2
Rectangular Enclosure	3
Ringfort (Rath /Cashel)	29

Table 3 (contd): Archaeological site types

Ringfort (Rath /Cashel) Site	3
Round Tower	1
Settlement Deserted Possible	1
Settlement Deserted Possible Site	1
Souterrain	2
Souterrain Possible	1
Standing Stone	13
Standing Stone - Pair	1
Standing Stone Possible	1
Stone Row Possible	1
Tower House	8
Tower House and Bawn	2
Trackway	1
Tumulus	1
Walled Enclosure	1
Watermill	1
Watermill Site	1
Wedge-Tomb	5
Wedge-Tomb Possible	4

Site complexes

Five archaeological areas incorporating more than one monument are found. These complexes are located in:

- Moymore/Ballygriffy North
- Ballyhennessy/ Garrynamona/ Rineanna North/ Rineanna South.
- Toonagh/Cahercalla
- Ballymarkahan/Knopoge
- Ballyvonnavaun

The complex in Moymore/Ballygriffy consists of enclosures, a possible field system and potential sites identified through aerial photographs. This complex is not dated. The complex in Ballymarkahan/Knopoge comprises a series of enclosures which again could date to any period. The similarly undated Ballyvonnavaun complex includes a standing stone, enclosure and clochan (s). Sixteen entries refer to standing stones, including one pair of stones and one possible stone row. Standing stones, when associated with other monument types such as *fulachta fiadh* and enclosures, are often interpreted as sites concerned with communal ritual activity (Grogan 1996).

The complex located in Ballyhennessy/ Garrynamona/ Rineanna North/ Rineanna South was partially destroyed in the mid 20th century with the construction of Shannon Airport. The townland of Rineanna South forms the centre of the international airport. This complex of ringforts, trackway and burial grounds bears testimony to the relevance of the Fergus estuary in the past.

Rineanna or 'Rineanny' is mentioned in the *Annals of the Four Masters* at the year 1564 (O'Donovan and Curry 1997).

The complex in Toonagh/Cahercalla is significant in that it comprises a wider range of monuments including an enclosure, battlefield, bullaun/basin stone, cairn, standing stone, holy well and an inauguration site. This complex is otherwise known as Magh Adhair, and has been interpreted as a ritual and inauguration complex of national importance (Condit and Cooney 1998). The sites that make up the complex range in date from the prehistoric period through to the medieval period. The complex is located within a natural amphitheatre-like hollow along the east bank of the Hell River. The complex centres on a probable Bronze Age burial mound. The mound appears to have been modified in the medieval period. A second smaller mound is located to the north-west of the larger mound (*ibid*).

This site has been interpreted as the medieval inauguration site of the Dalcassian kings and a place of ancient gatherings or *iraghts* that continued down to the early 19th century (Westropp 2000). The standing stone and bullaun/basin stone may relate to such activities. Standing stones and basin stones are a notable feature of inauguration sites in Ireland. In this instance the basin stone has two depressions (one man-made) on the upper surface of the stone (Condit and Cooney 1998). The *fulachta fiadh* located in the vicinity of the complex may also have played a part in the inauguration rituals or festivities (*ibid*).

At least 59 sites are termed *fulacht fiadh* (plural *fulachta fiadh*). These sites are generally regarded as prehistoric (and often Bronze Age) feasting places, that along with other site types such as standing stones and enclosures, may have served as a focus for community ceremony and ritual.

Toonagh townland is also reputed as a battlefield. O'Donovan and Curry (1997) note that Magh Adhair is referred to in *Caithreim Thoirdhealbhaigh* or *Wars of Turlough*. This work refers to political events concerning the O'Brien and MacNamara families, which took place between *c.*1242 A.D. and 1311 A.D. O'Donovan and Curry also mention the 'celebrated' Hill of Urchaill or Fuarchoill in Muckinish townland, which is also mentioned in the *Wars of Turlough* at the year 1318, as the site of a battle between the O'Briens and Geraldines.

Ecclesiastical sites and holy wells

Ecclesiastical remains are recorded at Killian, Drumcliff and Castletown. Very little is known of the complex at Killian or *Kyleeáne*, which includes a possible church site, burial ground and a bullaun stone. The presence of a bullaun stone is an indicator of an early church site. The bullaun or basin stone is annotated on the 1842 Ordnance Survey map as 'Doughnambraher font'. The burial ground is identified by Westropp (2000) as a *killeen*, a place for the burial of strangers and unbaptized children. It is often the case that *killeens* occupy the sites of forgotten churches. Of the 17 'burial ground' entries and 14 'graveyard' entries, *killeens* are recorded at Killian and Kilvoydan South.

Plate 3 Spring and stream at Killeenan Holy Well, near Dysart O' Dea

Very little information is available on the ecclesiastical remains at Castletown. The presence of an enclosure would indicate an early date for these remains. There is a holy well located to the north-east of the ecclesiastical remains which is annotated on the 1842 Ordnance Survey map as 'Toberinneenboy'. Westropp (2000) identifies this holy well as one of at least 17 holy wells located in central Clare dedicated to Saint *Inghean Baoith* (*c*.630). Very little is known of this saint, given that she inspired such a cult of worship (MacMahon 2000). The proximity of the holy well to the ecclesiastical remains may also be indicative of an early date.

Nineteen holy wells are recorded in the study area in the townlands of Soheen, Kilkee East, Kilvoydan South, Ballaghboy, Castletown, Clooney, Cahercalla/Toonagh, Cahercalla, Kilbreckan, Noughaval, Drim, Ballymacloon East, Kilkieran, Cullaun, Killanena, Kilnacrandy and Clenagh. These wells are associated with a variety of saints. These sites are generally regarded as post-medieval in date, but if associated with other ecclesiastical features, they can indicate an Early Christian date. Patterns are recorded at *Tobar Lonain* or Saint Lonan's well in Clooney where cures were sought for diseases of the eyes and limbs (O'Donovan and Curry 1997). Westropp (2000, 56) makes reference to 'rounds' associated with this well.

There is also a well, Toberlonan, a little more than a mile from the lake near Clooney church … at which 'rounds' are preformed, but these are reputed to be useless until after the rites are done at the lake, with which the well is supposed to communicate by a long passage.

The presence of a holy well, bullaun stone and *killeen* at Kilvoydan South indicates an early date, even though there is no record of a church apart from that implied in prefix 'Kil'. This well is also dedicated to *Inghean Baoith.*

The ecclesiastical remains at Drumcliff are significant in that they include a round tower as well as a church and graveyard. The south wall and windows

date to the 11th century and the east gable date to the 15th century. The founder of the church is unknown. The round tower was extant in 1839 (Westropp 1900). The remains at Dromcliff suggest an early ecclesiastical settlement. The graveyard is used to the present day as the main burial ground for the nearby town of Ennis. Westropp (2000) relates a story of a spectral dog which accompanies a human ghost on a nightly patrol between the railway bridge and Drumcliff church and tower. Westropp (2000) refers to a legend, which tells that 'hidden bells of Dromcliff Round Tower' are hidden in the pool of Poulnaclug and the marsh below the monastery at Kilnaboy.

Apart from the ecclesiastical remains already referred to, 11 other entries relate to churches. These are located in Ballymacrogan West, Kilcurrish, Ballyallia, Ballymaconna, Bunnow, Clooney, Killow, Noughaval, Clonlea, Kilmaleery and Rineanna North. The church in Ballymaconna is the original parish church of Kilraghtis, today Barefield, and thought to date to the 15th century AD (Westropp 1900). The associated burial ground probably dates to the post medieval period. The burial ground surrounding the church has remained in use to the present day. The name translates as *Cill Reachtais,* the Church of Reachtas. A more recent translation of the name Kilraghtis provides an interesting interpretation 'Church of the legislation' (Flanagan 1994). O'Donovan and Curry (1997) deliberate whether Reachtas is the name of a saint or the place. The Letters say that St. Finghein of Quin was worshipped in Kilraghtis but all memory of the Patron Day is lost, that is if there was one to begin with. O'Donovan and Curry also note a 1601 reference to the place in the Annals of the Four Masters.

The founder of Clonlea Church is unknown. The church is located on the edge of Clonlea Lake, and has been dated to the 15th century (Westropp 1900). A legend associated with this building tells that the church of Clonlea once stood at the opposite side of the lake, near St. Senan's well in Killaneena, until one night it travelled down the old lane that runs into the lake, passed under the water, and reached its present site (Westropp 2000). Very little is also known of Killow church. The name translates as *Cill Lugha* or 'Lugha's Church'. Saint Lugha was venerated on the 16th June and the 1st July (O'Donovan and Curry 1997).

Evidence of archaeological sites from rescue excavations

Records from the excavations associated with development projects provide information on the potential for below ground remains.

The results of excavations associated with small-scale development projects in Bunratty Lower, Bunratty Upper, Inchiquin and Islands show that apart from the excavations at Clonlea (00E0670) and Killanena (02E1643), the vast majority did not produce archaeologically significant results. The excavation at Clonlea is particularly notable in that it points towards the possible existence of an ecclesiastical settlement in that townland.

Excavations associated with the laying of the natural gas pipeline revealed further information on the archaeology of certain townlands within the Baronies

of Bunratty Upper and Islands. Most sites related to burnt mound/ *fulacht fiadh* activity, and date to the Bronze Age/ Iron Age period. Such sites have been found in Ballymaconna, Bearnafunshin, Cahernalough, Cappagh Beg, Ballycorick, Cragbrien and Lisheen. *Fulachta fiadh* are generally interpreted as feasting sites. However as Brindley and Lanting (1990, 55) note, there is '…no evidence or even compelling argument to indicate that *fulachta fiadh* are primarily cooking sites, although their widespread distribution and apparently fairly regular use might support such a function.' The discovery of possible industrial pits (02E1514) located in Cappagh Beg in an area of *fulachta fiadh* type activity suggests alternative functions. Possible production areas associated with burnt mounds have been uncovered in Ballycorick townland (02E1185 and 02E1186). Charcoal production pits have been found in Cahernalough (02E1187), Ballycorrick (02E1011) and Lisheen (02E1063).

Funerary activity is represented by the cremation pits in Racorcraun (02E1153), Cloonagown (02E1334), Ballycorrick (02E1014) and Cragbrien (02E1299). The example in Racorcraun has been dated to the Bronze Age, the pit in Cragbrien was dated to the Iron Age and the Ballycorick burial has been dated to the Late Iron Age/ Early Christian transition period. Probable prehistoric activity of a more domestic or ceremonial nature has been found in Cloonagown (02E1334, 02E1337 and 02E1339) and Ballaghafadda West (02E1367). Circular ditches were uncovered in both of these townlands. The possible log boat from Skehanagh/ Clareabbey (03E0234, 03D012, 03R017) may date to the Early Christian period and could relate to the nearby 12th century site of Clare Abbey, CL033-120 and CL033-0121.

The medieval and post-medieval period is represented by the sites found in Kilbreckan (02E1059, 02E1060 and possibly 02E1523) and Barntick (02E1368). The wide range of industrial activity evidence uncovered at Kilbreckan may relate to the nearby possible deserted medieval village CL034-210 in the same townland. A post-medieval structure was uncovered in Barntick (02E1368).

The Ennis Bypass and N85 Western Relief Road revealed relatively fewer signs of human activity. The most significant sites were found in the townland of Carrowdotia (03E1426 and 03E1442). Evidence was uncovered of activity dating to the prehistoric, Early Christian and post-medieval periods. The Early Christian evidence took the form of a cashel and metal working pits. A cashel was also identified in Knockanean (03E0848) and tentatively dated to the post-medieval period. The discovery of a post-medieval roadway in Carrowdotia, a possible precursor of the current N18, is of particular interest. Other excavations in this townland (03E1443 and 02E1492) excavated two previously recorded enclosures and one previously unrecorded *fulacht fiadh*.

Early Christian enclosure adjacent to Kilrush Road, Ennis. The site had no above ground expression and was found during archaeological testing for the N18 Ennis Bypass

Plate 4

Excavations carried out in advance of the N18/ 19 Ballycasey-Dromoland Road Improvement Scheme uncovered a number of very significant new sites along the edges of the River Fergus estuary.

A Late Neolithic/ Early Bronze Age ditched enclosure was uncovered in the townland of Latoon South (98E0332 and 98E0332 ext.). The debitage nature of the lithic assemblage suggests some kind of specialisation in tool or maybe leather manufacture. A kiln and post-medieval finds were also found. Evidence of medieval habitation was uncovered at another site in this townland (98E0338).

A Middle-Late Bronze Age cremation cemetery was uncovered in Ballyconneely townland (97E0042). Evidence for more secular activity includes a Late Bronze

Age trackway, a circular furnace and numerous post holes/ stake holes consistent with structures. The discovery of early medieval ring ditches and a kiln demonstrates the continuing relevance of the Ballyconneely/ Ballygirreen (00E0284) area in the early historic period. Other excavations in Ballyconneely (00E0073/ 00E0284 and 00E0284) have yielded evidence for post-medieval activity, possibly connected with an encroachment of settlement on marginal areas during the population peak of the early 19th century.

The townland of Ballynacragga produced a range of sites (98E0333). These included possible prehistoric burnt mounds and a wooden platform and a post-medieval/ modern trackway.

The prominent location of the Ballyconneely cremation cemetery on a platform within the River Fergus marshes overlooking the estuary is suggestive of a sacredness attached to this landscape in prehistory. In addition the presence of a prehistoric ditched enclosure in Latoon South and the early medieval ring ditches in Ballyconneely/ Ballygirreen suggest that these wetland areas were relevant in a nutritional or economic sense. Areas such as wetlands need not necessarily be seen as agriculturally unviable. Riverbanks, lakeshores and estuary marshes are in fact areas of diverse resource. Today the east side of the Fergus estuary is flanked by an area of alluvial soils reclaimed from the marshes through artificial means. In prehistory there would have been more extensive wetlands along the course of the estuary. These wetlands would have included mudflats, salt marshes, rock, reed-swamps, sedge-fens and fen-car woodland of alder and willow (Grogan 2005). The recovery of a late prehistoric wooden fish weir from these mudflats adds credence to the relevance of this landscape in prehistory (O' Sullivan 1996).

Results of research based excavations

The North Munster Project, part of the state funded Discovery Programme, has provided insights into the archaeological resource of southeast Clare. This has reviewed settlement history in the Shannon region in the context of landscape setting. Excavations at Clenagh and Mooghaun South have yielded evidence of two enclosures dated to the later prehistoric period. Previous investigations into this period have been hindered by a lack of monuments of definite later prehistoric date. The Discovery Programme has identified twenty-nine hillforts or hilltop enclosures, tentatively dated to the Middle-late Bronze Age. These sites are concentrated along the lower reaches of the Shannon, and particularly along the upland rim of the Limerick lowlands extending towards Tulla in southeast Clare (Grogan 2005). Grogan (2005) suggests a model of settlement organisation for the later prehistoric period consisting of a four-tier hierarchy of occupation sites. Substantial hilltop enclosures or 'hillforts' represent the highest level of this settlement hierarchy followed by substantially defended hilltop enclosures, with lakeside settlements and poorly defended enclosures forming the lower levels. The enclosure at Mooghaun belongs to the highest level, whereas Clenagh would slot in further down.

