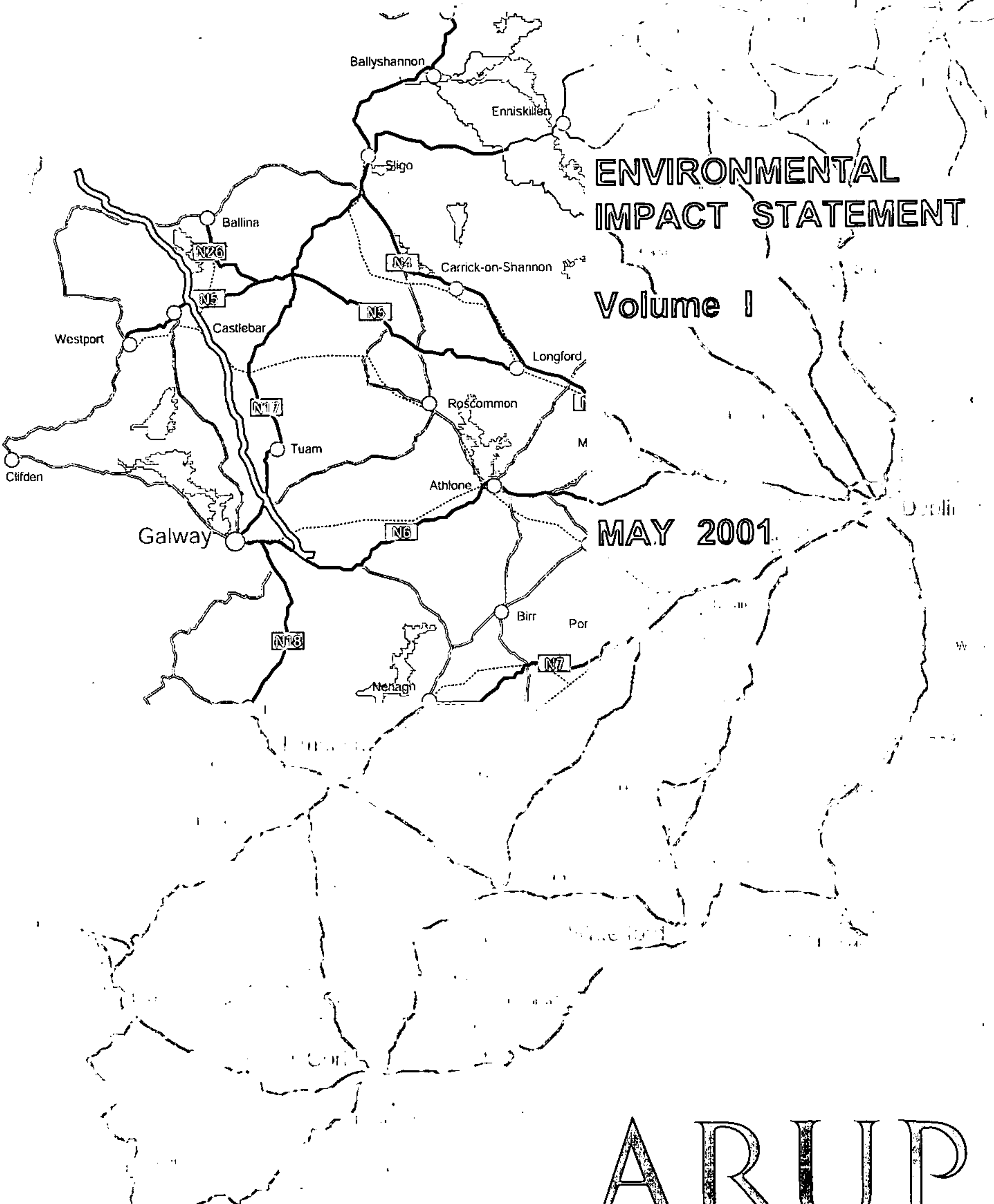
BORD GÁIS
TRANSMISSION BUSINESS UNIT

MAYO-GALWAY GAS PIPE LINE

E/S No 1633
PART 1 of 3



ENVIRONMENTAL IMPACT STATEMENT

Volume I

MAY 2001

ARUP

Mayo - Galway Gas Pipeline

Environmental Impact Statement
Volume 1 - Main Text

May2001

Job No. C689/10

Mayo - Galway Gas Pipeline

Environmental Impact Statement
Volume 1 - Main Text

Prepared By: Daniel Garvey
Signed: Dan Garvey
Date: 11 05 01

Checked By: Ria Lyden
Signed: Ria Lyden
Date: 11-5-01

Passed By: Eoghan Lynch
Signed: Eoghan Lynch
Date: 11 May 2001

Revision Record

Issue No.	Date	Status	Prepared	Checked	Passed
1	**1 May 2001**	**Draft**	**DG**	**RL**	**EJL**
2	**11 May 2001**	**Final Issue**	**DG**	**RL**	**EJL**

ARUP
Consulting Engineers

TABLE OF CONTENTS (VOLUME I)

Appendices

Glossary

References

Appendix 9.1:	Method Statements For Flora And Fauna Impact Assessment On The Downstream (Onshore) Section
Appendix 9.2:	Habitat Survey Results From The Terminal To Craughwell
Appendix 9.3:	Fauna
Appendix 9.4: Notes	Habitat/Vegetation Types Occurring Along The Pipeline Route And On Rare Species
Appendix 9.5:	Designated Conservation Areas
Appendix 9.6:	Sample Route Survey Card
Appendix 10.1:	Detailed Site Descriptions Of Watercourse Crossings
Appendix 13.1:	National Freshwater Quality Database
Appendix 13.2:	Hydrometric Data
Appendix 14.1:	List of Known Archaeological Sites and Monuments Within 500m of Pipeline
Appendix 14.2:	List Of Stray Finds
Appendix 14.3:	National Monuments Legislation
Appendix 14.4:	Classification Table for EIS
Appendix 14.5:	Archaeological Site Investigation Sheet

LIST OF FIGURES (VOLUME II)

Non Technical Summary

1 Introduction