Evidence from topographical files

Topographical files provide further information on past impacts of human activity (Gibbons, Gibbons and MacDermott, 1999). Approximately 178 entries are noted for the study area. These finds are located in the townlands of Ballagh, Ballyallia, Ballycally, Barntick, Clooney, Cloonfeaghra, Dromore, Durra, Edenvale, Enagh East, Garrynamona, Keevagh, Killian, Mooghaun North (Mooghaun), Moyreisk, Newhall, Rathcahaun and Rineanna South. Details of the finds are listed in TVAS (2006). Metal finds form the bulk of the assemblage, followed by finds composed of stone and bone. It should be noted that the Topographical finds are not updated since 1999 to include the results of the large number of excavations, which have been carried out since then.

A number of isolated finds area known from Ballagh, Dromore, Durra, Killian and Rathcahaun. Edenvale, Newhall and Barntick are renowned locally for their caves and the finds they have yielded. Finds from Edenvale include flint scrapers, animal bone, teeth including a perforated bear's tusk, worked bone including a bone bracelet, an amber bead, a pierced shell, iron objects and coins. The Newhall caves have produced a similar range of finds. Less finds are known from Barntick, but they do include a bone object with a dot and circle ornament. Stone axeheads are known from Ballyallia, Cloonfeaghra and Moyreisk. Flat copper axeheads are listed from the townlands of Coonagh and Keevagh. These objects are important in that they represent a significant part of a small number of Early Bronze Age finds known from south-east Clare. Clooney townland has also yielded tallow-encased bog butter.

It comes as no surprise that a large number of objects are listed for Mooghaun North (Mooghaun) townland. This hoard of gold objects is significant due to its proximity to the Late Bronze Age hillfort located in Mooghaun South. The hoard was discovered in 1854 during construction of the Limerick-Ennis railway line. The objects are but a small representation of what may originally have been a much larger hoard. The objects that survive are ornamental in nature; collars, bracelets, gorgets, rings, armillae, armlets and torcs, and have been interpreted as Late Bronze Age in date (Grogan 2005). Another significant hoard represented in the topographical files is the Late Bronze Age bronze tool hoard from Enagh East. This hoard contains bronze socketed axeheads, socketed knives, a gouge, a chisel and rings. This hoard was located southeast of a hilltop enclosure in Enagh East and northeast of a ceremonial enclosure in Enagh West (Grogan 2005).

The North Munster project has stressed the regional character of the high status gold ornaments retrieved from the area (Grogan 2005). Items of personal ornament are the norm in North Munster whereas more 'communal' objects typify the area to the south and west. A distinctive North Munster character is also notable with regard to the deposition of objects (*ibid*). There is a general emphasis on water margins, whether lake, river or estuarine in later prehistory. Also, tools usually turn up on dryland, whilst weapons are generally found in bogs.

The townland of Garrynamona has produced the largest number of finds. A partial excavation of Garrynamona ringfort (rath/cashel) CL061-004, was undertaken by Rynne in the 1940's, in advance of the construction of a runway for Shannon Airport (Ryan 1980). A variety of finds were recovered during the excavation, including bone (notched and polished), glazed pottery in a variety of colours, glass, iron objects, a bronze binding strip, 18th century coins, quernstone fragments and clay pipe fragments. The site has been dated to the late medieval period (main period of occupation 14th to 16th century), with intermittent occupation and use recorded up to the early 20th century.

Ballycally townland also had a large number of entries. These finds came from the excavation of another ringfort (rath/cashel) known as 'Thady's fort', CL051-120, also excavated by Rynne in similar circumstances. This excavation yielded a similar late medieval date and a similar range of finds (Ryan 1980). In addition a trackway CL061-00303 which ran through the townlands of Ballyhennessy, Garrynamona and Rineanna South was excavated in advance of runway construction. This roughly cobbled route formed an extension of a road which ran alongside the aforementioned ringfort in Garrynamona. An undated human skeleton was found along the eastern edge of the trackway. Coins (16th and 19th century), hammerstones, irons objects, a brass spoon bowl, a clay pipe bowl, pig and ox teeth, a bronze/ copper harp peg and quernstone fragments were uncovered, giving the trackway a late medieval date (Ryan 1980).

4.2.2 Evaluation

Strict evaluation of the significance of the archaeological heritage in this landscape is not possible, for the following reasons:

- Existing records are not linked to their landscape context.
- No comparative evaluation is possible for other parts of Clare
- Available information is incomplete. It is likely that there are particular gaps in the record from underdeveloped areas which are of high value for biodiversity such as wetlands, estuarine environments, lacustrine environments, marginal land, bog, etc.

Therefore only tentative conclusions can be drawn from this review:

There are currently 719 individual sites of archaeological interest representing all periods of settlement. Many more remain to be undiscovered.

Limited evidence suggests that the following features of the archaeological heritage are of particular interest; the many undated (but probably prehistoric) enclosures, Neolithic and Bronze Age burial sites, *fulachta fiadh* (probably from the Bronze Age) the Early Christian ringforts and cashels, secular and ecclesiastical structures from the medieval period and post-medieval structures and sites.

The "archaeological complexes" identified in the desk based survey could be interpreted as areas of "vulnerable landscape" requiring particular recognition and management. These are Moymore/Ballygriffey North, Toonagh/Cahercalla, Ballymarkahan/Knopogue, Ballyvonnavaun, and Ballyhennessy/Garrynamona/Rineanna North/Rineanna South.

The complexes at Moymore/Ballygriffey North, Toonagh/Cahercalla, Ballymarkahan/Knopogue and Ballyvonnavaun comprise mainly enclosures dating to at least the Early Medieval period (AD 450 – AD 1170). Although the complex at Ballyhennessy/Garrynamona/Rineanna North/Rineanna South was partially destroyed in the mid 20th century it is nonetheless significant in that it bears testimony to the relevance of the Fergus estuary in the past. This complex comprises ringforts, trackway and burial ground. Of particular importance is the complex at Toonagh/Cahercalla or *Magh Adhair*, including enclosure, battlefield, bullaun/basin stone, standing stone, holy well and inauguration site, dating from at least the Bronze Age (2300 BC – 700 BC) to the medieval period (AD 450 – AD 1547) which has been researched through the Discovery Programme. This landscape has been interpreted by scholars as a ritual and inauguration complex of national importance (Condit and Cooney 1998).

These complexes are important in that they represent clusters of settlement and ritual activity which may in turn mirror prehistoric patterns. The lack of dating evidence for the majority of known enclosures often leads to a blinkered interpretation, relying on the general assumption that most date to the early medieval period, when in fact they could be of greater antiquity. As records within the study area exist for 372 mostly circular enclosures, 43 cashels, 29 ringforts (rath/cashel) and 4 rectangular enclosures, further research including dating may lead to the designation of more "complexes", or places within the landscape of high value for archaeology.

Other archaeological complexes are difficult to identify as the boundary of the study area is not related to an archaeological context. The central focus of an archaeological complex such as Mooghaun lies just outside the study area. Evidence has been found of settlement on Mooghaun hill from at least the Bronze Age to the medieval period. It has been suggested that the Late Bronze Age ramparts (1200 BC – 700 BC) enclosing the hilltop were constructed with a visual impact in mind as opposed to a defensive one. The Mooghaun landscape could be therefore said to include a wide hinterland which undoubtedly extends into the study area. It should also be noted that Mooghaun North townland, which is included in the study area, was the site of one of the largest Bronze Age gold hoards ever found in the country.

The megalithic structures at Ballymacloon East, Ballymarkahan, Carrownanelly, Clooney, Creggaun, Dooneen, Drumullan, Kilcornan, Kilcurrish, Monanoe and Toormore and the landscape around them, are significant in that they are conceivably the earliest monuments in the landscape, maybe dating to the Neolithic period (4000 BC – 2300 BC). Those monuments classified as 'cairns' and 'mounds' may also fall into this category.

Other areas which are not termed as complexes, but are nonetheless significant, include Clenagh townland. Excavations carried out by the Discovery Programme at Clenagh hilltop enclosure suggest that the site was occupied sometime prior to the Iron Age (700 BC – AD 450). This excavation evidence coupled with other enclosures, cashels, ringforts (rath/cashel), a tower house and bawn and a fortified house known from the townland, suggests a pattern of settlement extending as far back as the prehistoric period and continuing down to the medieval period.

Another probable area of interest includes those monuments at Enagh West and Enagh East, which again depict a settlement picture dating from at least the early medieval to the post-medieval period, comprising enclosures, tower house and bawn, burial ground and 17th century house. Of additional interest is the Bronze Age tool hoard found in Enagh East and the folklore descriptions of Enagh as a fair location or gathering place.

At least 59 sites termed *fulachta fiadh* were identified during the survey. These possible prehistoric feasting places may have along with other monument types such as standing stones and enclosures have served as foci for community ceremony and ritual.

Areas with ecclesiastical remains such as those at Killian, Drumcliff and Castletown are of obvious significance. Other possible early ecclesiastical sites include Kilvoydan South with its *killeen*, holy well and bullaun stone.

Areas illustrating the settlement picture of the later medieval and post-medieval (AD 1547 – present) periods include the various tower houses (Ballyallia, Ballygriffey South, Ballymarkahan, Castletown, Clenagh, Craggaunowen, Danganbrack, Enagh West, Kilkishen Demesne, Knopoge), castles (Ballyconneely, Bealnalicka, Corbally, Clooney, Cloonmore, Deerpark North, Kilkee East, Muckinish), fortified house (Ballysallagh West), 17th century houses (Ballykilty, Barntick, Clooney, Enagh West, Kilmoraun, Knockanimana, Tooreen), deserted settlements (Kilbreckan, Latoon South) and watermills (Ballykilty, Cloonagown). The Muckinish monuments which include an earthwork, cashel, enclosures, graveyard and battlefield are of particular interest in this regard. The celebrated hill of Urchaill or Fuarchoill is located in Muckinish and mentioned in the *Wars of Turlogh* (1318) and the *Annals of the Four Masters* (1559) as the site of a great battle between the O'Briens and Geraldines (O' Donovan and Curry 19839, published 1997, reprinted 2003).

4.3 Habitats

4.3.1 Habitats and their cover

Fieldwork revealed the presence of forty four habitats in the entire area.

Fig. 9 provides an illustration of habitat diversity in the study area (212km2). *This figure is shown for illustration purposes only. Large (A0 or A1) size hard copy maps are available for 1) the Ennis and Environs Development Plan area and 2) the eastern part of the study area and the Shannon Estuary*

Figs 10 and 11 are habitat maps of sample areas at an appropriate scale.

Details of the habitats and the area which they occupy are shown in Table 4 (for the area digitised in 2006) and in Table 5 for rural areas within the Ennis and Environs Development Plan Area.

As the information is available in digital form maps and such tables can be produced for any part of the study area.

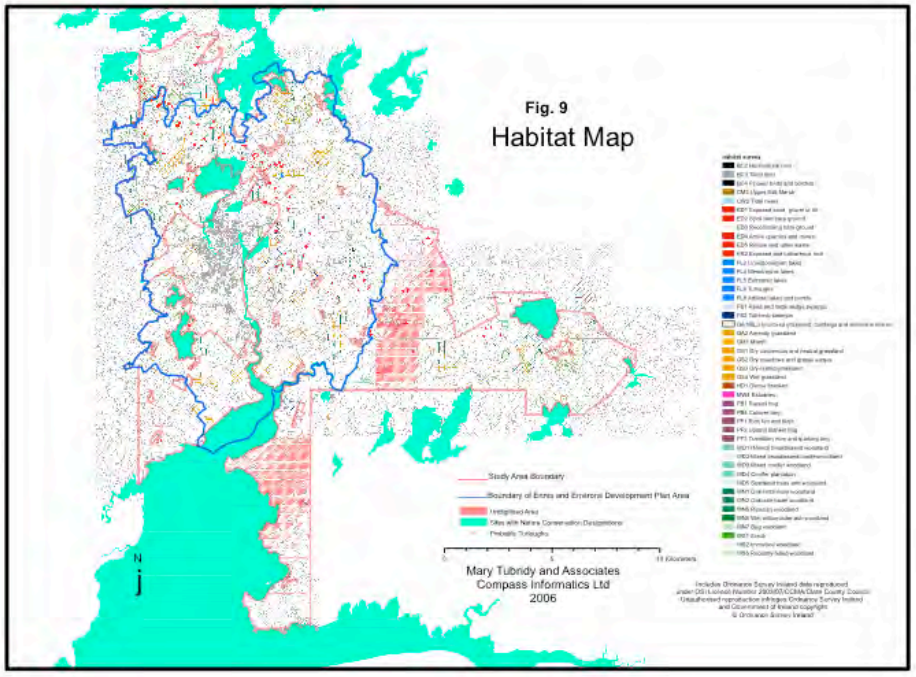


Table 4
Habitats mapped and digitised throughout the study area

Habitat	Code	Area (ha)	% total area
Lower salt marsh	CM2	10.26	0.19
Upper salt marsh	CW2	1.96	0.037
Exposed sand, gravel and till	ED1	0.08	0.001
Spoil and bare ground	ED2	10.48	0.199
Recolonising bare ground	ED3	79.70	1.521
Active quarries and mines	ED4	24.12	0.460
Refuse and other waste	ED5	8.43	0.161
Exposed calcareous rock	ER2	36.64	0.700
Limestone/ marl lake	FL3	3.00	0.057
Mesotrophic lake	FL4	206.66	3.943
Eutrophic lake	FL5	2.24	0.043
Turlough	FL6	7.90	0.150
Artificial lakes and ponds	FL8	3.43	0.065
Reed and large sedge swamps	FS1	257.90	4.921
Tall-herb swamps	FS2	3.66	0.070
Amenity grassland	GA2	25.62	0.489
Marsh	GM1	13.43	0.256
Dry calcareous and neutral grassland	GS1	388.59	7.415
Dry meadows and grassy verges	GS2	65.80	1.256
Acid grassland	GS3	28.56	0.545
Wet grassland	GS4	1196.47	22.831
Dense bracken	HD1	14.58	0.278
Horticultural land	BC2	0.38	0.007
Tilled land	BC3	0.14	0.003
Flower beds and borders	BC4	0.50	0.009
Estuary	MW4	2.56	0.049
Raised bog	PB1	15.16	0.289
Cutover bog	PB4	104.29	1.990
Rich fen	PF1	182.62	3.485

Table 4 (contd). Habitats mapped and digitised throughout the study area

Habitat	**Code**	**Area (ha)**	**% total area**
Poor fen	PF2	5.37	0.102
Transition mire and quaking bog	PF3	2.57	0.049
(Mixed)broad leaved woodland	WD1	629.63	12.014
Mixed broadleaved/ conifer Wood	WD2	98.76	1.884
(Mixed) conifer woodland	WD3	3.09	0.058
Conifer woodland	WD4	178.18	3.400
Scattered trees and parkland	WD5	20.36	0.388
Oak-birch-holly woodland	WN1	2.62	0.0498
Oak-ash-hazel woodland	WN2	633.09	12.0815
Riparian woodland	WN5	4.18	0.079
Wet willow-alder-ash woodland	WN6	41.49	0.791
Bog woodland	WN7	35.53	0.678
Scrub	WS1	764.89	14.595
Immature woodland	WS2	122.49	2.337
Recently- felled woodland	WS5	2.97	0.056
TOTAL AREA		**5240.42**	

Table 5 shows the results of habitat mapping in the rural areas covered by the Ennis and Environs Plan

Table 5 Habitats within rural parts of the Plan area

Habitat	**Code**	**Area (ha)**	**% total area**
Horticultural land	BC2	0.26	0.01
Tilled land	BC3	0.14	0.00
Lower salt marsh	CM2	5.55	0.17
Upper salt marsh	CW2	0.81	0.02
Spoil and bare ground	ED2	10.48	0.32
Recolonsing bare ground	ED3	77.90	2.34
Active quarries and mines.	ED4	16.14	0.49
Refuse and other waste	ED5	8.44	0.25
Exposed calcareous rock	ER2	17.74	0.53
Limestone/ marl lake	FL3	3.00	0.09
Mesotrophic lake	FL4	73.71	2.22
Eutrophic lake	FL5	1.42	0.04
Turlough	FL6	3.37	0.10
Artificial lakes and ponds	FL8	3.43	0.10
Reed and large sedge swamps	FS1	183.72	5.52
Tall herb swamps	FS2	1.72	0.05
Amenity grassland	GA2	25.62	0.77
Marsh	GM1	13.43	0.40
Dry calcareous and neutral grassland	GS1	274.28	8.25
Dry meadows and grassy verges	GS2	50.54	1.52
Acid grassland	GS3	28.56	0.86
Wet grassland	GS4	841.54	25.30
Dense bracken	HD1	10.97	0.33
Estuary	MW4	1.87	0.06
Cutover bog	PB4	18.72	0.56
Rich fen	PF1	132.41	3.98
Poor fen	PF2	4.51	0.14
Transition mire and quaking bog	PF3	2.57	0.08

Table 5 (contd). Habitats within rural parts of the Plan area

Habitat	Code	Area (ha)	% of the area digitised
Mixed) broadleaved woodland	WD1	404.41	12.16
Mixed broadleaved / conifer woodland	WD2	95.69	2.88
(Mixed) conifer woodland	WD3	0.69	0.02
Conifer woodland	WD4	54.49	1.64
Scattered trees and parkland	WD5	15.56	0.47
Oak-ash-hazel woodland	WN2	388.54	11.68
Riparian Woodland	WN5	3.33	0.10
Wet willow-alder-ash woodland	WN6	10.11	0.30
Bog woodland	WN7	1.12	0.03
Scrub	WS1	465.85	14.01
Immature woodland	WS2	70.09	2.11
Recently- felled woodland	WS5	2.97	0.09
TOTAL AREA		**3325.72**	**100.00**

Fig. 10 Habitats in Land East of Ennis

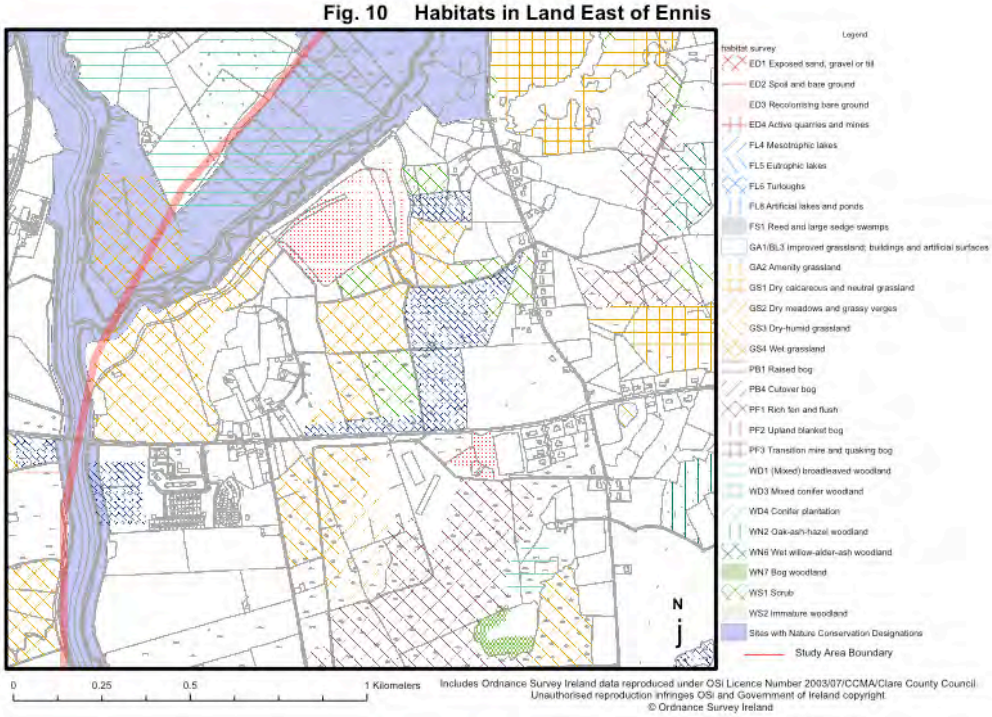
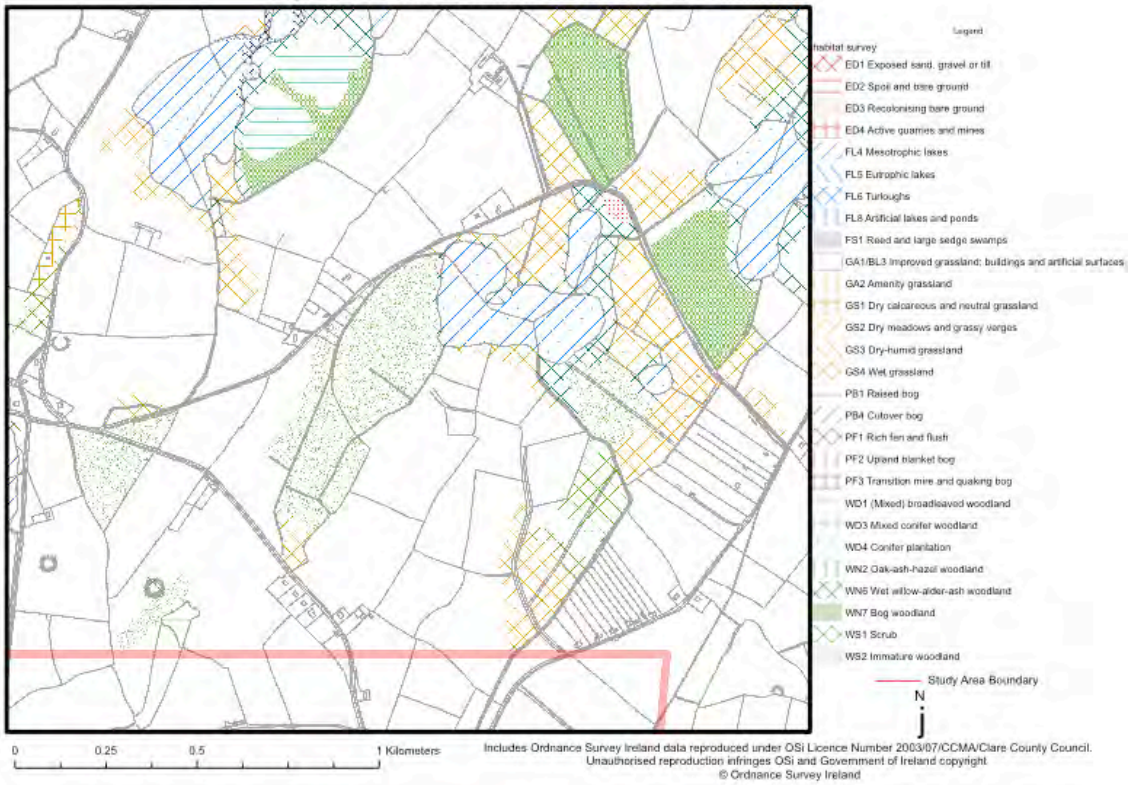


Fig. 11 Habitat in Lands South-east of Kilkishen



4.3.2 Wetland habitats

Description

A **turlough** (from the Irish word dry lake) is a type of lake found in a topographic depression in karst which is intermittently inundated on an annual basis, mainly from groundwater, and which has a substrate and/or ecological communities characteristic of wetlands. Turloughs are found throughout the study area, including the town of Ennis but are particularly abundant north of Ennis (*Fig.6*). While turloughs (vary in size, all are characterised by shallow areas of varying wetness surrounding a source, probably a swallow hole through which they are fed by groundwater. In contrast to lakes, turloughs dry out as they empty completely to groundwater. The extent of turloughs (8ha) has been underestimated for the following reasons. The study took place in summer during a period when turloughs dry out and the field based survey was not informed by the results of the desk based mapping exercise which identified "probable turloughs". The habitat category "Turloughs"(mapped from fieldwork and shown as FL8 in habitat map) and point locations of "Probable Turloughs" (mapped by Dr Robbie Meehan and shown on Fig.6) accurately depict the location if not the full extent of turlough habitats within the study area.

GIS analysis of the habitats in which "probable turloughs" were located in the rural areas covered by the Ennis and Environs Development Plan provided the following results (Table 6).

Table 6 Habitats associated with "Probable Turloughs"

Habitat	Number of Locations
Spoil and bare ground (ED2)	1
Refuse and other waste (ED5)	1
Exposed calcareous rock (ER2)	1
Mesotrophic lake (FL4)	2
Eutrophic lake (FL5)	1
Tall-herb swamps (FS1)	9
Dry calcareous and neutral grassland (GS1)	1
Wet grassland (GS4)	13
Rich fen and flush (PF1)	7
Mixed broadleaved woodland (WD1)	2
Oak-ash hazel woodland (WN2)	4
Scrub (WS1)	6
Improved grassland and buildings GA1/BL3	35
Total	83

As expected these results show that most turloughs do not correspond to the lakes/turloughs (FL6) found in summer surveys. While many still support

valuable wetland habitats the analysis shows that most turlough habitats have been reclaimed and are now used for good quality grassland. Other typical habitats associated with turloughs include high quality wetlands such as swamps and fens.

Three lake types were identified in the study area. Most were **mesotrophic lakes (FL4)** (**207ha)** with a few **limestone/ marl lakes (FL3)(3ha)** and **eutrophic lakes (FL5) (2.3ha)**. Mesotrophic lakes are characterised by a reed swamp fringe with patches of floating vegetation dominated by water-lilies in sheltered corners. A lake with these characteristics was identified as mesotrophic if most or all of the shoreline had a band of semi-natural vegetation separating and buffering it from improved farmland, i.e. run-off of nutrients into the lake is reduced or absorbed by the surrounding semi-natural vegetation. A **limestone/marl lake (FL3)** is a type of mesotrophic lake which has such as high calcium carbonate content that it precipitates out of solution to form marl on the lake bed. If a marl lake is healthy, the water will be very clear and may have abundant stoneworts, types of algae that look like a higher plant, and use calcium carbonate as part of their cell structure.

Plate 5 Turlough at Licknaun. Note pockmarked boulders in the stonewall.

Lakes with little or no surrounding semi-natural vegetation and ponds were mapped as **eutrophic lakes (FL5) (2.3ha)**. They are usually found in low-lying areas in pasture fields where the water table is at the surface for most or all of the year. They are small (approx. 20m diameter)and their vegetation typically grades from (semi-)improved dry grassland into wet grassland. The wet grassland is usually species-poor and dominated by yellow iris, soft rush and creeping bent-grass. In most cases livestock have open access to the ponds and this contributes to their nutrient-enriched status. They are sometimes characterised by a green scum of duckweeds on the surface (particularly obvious later in the summer).

A small number of artificial wetlands (**other artificial lakes and ponds (FL8) (3ha)**) were found, associated with an abandoned mine at Kilbricken and derelict quarry near Ennis. While entirely man made these wetlands also provide good habitat for certain wetland plants and coarse fish.

The area occupied by a turlough and the environs of lakes support several different wetland habitats depending on substrate, topography and flooding regime. The most important of these is **rich fen and flush (PF1)(183ha)** which is found throughout in the study area, due to the karst geology which provides calcareous groundwater. Alkaline fens are listed under the Habitats Directive and the priority type is distinguished by the presence of abundant saw sedge.

The vegetation of the non-priority type is dominated by black bog-rush or a number of smaller sedges (e.g. yellow sedge, carnation sedge). It is found in association with turloughs. Wet flushes are characterised by relatively small areas dominated by bulrush and/or common reed.

Plate 6 Rich fen (PF1) to east of Ennis

Fen immediately adjacent to open waters in lakes (and to a lesser extent around turloughs as they have less permanent open water) **reed and large sedge swamp (FS1)(258ha)** habitat is found. Common reed is the dominant species. This habitat forms a wide band in shallow sheltered waters.

Swamp along tidal rivers such as Latoon Creek has less species rich vegetation, with common reed and/or greater pond-sedge, forming a band between saltmarsh and the river channel. This habitat has a naturally low diversity of plant species due to the dominance of the tall reeds. It is part of the transition of habitats from open water on a lake to more terrestrial habitats.

In areas with a lower table but still near to open water in lakes, rivers and turloughs the habitats **tall herb swamps** (**4ha) (FS2)** and **marsh (GM1)(14ha**) are found. They are characterised by a greater diversity of tall herbs such as hemp agrimony and water plantain (for the former habitat) and marsh thistle in the latter. These habitats were difficult to identify at the scale of mapping for this project as they were usually found in association with reed swamp and wet grassland, habitats which cover relatively larger larger areas.

Peat dominated wetland habitats are principally found in the east of the study area where **raised bogs** and fens fed by run off from their slopes developed in inter-drumlin hollows. Very small areas of intact bogs remain (mapped as **raised bog (PB1)(15ha), transition mire and quaking bog (PF3)(2.6ha) and poor fen and flush (PF2) (5 ha**). All peat deposits have been cutover, in some cases right through to the underlying marl. As a result no intact raised bogs were located. Bog like habitats principally comprise **cutover bog (PB4)(104ha)** which develops after exploitation for peat. The exploited bog is revegetated with a mixture of species which do not broadly fit in with another habitat category. Typically, cutover areas contain some or all of the following habitats; acid grassland; areas dominated by purple moor-grass, cottongrasses, ling and bell heathers, peat-mosses and other mosses; bracken, bog myrtle, gorse and willow scrub; and birch saplings/trees. Where the underlying alkaline fen peat or marl deposits have been exposed, black bog-rush quaking-grass and orchids can be found, mainly spotted-orchids and butterfly orchids. Old drains or deeper cut areas may still be wet, with species of quaking bog including a thick growth of peat mosses and typical bogland plants such as the insectivorous sundew.

Recently developed **bog woodland (WN7)(35ha)** is found on revegetated areas of cutover peat. It is dominated by downy birch with abundant willows. Additional species include oaks, rowan, holly and Scot's pine. Bracken and bramble are usually abundant in the shrub layer, often with honeysuckle. Bog species such as heathers, bilberry and purple moor-grass can be frequent to abundant, as well as ferns such as hard fern and male ferns. The ground layer is usually dominated by mosses.