Bord Gáis Éireann intends to construct a gas pipeline with associated installations, from Bellanaboy Bridge in County Mayo to near Craughwell in County Galway. This development will form part of a series of projects to develop the Corrib natural gas field, which lies in 350m of water in the Atlantic Ocean, and bring natural gas to the west of Ireland. The Corrib field is located 70km west of the nearest coastline of County Mayo. The gas will be conveyed by subsea and landfall pipeline to the reception terminal just north of Bellanaboy Bridge.

The proposed pipeline will connect the reception terminal to the proposed Pipeline to the West, at an above ground installation (AGI) near Craughwell. This will complete the transmission of the Corrib gas to the proposed national ring main connecting Cork, Galway and Dublin.

The proposed pipeline from the Bellanaboy Bridge Terminal to Craughwell will be approximately 150km long, 660mm (26") in diameter, and buried underground throughout its length. The pipeline will be constructed in high strength steel and will operate at 85barg. Fibre optic cables in ducts will be laid beside the pipeline from Craughwell as far as Block Valve Station 2, the potential off-take point for a gas supply for Ballina. The construction contract will be into two portions, with the dividing line close to the crossing point of the N5 Dublin to Castlebar road. There may be two construction contractors. The construction period will be during 2002 and 2003.

BGE was established under the Gas Act 1976 as the state agency responsible for the supply, transmission, distribution and sale of natural gas in Ireland. Production of natural gas commenced in Ireland in 1978, from the Kinsale Field, off the Cork coast. Since then BGE has extended the gas grid to cover a large area of the east and south of Ireland, and built an interconnector pipeline to Scotland, to connect to the European gas grid. In addition to the Mayo - Galway gas pipeline, BGE plan to construct the 'Pipeline to the West', from Dublin to Galway and onwards to Limerick, and a second interconnector to Scotland.