Evaluation

The important wetland habitats mapped in this survey cover 840ha of the study area. Certain habitats within this category are listed in the Habitats Directive.

They include turloughs, certain types of fen; limestone/marl lakes; tall-herb swamps and calcareous springs, transition mire and quaking bog and bog woodland. These habitats are similar to those within designated sites.

It is likely that some examples have potential to be recognised as sites of international biodiversity importance and some may be linked physically and functionally to existing sites with nature conservation designations. The relative value of individual examples of habitats depends on their naturalness and rarity. Turloughs are rare habitats, which while found elsewhere in the world have their headquarters in Ireland. In contrast most of the bogland type habitats have recently developed as a result of turf cutting. All wetlands are of relative high biodiversity value compared to drained and developed areas as their floras are dominated by native wetland plants. They are likely to support important animal species such as salmonid fish, invertebrates, birds (particularly winter migrants) and mammals particularly otter.

The large number of designated sites in the study area which are wetlands, reflects the importance of these habitats. There are obvious hydrological and ecological links between wetlands inside and outside designated areas. The national review of ecological networks (Tubridy and O Riain, 2001) stressed the importance of river courses and their associated wetland habitats as natural ecological corridors.

Wetlands also perform other functions, as amenity areas and in floodplain management. Undrained wetlands have a large capacity to absorb floodwaters without any interference with their biodiversity value.

Management by low level grazing is compatible with the maintenance of their biodiversity values. In the past farming was principally responsible for wetland destruction and removal. This threat has more or less receded. Wetland habitats are now under threat from infrastructure, development and waste disposal and wetland water quality from non point sources of pollution. Nearer Ennis there was evidence of construction in wetland areas and their use as dumping grounds for construction waste. Changes in hydrological regimes and water chemistry cause a less obvious and more gradual deterioration in wetland quality. Abstraction may also have negative impact. Therefore impacts on particular habitats need to be looked at carefully. The indirect effects on other wetlands in the catchment need to be considered, particularly if it is linked to a site with a nature conservation designation.

4.3.3 Estuarine habitats

Description

As the study excluded the Fergus estuary candidate Special Area of Conservation only a small number of examples of habitats associated with this environment were surveyed and mapped for this study. **Tidal rivers (CW2) (2ha**) include sections of river channel upstream of the Fergus estuary,near Ennis

which are subject to tidal influence and some degree of salinity, e.g. Latoon Creek upstream to Blackweir Bridge. Tidal rivers support little instream vegetation due to the daily changes in water level, as well as brackish conditions. Common club-rush occurs from time to time. There was no sign of the rare triangular club-rush in the study area.

Lower salt marsh /Upper salt marsh (CM1/CM2)(10ha) is found along the tidal rivers, and can be mainly categorised as upper salt marsh, a grassy vegetation type with red fescue, creeping bent-grass and saltmarsh rush, sometimes with common saltmarsh grass. Other species such as sea plantain, sea aster and arrowgrasses can be frequent.

Evaluation

Certain habitats within this category, examples of which are found in the study area, are listed in the Habitats Directive. They include tidal rivers within estuaries and upper and lower salt marsh.

The biodiversity of estuarine habitats is valuable as it features rare specialist plants and animals which can tolerate extreme conditons. The waters which flow into the Fergus provide feeding and commuting routes for birds and protected animals such as salmon and otter. As the estuarine environment in this area is adjacent to Ennis town there is evidence for particular pressures to its biodiversity arising directly and indirectly from infrastructure and development. These impacts include habitat removal, disturbance and water pollution.

4.3.4 Grasslands

Description

Almost all grasslands in fields are **improved grasslands** type **(GA1).** Improved grassland is considered the best quality grassland by farmers. It is of low value for biodiversity as it typically has a low diversity of species, a high cover of perennial rye-grass and lack of scrub. Weeds indicative of disturbance and nutrient enrichment such as nettles, thistles or docks can be abundant in less intensively managed examples. Improved grasslands were not mapped and digitised by this study. It can be assumed that if a field has not been indicated as supporting another habitat that it is covered in improved grassland.

Plate 7 Improved grassland (GA1) at Kilcurrish.

Many improved grasslands were developed in areas with a more natural type. A GIS analysis of the location of "probable turloughs' showed that 50% are present on land which supported improved grassland.

In rare situations these grasslands are of biodiversity value. This is when they provide feeding for migratory birds such as swans or geese. The biodiversity value of this grassland type can be improved by a reduction in inputs or management under an organic regime. Their use for housing will not reduce local biodiversity values as gardening will improve the local habitat for common birds and invertebrates.

Within the study area the habitat type **dry meadows and grassy verges (GS2) (66h)** is usually found in neglected or even improved grasslands, particularly in fields around housing in Ennis where land management for farming is in decline as development is being anticipated. In this type of habitat all species are allowed to flower and seed. This benefits the survival of plants and other forms of wildlife which feed on seeds or requires cover of long grass. If these grasslands are not grazed or cut and soil is rich they will eventually be dominated by a tussock forming species such as cock's foot and false oat grass, leading to the removal of other plant species and reducing the value of the grassland habitat as a feeding area for badgers and nesting birds.

In contrast to these types the following grassland habitats are of higher biodiversity value.

The cover of **dry-humid acid grassland (GS3)(28ha)** is low in the study area, as it requires acidic soil. It is typically found over peat on cutover or cutaway bog but may also be found on leached calcareous soils. Grass species typical of acid

soils are present such as bent-grasses and sweet vernal-grass, sometimes with Yorkshire fog and/or purple moor-grass. Sedges can be frequent or abundant, including carnation sedge, star sedge and yellow sedge. The herbs tormentil and devil's-bit scabious are frequent.

In the absence of grazing and management the habitat **dense bracken (HD1)(16ha)** appears in an acid grassland and later in a mosaic with scrub. It may dominate patches in scrub-calcareous grassland mosaic where soils have been leached. Very few other species can survive under dense bracken growth. This habitat is of low biodiversity value as it is species-poor and difficult to improve.

Wet grassland (GS4)(1196ha) is found within a turlough, in low-lying areas in fields, around lakes and near rivers, at the foot of drumlins, and in clay soils derived from shale rich glacial boulder clay. Some poorly-drained drumlins have wet grassland on their slopes. The most obvious component of wet grassland is rushes, while later in the summer purple loosestrife and meadowsweet are prominent in ungrazed or unmown fields. The value of this habitat for biodiversity is variable. The least valuable types comprise wet patches in intensively-managed improved fields which are affected by run off of fertilizer etc.These are likely to have a few native wetland plants such as soft rush, sometimes with creeping bent-grass. Semi-improved wet grassland fields (low management) are dominated by these two species with Yorkshire fog, sharp-flowered rush and creeping buttercup. Other species that may be frequent to abundant are meadowsweet, yellow iris, hairy sedge and marsh thistle. These areas are grazed and are often mown or topped once a year.

The most important type of wet grassland is that which is rarely mown or topped; is not affected by fertilizer of pesticides and is being being maintained by grazing only. These can support purple moor grass, abundant orchids, including spotted-orchids and butterfly orchids, as well as sedges.

Dry calcareous and neutral grassland (GS1) (389 ha) is found in dry farmland in the study area but particularly above karst. It is distinguished from improved grassland by the greater variety of grass species, a general absence of nutrient-indicating weeds (though these may be locally abundant at winter feeding cattle sites), high cover of clover and a moderate to high diversity of broad-leaved herbaceous species. The fields in which it is found usually have scrub and/or rock outcrop or they might be on the steeply sloping ground on the sides of drumlins. The main grasses found in this habitat are crested dog's-tail, red fescue, sweet vernal-grass and bent-grasses. The most common broad-leaved species include dog daisy, common knapweed, selfheal, yarrow, red clover and common cat's-ear. Mosses are abundant depending on the degree of fertilization. There is a particularly good example at Drummeer east of the R476 adjacent to landscape pavement.

Plate 8 Orchid rich calcareous grassland at Drummeer

Its biodiversity is characterised by the presence of high plant diversity, rare plants and associated invertebrates. The fields are suffering from scrub invasion. Outcropping karst is nearby or just under the surface of the land. The priority type grassland is characterised by the presence of grass species such as quaking grass, *Helictotrichon pubescens* and *Trisetum flavescens* and other species such as birds foot trefoil, flax, red fescue, cowslip, pyramidal orchid, marsh orchids and fragrant orchid.

Habitats adjacent to fields usually include hedgerows and treelines. **Hedgerows (WL1)** provide important reservoirs for biodiversity, particularly in areas dominated by improved grasslands. They usually contain native plants; they provide nesting sites for birds and feeding areas for small mammals. Where they are adjacent to bat roosts they are used as commuting routes by these species.

Evaluation

The grassland habitat of highest biodiversity value in the study area is an orchid rich dry calcareous type of GS1 which is listed in the Habitats Directive. It is only identified after careful scrutiny of plant species. Species rich wet grasslands are also valuable as some may qualify as the annexed habitat "Molinia meadow"

The biodiversity value of grasslands is directly linked to management. The most valuable types are those which are managed extensively and have not been reseeded in living memory. As self sufficient grassland ecosystems they represent a unique form of grassland which has been compatible with farming over hundreds and perhaps thousands of years. They are important reservoirs of grassland biodiversity (plants and invertebrates) now absent from most grasslands in the countryside. They require management under a low intensity

grazing regime to prevent scrub invasion. The biodiversity value of all semi-natural habitats is increased if they are adjacent to complementary types with which they share species. Wet semi-natural grasslands will share species with other forms of wetlands. Dry semi-natural grasslands will share species with scrub, hedgerows and the edges of woodlands. If the adjacent habitat areas are of high quality, then the value of the habitat outside the area is increased.

While the intensification of use of farm grasslands is not happening at a significant rate, new pressures have appeared such as abandonment, and use of wet fields to accept landfill. As wet grasslands are of low value for farming infilling is attractive to farmers as it appears to offer an opportunity to improve their land. Local authorities can play a direct role in managing the development of these types of semi natural grasslands through the waste permit system.

4.3.5 Limestone pavement and scrub

Description

Exposed karstified calcareous rock (ER2) is a feature of particular interest to ecologists and geomorphologists. While sometimes appearing bare (although crevices are vegetated) it is usually present as a mosaic with hazel scrub and grassland. It is concentrated north of Ennis in the vicinity of Drummeer, Caherclancy, Bealnalicka and Ballygriffy North with smaller amounts elsewhere. Exposed calcareous rock is easily identified using aerial photography. Its cover has been underestimated by this study as habitat map conventions state that only areas with <50% vegetation should be mapped as bare rock. Therefore areas with scrub or dry grassland adjacent to areas mapped as having exposed calcareous rock should be considered as a unit.

Plate 9 Limestone pavement at Drummeer

Scrub (WS1)(765 ha) is a transitional habitat which appears when land is neglected or/and grazing ceases. The principal species comprising scrub in the study area are either 1) hazel, whitethorn (hawthorn)/ blackthorn, 2) gorse and 3) willows. The former three species but particularly hazel are often found on limestone pavement or in fields where rock is close to the surface. Gorse dominated scrub is found on more acid soils on steep slopes (particularly of drumlins where management is difficult) and on cutover bog. A willow dominated scrub is frequent on cutover bogs and in wet areas adjacent to river or lakes.

Evaluation

Exposed calcareous rock corresponds to the annexed habitat Limestone Pavement listed in the Habitats Directive. It is the classical Burren habitat. Areas with this type of habitat are important for native plants, invertebrates, algae and mammals including rare species or species with restricted distribution. As the extent of exposed calcareous rock has been underestimated by habitat mapping any areas with scrub or dry grassland adjacent to exposed rock should also be considered as representing limestone pavement.

Scrub is a valuable semi-natural habitat as it is dominated by native plants. The value of different types depends on the length of time the habitat has been present, the habitat it has replaced and dominant species. Mature hazel scrub may have the characteristics of a climax woodland if present for hundreds of years on bare limestone pavement. Gorse appears rapidly if land is not grazed and the ground flora under it tends to be of low diversity due to dense shading and thick shrub growth.

Small patches of scrub in fields will greatly improve the value of a field for birds. However the complete replacement of a valuable orchid rich dry grassland with scrub will reduce local and nationally biodiversity values. In the past the cover of scrub reflected the fortunes of farming. Intensive grazing, drainage and reclamation kept scrub cover low. As farming becomes less intensive or land is awaiting redevelopment scrub invades. This is a particular problem in the Burren where scrub invasion has been shown to cause the removal of substantial areas of valuable grasslands. The management of hazel scrub needs careful management. Too much scrub and associated grasslands will disappear. Unsupervised scrub clearance can lead to the appearance of a dull improved grassland.

Within the study area limited evidence was seen of the removal of high value scrub. No evidence of scrub clearance on limestone pavement was found in the study area. Scrub clearance was seen in a field where a JCB used to excavate house foundations was used to remove scrub. While little direct evidence was found of abandonment, it was clear from consultations that farmers rarely or never went into areas covered in expanses of scrub.

4.3.6 Woodland

Description

Dominant tree species characterise woodland habitats. Woodlands of particular importance for biodiversity are dominated by native tree species. Nine types of woodland habitats are present in the study area.

They can be divided into three groups on the basis of naturalness or biodiversity value.

The following types; **oak-birch-holly woodland (WN1)(3ha), oak-ash-hazel woodland (WN2)(633ha), riparian woodland (WN5)(4ha); wet willow-alder-ash woodland (WN6)(41.5ha)** rank highly in naturalness as they are dominated solely by native tree species. They developed spontaneously in the absence of grazing and they have a long history of low intensity management. They would be difficult to replace if removed.

There are many stands of **oak-ash-hazel woodland (633ha)** particularly on outcropping limestone and on slopes where this rock is near the surface. They have survived due to the difficulty of clearing and maintaining farmland. Many of these woods are grazed and have an open shrub layer. The diversity of the ground layer varies depending on the age and structure of the wood and the degree to which it is grazed. The most frequent species are wood sorrel, wood sanicle, wood false-brome, pignut, primrose, hart's-tongue fern, male-ferns and violets. Ivy is frequent to abundant in most of these woods. Oak is rare and indicates particular antiquity and lack of management. Some stands of hazel scrub ressemble this habitat and may be present in association with it.

Few stands of **oak-birch-holly woodland** were found. Neither was a good example of its type. A stand near the Owenogarney River is dominated by a few mature oaks with abundant holly, and grades into a wet woodland type nearer the river, with abundant willows and alder.

Wet woodlands are found along rivers, lakes and in wet hollows. Along rivers it is usually found as a narrow strip (**riparian woodland (4ha)**), the extent of which, has probably been underestimated if present in narrow bands. Around lakes, **wet willow-alder-ash (41ha)** woodland is found as a narrow band along the shore, or over relatively large areas where land has not been reclaimed, for example as secondary vegetation on old cutover fen peat. Along rivers, alder and ash are the main species, while willows tend to dominate wet woodland around lakeshores. Ground flora in this woodland type is variable, but generally has a large component of grasses and sedges. A high proportion of bare ground is typical in some situations, where a dense tree canopy and seasonal flooding combine to limit the growth of understorey plants.

The following type of woodland, (**mixed) broadleaved woodland (WD1)(630 ha)** is less natural than the previous type as it contains non native broadleaved trees. The high cover is accounted for by the large area of planted beech woods which are owned by Coillte. One of the Coillte biodiversity areas, Ballygriffy Wood is currently of this habitat type. The long-term management for most of the site is to return it to native woodland cover, as oak-ash-hazel woodland (WN2). Natural regeneration of these species is taking place where gaps in the canopy of beech allows. It also includes areas of planted conifers such as Norway spruce, Scots pine, sitka spruce and Japanese larch. Other areas are dominated by beech. Existing pockets of semi-natural woodland, and regenerating clear felled areas support ash, hazel, blackthorn, whitethorn, holly, spindle and grey willow.

This type of non native broadleaved woodland is frequently found in bands on the steep sides of drumlins particularly where rock is near the surface. Non-native beech and sycamore are the most abundant species, along with native ash and oak. Shrub and ground layer diversity is highly variable, depending on the species mix of the canopy trees, whether the trees were planted on an older woodland site, and current use, e.g. whether the woodland is grazed. Extensive beech woodland on exposed limestone is found around Craggaunowen as well as at some other locations. Beech-dominated woodland such as this has a very sparse shrub layer and ground flora dominated by mosses, due to heavy shading and compounds in the beech leaves which acidify the soil and suppress the growth of other plant species.

Plate 10 Planted broadleaved woodland on drumlin at Ballygriffy, north-west of Ennis

Mixed broadleaved/conifer woodland (WD2)(99ha) are mature planted woodlands, often around old houses, which contain a mixture of non native and

native broadleaves and conifers. Some areas of new planting also contain a mixture of conifers and broadleaves.

The habitat **scattered trees and parkland (WD5)(20 ha)** is a feature of old demesnes, and is found scattered or in small groups in large fields, usually the fields nearest the original house, and sometimes as groups near the house and original farm yard. Non-native beech, sycamore and horse-chestnut are the most frequent species; however native ash and oak are also abundant all grown as specimen trees. As they are usually growing in fairly intensively-managed grassland, they do not have an associated woodland ground flora.

Of lesser biodiversity interest are the following habitats: (**mixed) conifer woodland (WD3) (3ha) and conifer plantation (WD4)(178ha).**

Planted conifer woodland of these two types is scattered throughout the study area particularly on peat based soils. It is dominated by sitka and Norway spruce, sometimes with Scot's pine or lodgepole pine. Much of this woodland type has been planted on cutover peat, and so is often found in low-lying areas beside lakes and frequently with pockets of bog woodland or wet woodland at its margins or as 'islands' within the planted woodland. Ground flora under conifer plantations is usually poor, being dominated by mosses and some ferns. Bramble may be frequent to abundant. Where there are clearings or the canopy is more open, shrub and ground flora diversity may be greater. The species found depends on the past land-use; e.g. bilberries can be abundant in some conifer plantations on cutover bog.

Fieldwork revealed evidence for the establishment of new woodlands (**immature woodland (WS2)(122ha)**. The main species used in new broadleaved plantations are ash, oak and maples. This type of habitat is being established principally in wet grassland and cutover bog.

This habitat category covers planted woodland areas where the saplings are less than 4-5m tall. They have no closed woodland canopy, and the ground flora is dominated by species of the habitat type prior to planting, such as wet grassland or cutover bog, as well as species of disturbed ground such as rosebay willowherb. Closely-spaced parallel drains are a characteristic feature of this habitat type. **Recently felled woodland (WS5)(3ha)** is dominated by tall tussocky grasses.

Evaluation

Woodlands are important reservoirs for biodiversity particularly of native trees, shrubs and specialist woodland herbs. They support large populations of birds which may include specialist woodland types and raptors. Mammals such as pine marten and bats are associated with woodlands. They provide a habitat for specialist invertebrates which live off decomposing wood.

Planting of woodlands is occurring particularly on wet soils. In recent years this comprises more broadleaves or a mixture of broadleaves and conifers. Older

planting (last 10 years or older) tends to be conifer. This is in response to government initiatives to promote broadleaved forestry among private landowners. Thus recent government and local policies seem to be promoting an approach to planting that will be of greater value for biodiversity. Existing semi natural woodlands can support carefully managed tree removal, low level grazing and limited shelter for animals in winter. The biodiversity interest of all semi-natural woodlands is threatened by lack of management.

4.3.7 Artificial habitats

Description

This group of habitats are types which can be easily replaced. They are the product of active management and many require active management to maintain them. Associated with some houses in rural areas **horticultural land (BC2)(.4ha)** and **flower beds and borders (BC4)(.5ha)** were mapped. **Amenity grassland (GA2)(26ha)** was associated with playing pitches and comprises recently seeded and regularly mown grassland.

The exploitation of rock has led to the development of several habitats; **exposed sand gravel and till (ED1)(.1ha)** and **active quarries and mines (ED4)(24ha).** The area occupied by active quarries is underestimated as the outline of these sites was drawn from 2000 aerial photography. Operational areas in quarries have a low biodiversity value. However the land adjacent to pits owned by the quarry usually increases in naturalness as its management becomes less intensive. Finally when quarries cease their biodiversity value increases considerably as a range of habitat types appear. East of Ennis, a disused quarry contains a large lake and in uneven dry ground there is a mosaic of habitats including a high quality dry calcareous grassland and scrub. Species found include carline thistle, marsh orchids and yellow rattle.

Plate 11 Lake in disused sand pit adjacent to Ennis.

Other types of disturbed land provide the habitats **recolonising bare ground (ED3)(80ha**); **spoil and bare ground (ED2)(10ha)** and **refuse and other waste (ED5)(8ha)**. The first two are principally associated with building and development as they describe land from which the original vegetation has been stripped bare before construction commences.

Evaluation

These types of habitats are of low biodiversity value unless species which provide food for invertebrates are sown in gardens or old quarries and dumps are allowed revegetate naturally. Abandoned quarries or mines in built up areas which have been allowed develop naturally provide reservoirs for biodiversity and areas of potential amenity value. Planning conditions can assist in ensuring that re-instatement enhances these values.

5 Management guidelines

5.1 Introduction

The survey has highlighted these characteristics of the vulnerable landscape:

- The presence of habitats of biodiversity importance some of which are rare types protected under the Habitats Directive.
- A landscape of high geomorphologic interest north of Ennis
- The abundance of individual archaeological sites and the presence of groups of sites in particular areas

While all the results have implications for spatial planning the review of habitat diversity is particularly significant. Under the Habitats Directive there is an obligation on all stakeholders including the Local Authority to protect good examples of listed habitats. As many areas of habitat are linked functionally to sites with nature conservation designations there are further obligations to protect these linkages in order to protect the integrity of the network of designated sites.

5.2 Sensitivity analysis

To support spatial planning in the Ennis and Environs Development Plan area the relative sensitivity of the heritage in different part of the vulnerable landscape was assessed. Sensitivity analysis was based on the following criteria:

- Recognition of existing statutory obligations and policy objectives for habitats.

- Compatability with other non-statutory ranking systems

- Expert assessment of the results of heritage surveys in 2006. As habitat diversity was examined in most detail in 2006 the sensitivity analysis is based primarily on the results of habitat mapping.

Depending on the habitats which they contain, areas within the Ennis and Environs Development Plan area (examined for this study) were ranked on a scale from Highly Sensitive, Very Sensitive, Sensitive, Robust and Very Robust. Fig. 12 shows the location and extent of these areas. As the study excluded sites designated for biodiversity (SAC's, SPA's and NHA's) they are not represented by this analysis.

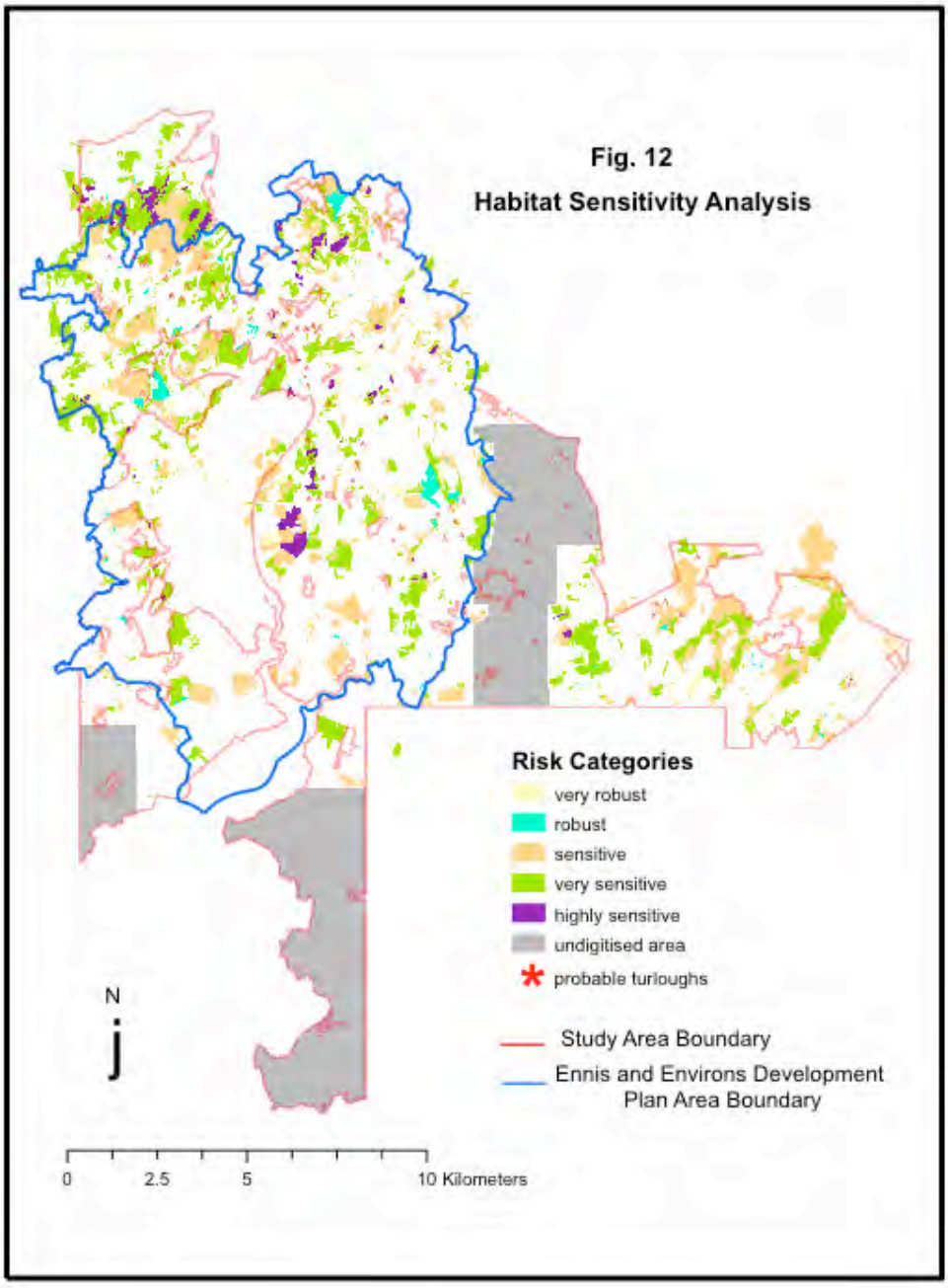


Fig. 12
Habitat Sensitivity Analysis
Risk Categories
very robust
robust
sensitive
very sensitive
highly sensitive
undigitised area
probable turloughs
Study Area Boundary
Ennis and Environs Development Plan Area Boundary
N
0
2.5
5
10 Kilometers

5.2.1 Highly Sensitive Areas and Features

Land categorised as having Highly Sensitive Areas and Features (153ha) contains one of the following habitats:

- Turloughs (FL6). Sites are mapped as Turloughs* (FL6) in the Habitat Map and 'Probable Turloughs (shown on Fig.6).
- Limestone pavement*. Limestone pavement is mapped as Exposed Limestone Rock (ER2) in the Habitat Map
- Rich fen and Flush* (PF1) , which is shown in the Habitat Map.

All these habitats are listed in the EU Habitats Directive. The first two are priority types. The habitat Rich Fen and Flush is a non-priority type.

In practice additional areas could be added to this category if they have characteristics listed below:

1. Land north of Fountain Cross-Drumcliff-Ballymaley and Gaurus Gorteen-Feenagh identified by the geodiversity study as containing a dense collection of karst features. This is illustrated on Fig. 8.
2. Land on which is found monuments listed in the Records and Monuments and Places.
3. Watercourses supporting salmonid species.
4. Roosting sites of lesser horseshoe bat (priority species under the Habitats Directive).

These areas were not mapped as detailed information was not available on their status in the study area.

5.2.2 Very Sensitive Areas and Features

Land within this category covers 1460ha and contains the following habitats:

Limestone lakes (FL3)*
Eutrophic lakes (FL5)
Mesotrophic lakes (FL4)
Tall-herb swamps (FS2)*
Reed and large sedge swamps (FS1)
Marsh (GM1)*
Poor fen and flush (PF2)
Transition mire and quaking bog (PF3)*
Tidal rivers (CW2)*
Estuaries (MW4)*
Upper and lower salt marsh (CM1/CM2)*
Dry calcareous and neutral grassland (GS1)*
Dry humid acid grassland (GS3)
Scrub (WS1)

Oak-birch-holly woodland (WN1)
Oak-ash-hazel woodland (WN2)
Riparian woodland (WN5)
Wet willow-alder-ash woodland (WN6)

Habitats marked* are listed in the Habitats Directive. They cover 1455ha within the rural parts of the Ennis and Environs Development Plan area.

Additional areas could be categorized similarly if they contained habitats which have functional links with sites which have the nature conservation designation "Special Area of Conservation" or were identified as a floodplain by the Office of Public Works.
.

5.2.3 Sensitive Areas and Features

Land within this category covers 1315ha and contains the following habitats:

Raised bog (PB1)(Damaged)
Cutover bog (PB4)
Bog woodland (WN7)*
Dry meadows and grassy verges (GS2)
Wet grassland (GS4)*
(Mixed) broadleaved woodland (WD1)

Habitats marked* are listed in the Habitats Directive. Additional areas could be categorized similarly if they contained habitats which have functional links with sites which have the nature conservation designation "Natural Heritage Area".

5.2.4 Robust Areas and Features

Land within this category covers 182ha and contains the following habitats:

Artificial lakes and ponds (FL8)
Land covered in dense bracken (HD1)
Mixed broadleaved/conifer woodland (WD2)
(Mixed) conifer woodland (WD3)
Conifer plantation (WD4)
Scattered trees and parkland (WD5)

All of these have been mapped on the Habitat Map.

5.2.5 Very Robust Areas and Features

Land within this category covers 11,437ha and contains the following man modified habitats:

Exposed sand, gravel and till (ED1)
Spoil and bare ground (ED2)
Recolonising bare ground (ED3)
Horticultural land (BC2)
Flower beds and borders (BC4)
Active quarries and mines (ED4)
Refuse and other waste (ED5)
Amenity grassland (GA2)
Immature woodland (WS2)
Recently felled woodland (WS5)

To these habitats is added all areas with improved grassland (GA1) and existing buildings and artificial surfaces (BL3). These cover an area of 11,226ha and thus account for the significant amount of land within this category.