The Mayo - Galway gas pipeline project was initiated by Enterprise Energy Ireland Ltd as part of the Corrib field development. In late 2000 Bord Gáis Éireann (BGE) signed a contract with Enterprise Energy Ireland Ltd, whereby BGE will undertake the detailed design and construction of the pipeline.

For the route of the pipeline refer to Plate 1.

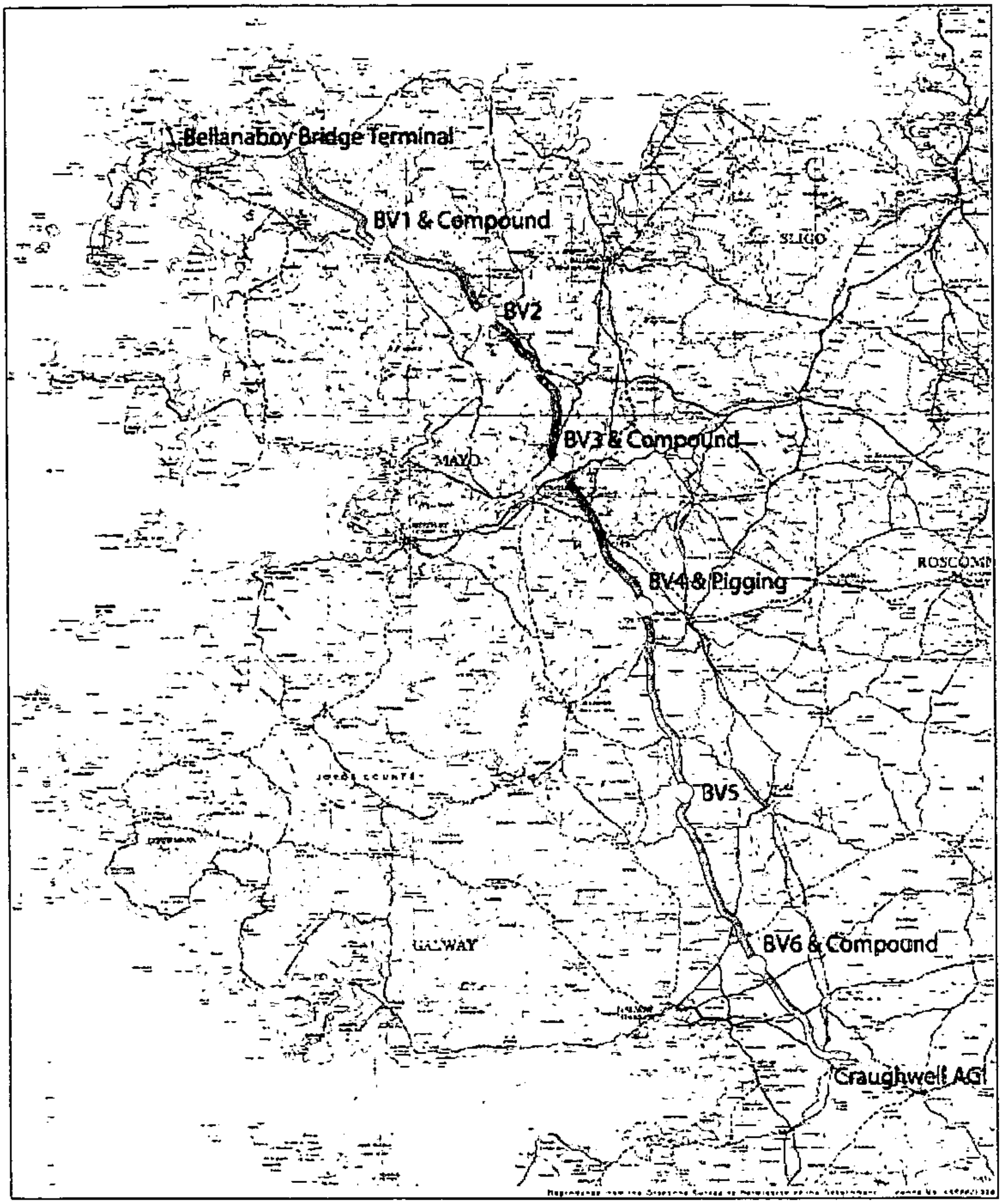


Plate 1: Pipeline Route

For more detailed information on the Environmental Impact Assessment, refer to the full EIS document, ***Mayo-Galway Gas Pipeline Environmental Impact Statement, Volumes I and II.***