5.3 Guidelines for spatial planning

The nature of the vulnerable heritage in the study area has the following implications for planning:

- All local development plans or inventories should refer to the heritage items categorized as being sensitive to development. References should be illustrated by examples and any listings must be qualified by the following statements:

    1) The valuable features associated with a habitat, designated site or feature of archaeological interest may extend outside the boundary of the area mapped. Sites of archaeological interest may be present in areas which appear today to have few signs of intensive development such as, estuarine environments, lacustrine environments, marginal land and bog land.

    2) Linkages between particular heritage items should be recognised and protected. An archaeological site cannot be divorced from its landscape context. Habitats are linked to similar types. The plan should state the necessity to protect the landscape of a monument, habitats from fragmentation and avoid isolating populations by maintaining corridors.

    3) The possibility that the sensitivity ranking ascribed to features or sites will be amended as a result of fieldwork/excavation or research.

- Strategic planning should recognise the relative sensitivity of different areas and their priorities for development. It should encourage change in areas characterized as Robust or Very Robust. This covers c 80% of the land area, and principally comprises land which has improved grassland or had already been developed. Major changes should not be encouraged in habitats categorized as Sensitive (either Highly Sensitive, Very Sensitive or Sensitive) or those with functional linkages to sites with nature conservation designations. These are principally wetlands and unimproved grasslands. Priorities here should be to retain and enhance existing biodiversity.

- Specific policies should be contained in the Development Plan to require developers to evaluate the impact of proposals on habitats within Sensitive categories. Accounts should be provided of 1) the habitats directly affected, 2) those indirectly affected and 3) proposed measures to integrate biodiversity with development through avoidance, mitigation or compensatory measures. Access should be provided to the habitat map to expedite this request.

- All developers in the area shown on Fig. 8 should be requested to 1) provide a detailed map and photograph of karst features within a 250m radius of the proposed development site and 2) assess suitability of the site to assimilate waste water following the protocols used in the FAS/EPA FETAC Certificate course "Site Suitability Assessment for on Site Wastewater Treatment Systems. Spot checks to assess sites should take place in this region at a higher percentage level than elsewhere in the county and a database should be compiled to record the karst features mapped by developers.

- To protect archaeological sites and monuments policies should state explicitly that a buffer area >25m may not always be adequate to protect them from development. Protection should be offered to the landscape of the monument and developers should be made aware that archaeological assessments may be requested in areas in which monuments are not currently recorded.

- The value of the sensitivity analysis should be maximised when preparing the SEA for the Ennis and Environs Development Plan. The current status of certain habitats should be used as a baseline, against which those impacts which can be managed by the local authority can be measured. The process of plan development should encourage agreement among stakeholders on the targets which should be set to measure the impact of development on habitat cover. They should have access to the results of the survey and GIS support to generate mapping and data analyses. This exercise would require awareness of the potential of planning to influence habitat cover, an understanding of the impact of previous development plans and agreement between stakeholders on the changes which are

desirable. The potential of GIS should be maximised to allow for the calculation of the relative sensitivity of individual pockets of land of varying sizes and the implications of different planning/zoning scenarios.

5.4 Initiatives to support the integration of vulnerable heritage and spatial planning

Information from these surveys is principally of value to inform the Ennis and Environs Development Plan. The results suggest other initiatives need to taken to ensure that the value of the study is optimized. These are related to training and provision of expertise within the local authority, local environmental education and research.

5.4.1 Training

Training is required to enhance the potential of planners to manage development impacts on habitats and other vulnerable features of local heritage. This should enable them to identify sensitive habitats and their management needs.This training should take the of form of active learning in-house and the approach should be based on an awareness that:

- Planners are very busy. The management of heritage features is only one of the issues about which they need to be better informed
- They value practical assistance more than theory
- Course content needs to be relevant to Clare

The programme should include:

- In house sessions with heritage experts (archaeology, geodiversity and habitats) based on case studies, examination of the habitat map and sensitivity analysis which should maximise discussion and participation among a group of planners.
- Production of user friendly guidelines for planners arising from these sessions
- Direct assistance to planners. This should involve a review (by a biodiversity expert and planner) of the biodiversity issues arising from their typical case load or/and inspection of the biodiversity values associated with typical development sites.

In house training would take place during 2X 2 hour sessions over two weeks.

The first session should cover:

- Legislative and administrative frameworks and impact assessments.
- Use of the sensitivity analysis

- Nature of local heritage (policy and practise, sources of information, introduction to the habitat map and other digital data bases)

Session two should cover case studies (hypothetical and real) from Clare, which will maximise the value of the information contained in the sensitivity analysis; (covering scoping, use of expert advice, location and connectivity, requests for further information, design, mitigation etc). Case studies will be researched in advance of this session.

Field visits should be carried out to provide opportunities to discuss real issues. Depending on time and resources, this part of the training could be delivered either through one afternoon session with all planners to visit a range of sites or on a one to one basis during which a heritage expert would work with each planner for a half day visiting sites to discuss development scenarios.

5.4.2 Expertise within the local authority

In the medium term resources should be available to the planning section of Clare County Council to employ an ecologist and archaeologist to assist planners deal with issues related to the impact of development on specialist heritage features. They should carry out research, become involved in pre-assessment of development applications, visit sites and liaise with the national authorities. This knowledge and expertise would further clarify the archaeological and biodiveristy potential of the area and provide more concise and relevant conditions attached to planning.

5.4.3 Environmental education

The results of these surveys should be made available to all stakeholders but particularly landowners, developers and agencies who have responsibility for advising on land use or making decisions about development. Meetings with landowners/developers revealed interest in the objectives of the surveys and concern that the results would interfere with development opportunities. The results should be communicated to them, to recognise their co-operation and concern. Notice should be provided in the local newspaper, offering access to the results. Any public notices should contain an explicit acknowledgement of the co-operation received from local landowners.

The habitat maps produced by the survey and full report should be made available in the Local Studies Section of Ennis Library for easy access by the public. Copies of the Habitat Map should be printed at 1:5,000 scale to aid interpretation. An explanatory sheet should state the objective of the survey and list the parishes/townlands which have been mapped. Farm planners working on the Rural Environment Protection Scheme (REPS) be encouraged to inspect these maps as a guide to the types of habitats which are present on REPS farms within the study area or/and could be established.

The Fields Monuments Advisory pilot scheme currently confined to west Clare should be extended to include the rest of the county, as local information is a vital resource in a fuller interpretation of the local archaeological landscape. Results from field excavations associated with local developments should be publicised locally to add to the inventory of information on local archaeology within the county.

5.4.4 Further research

In order to maximize the value of the sensitivity analysis a mechanism should be put in place for regular revisions. In the short term the Council should ensure that relevant additional information should be added to the GIS such as locations of lesser horseshoe bat roosts (when information is made available from NPWS) and floodplains (from the Office of Public Works).

The study should be extended to other parts of County Clare to ensure that spatial planning is fully informed by biodiversity values. Further work should be informed by the following SWOT
(Strengths/Weaknesses/Opportunities/Threats) analysis.

Strengths/Opportunities

- Integration of ecology and geodiversity.
- Use of aerial photography, 1st ed OS mapping and Teagasc/EPA digital data layers to aid habitat identification and mapping in the field
- Representation of drumlins on aerial photographs
- Engagement with landowners. Only two landowners refused permission for his land to be inspected and some were keen to assist the study.

Weaknesses/Threats

- Research to identify turloughs and other karst features should have taken place prior to fieldwork so that sites of possible turloughs could be represented on aerial photos and checked in the field by ecologists.
- Date/time taken should be shown on aerial photo. Ideally all aerials should be taken in the same season.
- Name of townland (s) and grid should be placed on all field maps
- Habitats such as rivers, improved grassland and buildings should be digitised.
- Teagasc /EPA maps of landcover should not be used to map habitats to Level 3.
- The principal weakness of this study arose from the absence of fieldwork to characterise archaeology and geodiversity. Fieldwork should have informed all heritage surveys in order to provide a comprehensive assessment of the vulnerability of the landscape.The absence of fieldwork to examine archaeology meant that an assessment of the relative sensitivity of the archaeology of different parts of the study area could not be made. A similar constraint applied to geodiversity. The lack of detailed

fieldwork for these heritage features limited the overall assessment of the vulnerability of the study area

Support should be sought from NPWS to carry out survey work on all the sites mapped as"Turloughs and Probable Turloughs", as development in these areas has particular implications for water quality and biodiversity.

The landscape and features of high geodiversity interest north of Ennis should be characterised through field studies. This could be carried out as part of the Geopark project.

Researchers should be encouraged to use the habitat data. In return they should be requested to lodge copies of resulting studies with the Clare Biodiveristy Data Centre and Local Studies Section of the County Library or/and communicate the results locally.

The "characterisation of the landscape" which has led to the definition of landscape areas within the county should be revised to consider the results of habitat mapping, as this would lead to a more accurate description of landscape types.

A hedgerow survey should be initiated in the county. Hedgerows are a dominant semi-natural feature in the enclosed field based landscape and fieldwork revealed that some developed from old woodlands. This survey should start with a preliminary scoping study to identify field boundary/hedgerow types, consultation with stakeholders and the development of an approach to field survey. If development is promoted in areas dominated by improved grassland, these habitats will be removed.

Further GIS based research should be encouraged to identify the nature of linking areas needed for designated areas or as feeding, and commuting areas for designated species particularly the lesser horseshoe bat.

A resurvey of habitats should take place within five years to measure and record the impact of change on biodiversity.

6 Conclusions

The Vulnerable Landscape Study described and reviewed archaeology, geodiversity and habitat diversity. The review of geodiversity located an area of high value north of Ennis and revealed important links betweeen geodiversity, biodiversity and water quality in this area. The archaeological review suggested that the entire study area is of much greater archaeological interest than was suggested by the published record.

The presence of sites with nature conservation designations around Ennis is an indicator of the high biodiversity value of its landscape. Outside the designated

sites other areas of high biodiversity value exist. This study revealed that approximately 21% of the rural land within the Ennis and Environs Development Plan area is of importance for biodiversity. Some of this land contains examples of habitats which deserve protection under the EU Habitats Directive. Spatial planning must ensure that these areas are not lost due to development and that their valuable habitats and linkages are retained. There is a role for many stakeholders, particularly landowners and residents in appropriately managing these areas for biodiversity. Primary responsibility lies with the local authority through its role in spatial planning.

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Appendix 1
Characteristics of Landscape Character Areas within the Study Area

ENNIS DRUMLIN FARMLANDS

Key Characteristics

• Settlement of Ennis is the focal point of the area where both historical and modern development is apparent.
• Ennis situated within drumlin farmland, drumlins oriented northeast to southwest punctuated by small loughs.
• Area can be disorientating due to many small winding roads and limited views.
• Communication centre for the region with Ennis as county town, with Fergus River running through the town.

SIXMILEBRIDGE FARMLANDS

Key Characteristics
• Undulating, well maintained landscape, with the principal river, the Owengarney draining from Doon Lough in the north.
• An area of considerable archaeological and historical interest testifying to its strategic location and good land resources.
• Principal roads cross through this area such as the N18 and there is a significant urban and commercial centre at Shannon, as well as the smaller settlement of Sixmilebridge.
• Quin and Sixmilebridge are designated ACA (Architectural Conservation Areas).

EAST CLARE LOUGHLANDS

Key Characteristic
• The landscape is an attractive mosaic of loughs, farmlands and occasional limestone outcrops reflected in the presence of stonewalls.
• The area is predominately rural in character dissected by quiet minor roads, increasingly busy towards Sixmilebridge and Limerick.
• Settlement is traditional and scattered across the area in the form of single and two storey isolated dwellings, punctuated by small-nucleated settlements such as Bodyke and Kilkishen.
• An intact rural feel, declining towards the southern end; views are frequently limited due to drumlins, strong presence in the landscape.
FERGUS ESTUARY

Key Characteristics
• Flat estuarine farmland divided by drainage ditches, post and wire fences and degraded thorny hedgerows.
• Open expansive views are afforded across the estuary to the River Shannon, though these are limited in places due to flood defence embankments.
• Settlement is sparse reflecting the areas past tendency to flood, some settlement on higher ground. On eastern boundary, increased settlement due to proximity to Shannon Airport and town.
• Scattered holy wells with a number of graveyards and standing stones.
• Newmarket-on-Fergus and Killadysert are both designated Architectural Conservation Areas.

FERGUS LOUGHLANDS

Key Characteristics
• Undulating lowland mosaic of loughs, farmland and wooded limestone pavements.
• Loughs and rivers are oriented predominantly northeast to southwest reflecting historical glacial movements.
• Characteristic lowland limestone pavement in parts are vegetated with hazel scrub and is of high ecological value, e.g. Dromore Lough nature reserve.
• Important historical features include Dysert O'Dea.
• Area is largely rural in character dissected by quiet minor roads.
• Scattered settlement aside from the villages of Crusheen and Ruan.

Appendix 2
Habitats and species listed in the Habitats Directive

1 Habitats listed in annexes to the Habitats Directive (so called "annexed habitats")

Priority type habitats (listed in Annex I) are underlined in bold. Reference numbers refer to numbering system in EU (2003)

Freshwater types

Natural dystrophic lakes and ponds (3160)
Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae) (3160)
Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoteo-Nanojuncetea (3130)
Hard oligo-mesotrophic waters with benthic vegetation of *Chara* sp. (3140)
Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation (3150)
Turloughs (3180)
Watercourses of plain to montane levels with the Ranunculion-fluitanitis and Callitochio-Batrachion vegetation (3260)
Rivers with muddy banks with Chenopodium rubri p.p. and Bidention p.p. vegetation (3270)
Petrifying springs with tufa formation (Cratoneurion) (7220)
Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)

Grasslands and marsh

Semi-natural dry grassland and scrubland facies on calcareous substrates (Festuco-Brometea) (*important orchid sites) (6210)
Juniperus communis formations on heaths or calcareous grasslands (5130)
Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*) (6510)
Species rich Nardus grasslands on siliceous substrates in mountain areas (and submountain areas in continental Europe) (6230)
Calaminarian grasslands of the Violetaria calaminariae (6130)
Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleaea)
(6410)
Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)

Appendix 2 (contd). Habitats and species listed in the Habitats Directive

Heaths (areas dominated by heathers)

European dry heaths (4030)
Juniperus communis formations on heaths or calcareous grasslands (5130)
Northern Atlantic wet heaths with *Erica tetralix* (4010)
Alpine and boreal heaths (4060)

Peatlands (or boglands)

Active raised bogs (7110)
Degraded raised bogs still capable of natural regeneration (7120)
Blanket bog (*if active bog) (7130)
Depressions on peat substrates of the Rhynchosporion (7150)
Calcareous fens with *Cladium mariscus* and species of the Caricion davallianae (7120)
Alkaline fens (7230)
Transition mires and quaking bogs (7140)

Woodlands

Old sessile woods with *Ilex* and *Blechnum* in the British Isles (91AO)
***Taxus baccata* woods in the British Isles (91JO)**
Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-padion, Alnion incarae, Salicion albae) (91EO)
Bog woodland (91DO)

Exposed rock

Siliceous rocky slopes with chasmophytic vegetation (8220)
Calcareous rocky slopes with chasmophytic vegetaion (821))
Limestone pavements (8240)
Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Caleopsietalia ladani) (8110)
Calcareous and calcshist screes of the montane to Alpine levels (Thlaspietea rotundifolii (8120)
Caves not open to the public (8310)

Coastland

Vegetated sea cliffs of the Atlantic and Baltic coasts (1230)

Coastal lagoons (1150)
Estuaries (1130)
Salicornia and other annuals colonising mud and sand (1310)

Appendix 2 (contd) Habitats and species listed in the Habitats Directive

Spartina swards (Spartinion maritimae) (1320)
Atlantic salt meadows (Glauca-puccinellietalic maritimae) (1330)
Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosii) (1420)
Perennial vegetation of stony banks (1220)
Embryonic shifting dunes (2110)
Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")(2120)
Fixed coastal dunes with herbaceous vegetation ("grey dunes") (2130)
Decalcified fixed dunes with *Empetrum nigrum* (2140)
Atlantic decalcified fixed dunes (Calluno-Ulicetea ((2150)
Dunes with *Salix repens* ssp.*argentea* (Salicion arenariae) (2170)
Humid dune slacks (2190)
Machairs (* in Ireland) (21AO)

Marine

Reefs (1170)
Submerged or partly submerged sea caves (8330)
Annual vegetation of drift lines (1210)
Mudflats and sandflats not covered by sea water at low tide (1140)
Sandbanks which are slightly covered by sea water all the time (1110)
Estuaries (1130)
Large shallow inlets and bays (1160)

2 Species listed in annexes to the Habitats Directive (so called "annexed species")

Lesser horseshoe bat
Otter
Grey seal
Common seal
Bottle-nosed dolphin
Porpoise
Brook lamprey
River lamprey
Sea lamprey
Salmon (in freshwater only)
Twaite shad including Killarney Shad
White-clawed crayfish
Marsh fritillary butterfly
Kerry slug
Fresh water pearl mussel
Whorl snails (*Vertigo angustior, v. geyeri and v. moulisiana*)
Killarney fern
Slender naiad
Marsh saxifrage, Shining sickle moss and Petalwort

Appendix 3
Summary accounts of sites with nature conservation designations adjacent to the study area: Information from the files compiled by the National Parks and Wildlife Service.

Site name	Site Number and Status	Habitats	Features of Interest	Development Issues
Ballyallia Lake	14 pcSAC/SPA pNHA Boundary surveyed List of habitats in site file	Lake (dominant habitat) + Rivers and streams Drainage ditches Non marine islands Lowland dry grassland Lowland wet grassland Improved grassland Amenity grassland Freshwater marshes Reedbeds and other swamps Scrub Dry, broadleaved semi-natural woodland Old walls Buildings and roads	Wetland birds	Eutrophicaation resulting from fertilizer run off associated with farming

Appendix 3 (contd). Sites with nature conservation designations in the vicinity of the study area.

Site name	**Site Number and Status**	**Habitats**	**Features of Interest**	**Development Issues**
Ballycullinan Lake + extension into Cragmoher Shaneally and Drumcaveen Lough agreed in 2001	16 pcSAC pNHA Boundary surveyed	Lake (dominant habitat) + Rivers and streams Drainage ditches Lowland wet grassland Improved wet grassland Reedbeds and other swamps Freshwater marshes Scrub Limestone pavement Old Walls	Cladium rich fen Limestone pavement Reedbed of value to waterfowl.	Scrub removal considered a threat
Cahiracalla Wood	1001 pNHA	Site file not available in NPWS, Ely Place.		

Appendix 3 (contd). Sites with nature conservation designations near the study area.

Site name	Site Number and Status	Habitats	Features of Interest	Development Issues
Castle Lake, Sixmilebridge	239 pNHA Boundary survey List of habitats	Lake (dominant habitat) + Rivers and streams Drainage ditches Non marine islands Lowland wet grassland Reedbeds and other swamps Freshwater marshes Scrub Dry broadleaved semi natural woodland Mixed woodland Old Walls Buildings and roads	Wet woodland Cormorant colony	Scrub clearance a threat
Danes Hole, Poulnalecka	30 pcSAC Boundary survey List of habitats incomplete	Dry, broadleaved semi natural woodland Wet, broadleaved semi-natural woodland Caves	Roosts of lesser horseshoe bats (winter and summer)	

Appendix 3 (contd). Sites with nature conservation designations in the vicinity of the study area.

Site name	**Site Number and Status**	**Habitats**	**Features of Interest**	**Development Issues**
Doon Lough NW of Broadford	337 pNHA Boundary survey	Lake (dominant habitat) + Rivers and streams Drainage ditches Non marine islands Lowland wet grassland Improved grassland Raised bog Fens and flushes Reedbeds and other swamps Freshwater marshes Scrub Wet broadleaved semi natural woodland Mixed woodland Old Walls Buildings and roads	Raised bog	Burning to improve productivity of farmland Spread of Rhododendron in woodland

Appendix 3 (contd). Sites with nature conservation designations in the vicinity of the study area.

Site name	Site Number and Status	Habitats	Features of Interest	Development Issues
Dromoland Lough	1008 pNHA List of habitats	Lake (dominant habitat) + Drainage ditches Non marine islands Fens and flushes Reedbeds and other swamps Scrub	Fen of potential value	Recreational activities considered a threat, particularly shooting.
Dromore Woods and Lough	32 pcSAC pNHA State owned Nature Reserve Boundary survey No habitat map List of habitats in site file	Lake (dominant habitat) + Turloughs Rivers and streams Drainage ditches Lowland wet grassland Reedbeds and other swamps Freshwater marshes Scrub Dry, broadleaved semi natural woodland Mixed woodland Commercial forest Limestone pavement Exposed rock Buildings and roads	House important for lesser horsehoeh bats.Habitats limestone pavement and calcareous grassland potentially of high value. Bird species listed in Birds Directive	Planting of conifers considere a threat

Appendix 3 (contd). Sites with nature conservation designations in the vicinity of the study area.

Site name	Site Number and Status	Habitats	Features of Interest	Development Issues
Fergus Estuary and Lower River Shannonn	2048 pcSAC pNHA	Colour aerial photos near R. Shannon	Valuable bird site. *Groenlandia densa* and *Scirpus triqueter* site.	Pollution from industry considered a threat
Inchincronan Lough	38 pNHA Boundary surveyed No habitat map List of habitats in site file	Lake (dominant habitat) + Rivers and streams Drainage ditches Non marine islands Lowland dry grassland Lowland wet grassland Improved grassland Cutaway bog Fens and flushes Reedbeds and other swamps Freshwater marshes Scrub Dry broadleved semi natural woodland Limestone pavement Exposed rock Quarries and sand pits Old walls Buildings and roads	Limestone pavement and fen of potential high value	Scrub clearance considered a threat

Appendix 3 (contd). Sites with nature conservation designations in the vicinity of the study area.

Site name	**Site Number and Status**	**Habitats**	**Features of Interest**	**Development Issues**
Lough Cullaunyheeda	1017 pNHA Boundary surveyed Habitats listed in site file	Lake (dominant habitat)+ Rivers and streams Drainage ditches Lowland wet grassland Improved grassland Amenity grassland Cutaway bog Reedbeds and other swamps Dense bracken Scrub Wet, broadleaved semi natural woodland Mixed woodland Old walls Buildings and roads	Nationally important numbers of duck and wildfowl. Wet woodland of potenial high value	Threatened by commerical forestry.

Appendix 3 (contd**).** Sites with nature conservation designations in the vicinity of the study area.

Site name	**Site Number and Status**	**Habitats**	**Features of Interest**	**Development Issues**
Lough Cleggan, Drumcliff	1331 pNHA	Lake (dominant habitat)+ Rivers and streams Drainage ditches Lowland wet grassland Improved grassland Reedbeds and other swamps Freshwater marshes Scrub Dry, broadleaved semi natural woodland Old walls Buildings and roads	Linked to Ballyallia Lake	Shooting a threat to birds
Loughnatorick Bog South NW Mountshannon	308 SAC Natura 2000 Site? Mgmt Plan and habitat map	Blanket bog(dominant) m+ Rivers and streams Heath Cutaway bog Fens and flushes Freshwater marshes Scrub	Good example of thransition type bog (upland and lowland, raised and blanket) Listed as Active Blanket bog	Coniferous forestry Overgrazing a threat

Appendix 3 (contd). Sites with nature conservation designations in the vicinity of the study area.

Site name	Site Number and Status	Habitats	Features of Interest	Development Issues
Newhall Cave and Edenvale complex	2091 Natura 2000 site SAC Newhall cave site and nursery roost (2007) Management plan has been prepared, incorporating habitat map. Site submitted to EU in 2000.	Inland water bodies Bogs, marshes, water fringed vegetation, fens Improved grassland Mixed woodland	Nursery colony of Lesser horseshoe in farmhouse. Nearby cave used as winter roost. Site includes mature woodland in between	Development of building used as a roost would threaten Bat roost.
Rosroe Lough	2054 pNHA Boundary surveyed in 1994	Lake (dominant habitat)+ Drainage ditches Lowland dry grassland Lowland wet grassland Improved grassland Heath Raised bog Dense bracken Scrub; Dry broadleaved woodland Wet broadleaved woodland Commercial forest Exposed rock Old walls	Holly dominated scrub and associated grasslands considered of high value.	Site listed in Fergus catchment report 1981

Appendix 3 (contd) Sites with nature conservation designations in the vicinity of the study area.

Site name	Site Number and Status	Habitats	Features of Interest	Development Issues
Slievecallan Mountain Bog Adjacent to Castle Lake	2397 pNHA	Site file not available	Blanket bog	
Toonagh Estate, North of Drumcliff	2247 pcSAC	Buildings and roads Improved grassland (dominant habitat) Mixed woodland	Maternity roost of lesser horse shoe bats in old stable	
Pouladatig Cave	37 pcSAC	Site file not available	Winter hibernation site for Lesser Horse shoe bats	

Records from NPWS data base

Number in brackets indicates number of records.

Annual Knawel
Badger (11)
Fallow deer (3)
Hairy violet
Irish hare (8)
Killarney fern
Meadow barley (4)
Mudwort (2)
Orange foxtail
Otter (36)
Penny royal (3)
Pine marten (4)
Round Prickly-headed Poppy (3)
Triangular Club Rush
White-clawed Crayfish (10)

Appendix 4
Evaluation Scheme

NRA Guidelines on ecological assessment of national road schemes (NRA 2004)

Rating
Internationally important
Sites designated (or qualifying for designation) as SAC* or SPA* under the EU Habitats or Birds Directives.
Undesignated sites containing good examples of Annex I priority habitats under the EU Habitats Directive.
Major salmon river fisheries.
Major salmonid (salmon, trout or char) lake fisheries.

Nationally important
Sites or waters designated or proposed as an NHA* or statutory Nature Reserves.
Undesignated sites containing good examples of Annex I habitats (under EU Habitats Directive).
Undesignated sites containing significant numbers of resident or regularly occurring populations of Annex II species under the EU Habitats Directive or Annex I species under the EU Birds Directive or species protected under the Wildlife (Amendment) Act 2000.
Major trout river fisheries.
Water bodies with major amenity fishery value.
Commercially important coarse fisheries.

High value, locally important
Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or significant populations of locally rare species.
Small water bodies with known salmonid populations or with good potential salmonid habitat.
Sites containing any resident or regularly occurring populations of Annex II species under the EU Habitats Directive or Annex I species under the EU Birds Directive.
Large water bodies with some coarse fisheries value.

Moderate value, locally important
Sites containing some semi-natural habitat or locally important for wildlife.
Small water bodies with some coarse fisheries value or some potential salmonid habitat.
Any water body with unpolluted water (Q-value rating 4-5).

Appendix 4 (contd). NRA Evaluation Scheme

Low value, locally important
Artificial or highly modified habitats with low species diversity and low wildlife value.
Water bodies with no current fisheries value and no significant potential fisheries value.

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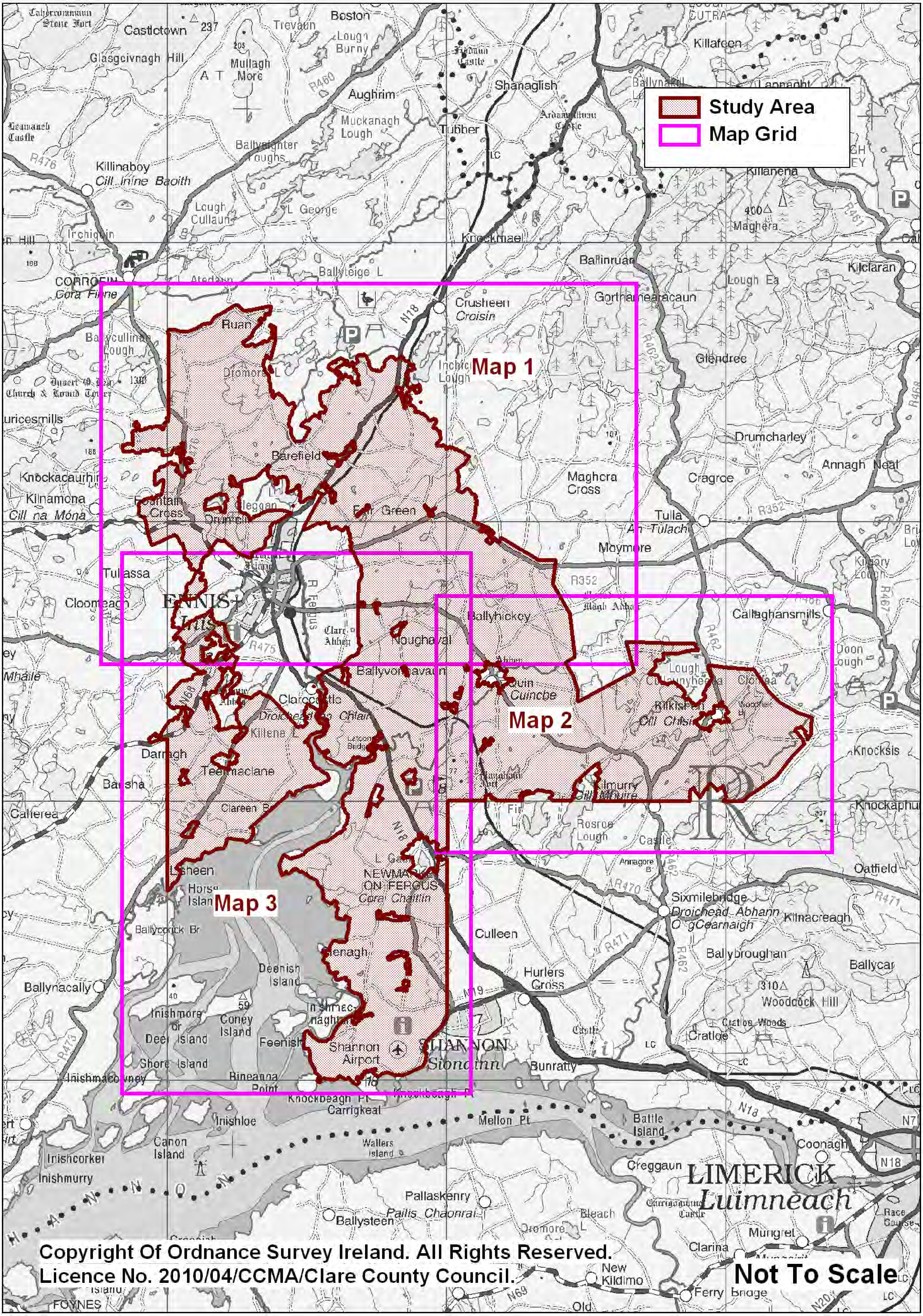
MAPS


Study Area
Map Grid
Map 1
Map 2
Map 3
ENNIS
Inis
Barefield
Ruan
Crusheen
Tulla
Quin
Kilkishen
Kilmurry
Clarecastle
Newmarket on Fergus
Shannon Airport
SHANNON
Sixmilebridge
Bunratty
LIMERICK
Luimneach
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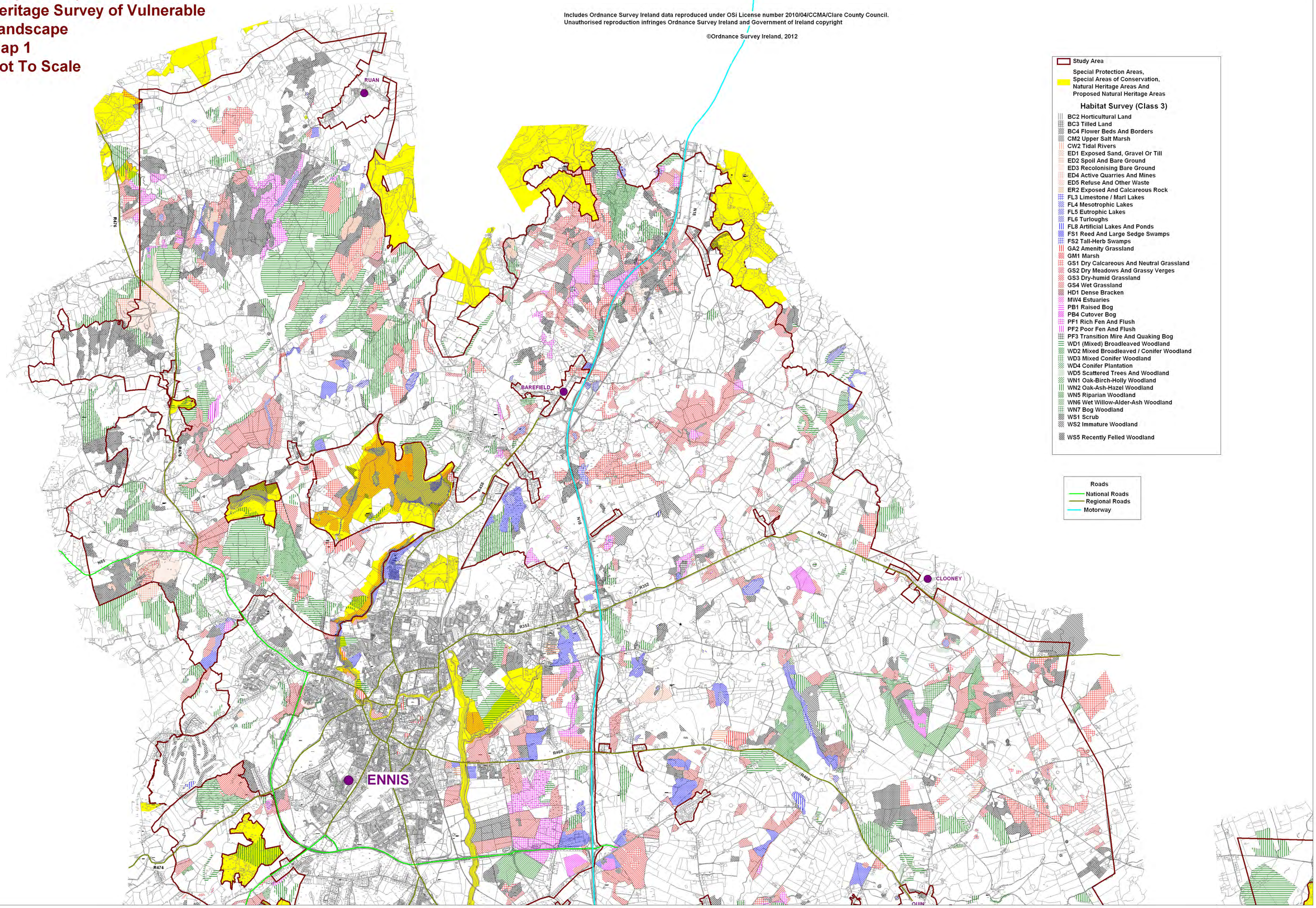
Not To Scale

Mary Tubridy & Associates
Heritage Survey of Vulnerable Landscape
Map 1
Not To Scale



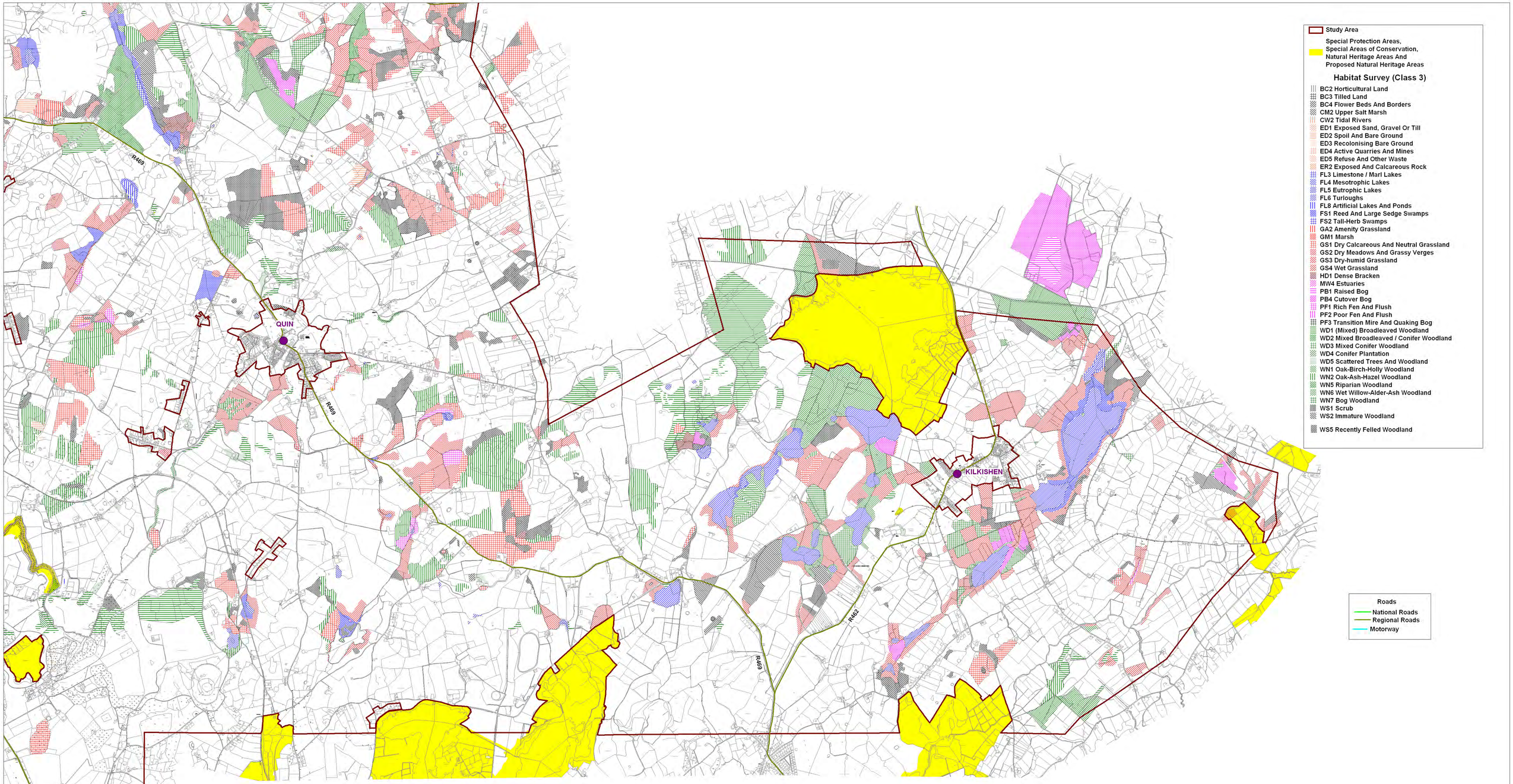
Study Area

Special Protection Areas,
Special Areas of Conservation,
Natural Heritage Areas And
Proposed Natural Heritage Areas

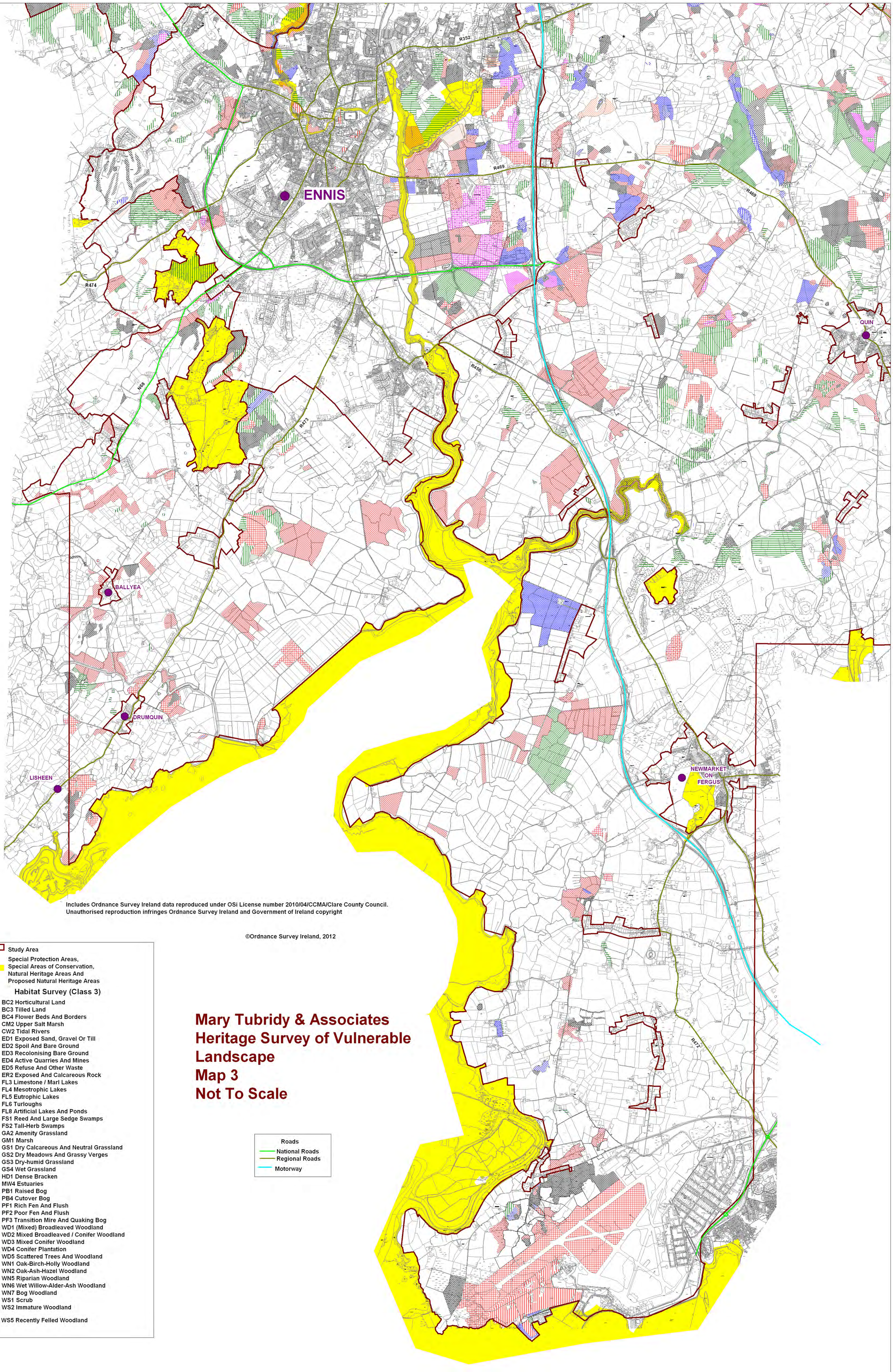
Habitat Survey (Class 3)

- BC2 Horticultural Land
- BC3 Tilled Land
- BC4 Flower Beds And Borders
- CM2 Upper Salt Marsh
- CW2 Tidal Rivers
- ED1 Exposed Sand, Gravel Or Till
- ED2 Spoil And Bare Ground
- ED3 Recolonising Bare Ground
- ED4 Active Quarries And Mines
- ED5 Refuse And Other Waste
- ER2 Exposed And Calcareous Rock
- FL3 Limestone / Marl Lakes
- FL4 Mesotrophic Lakes
- FL5 Eutrophic Lakes
- FL6 Turloughs
- FL8 Artificial Lakes And Ponds
- FS1 Reed And Large Sedge Swamps
- FS2 Tall-Herb Swamps
- GA2 Amenity Grassland
- GM1 Marsh
- GS1 Dry Calcareous And Neutral Grassland
- GS2 Dry Meadows And Grassy Verges
- GS3 Dry-humid Grassland
- GS4 Wet Grassland
- HD1 Dense Bracken
- MW4 Estuaries
- PB1 Raised Bog
- PB4 Cutover Bog
- PF1 Rich Fen And Flush
- PF2 Poor Fen And Flush
- PF3 Transition Mire And Quaking Bog
- WD1 (Mixed) Broadleaved Woodland
- WD2 Mixed Broadleaved / Conifer Woodland
- WD3 Mixed Conifer Woodland
- WD4 Conifer Plantation
- WD5 Scattered Trees And Woodland
- WN1 Oak-Birch-Holly Woodland
- WN2 Oak-Ash-Hazel Woodland
- WN5 Riparian Woodland
- WN6 Wet Willow-Alder-Ash Woodland
- WN7 Bog Woodland
- WS1 Scrub
- WS2 Immature Woodland
- WS5 Recently Felled Woodland

Roads
- National Roads
- Regional Roads
- Motorway



Mary Tubridy & Associates
Heritage Survey of Vulnerable Landscape
Map 2
Not To Scale



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- WN7 Bog Woodland
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- WS2 Immature Woodland
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Mary Tubridy & Associates
Heritage Survey of Vulnerable Landscape
Map 3
Not To Scale

Roads

- National Roads
- Regional Roads
- Motorway