The pipeline will be designed, installed, operated and maintained to meet the requirements of the latest edition of the IS 328 'Code of Practice for the Design and Installation of Gas Transmission Pipelines'.

2 Environmental Impact Assessment

BGE must obtain the consent of the Minister for Public Enterprise to construct and operate a gas pipeline. For gas pipelines greater than a certain size and length BGE must submit an EIS to the Minister to accompany the application for consent. The Minister may attach conditions to his approval.

Gas pipelines do not require planning permission. However any above ground installations, other marker posts, such as block valve stations require planning permission from the relevant Local Authority.

The EIS has been prepared in accordance with the requirements of the European Communities Environmental Impact Assessment (Amendment) Regulations 1999, which specify the projects requiring an EIS and the information to be provided.

The principal elements of the environmental assessment process, up to submission of the EIS, which were followed during this environmental impact study, are described below:

Scoping - determining the issues to be part of the study, including further issues identified by Consultees, and the availability of data

Determination of baseline conditions - determining the criteria with reference to which the likely environmental effects of the proposed development were to be evaluated

Consultation - undertaken throughout the assessment process in order to inform interested parties and invite comment

Evaluation of significant effects/determine mitigation - an iterative process whereby the significance of potential effects is determined and design improvements or appropriate mitigation identified in order to reduce adverse effects

Determination of significant environmental effects - once mitigation/design improvements have been incorporated, the significance of residual environmental effects was determined

Reporting - the findings of the assessment are reported in an EIS, which is a public document

Consultation

Consultation is a very important part of the environmental assessment process. Consultations took place with government departments and other agencies during the environmental assessment. The main organisations contacted were:

- Dúchas (Parks and Wildlife Section)
- Birdwatch Ireland
- Irish Peatland Conservation Council
- Department of Zoology, TCD
- Dúchas (Research, Bogs and Wetlands)

- Dúchas (Archaeological Section)
- National Museum of Ireland
- Western and Northwestern Regional Fisheries Boards
- Office of Public Works
- Bord na Móna
- Coillte
- ESB
- Eircom
- Mayo and Galway County Councils
- Geological Survey of Ireland

In addition a series of public exhibitions was held in June 2000, the feedback from which has been incorporated into this assessment.

3 Route Selection Process

Having identified the need to construct a pipeline, the optimal route between the Bellanaboy Bridge Terminal and the gas grid near Craughwell in County Galway, was determined.

Many factors were considered during the route selection process including environmental and planning constraints, archaeology, health and safety, and socio-economic impacts. Starting at Bellanaboy Bridge in County Mayo, and ending at the proposed above ground installation (AGI) near Craughwell in County Galway, a hierarchy of constraints was drawn up to guide and inform the routeing process. These are:

a) Designated conservation areas or National Heritage Areas
b) Areas of other environmental or archaeological significance
c) Areas designated in County Development Plans as requiring special consideration
d) Areas with geology, geomorphology and topography which would present difficulties for construction and increase costs
e) Areas of potential mineral resource and/or areas of existing or future extraction
f) Densely populated areas
g) Areas of forestry
h) Crossings of motorways, roads, railways, rivers and pipelines
i) Major developments planned along the route
j) Minimising the overall length of the pipeline corridor

Applying these criteria, a route was developed which avoids all known archaeological artefacts, and minimises impact on Special Areas of Conservation (SAC).

Features of archaeological, ecological or heritage value, lying within 1 km of the proposed route were identified. The route was carefully chosen to avoid or minimise the impact of the pipeline on these features, which include:

- three proposed Natural Heritage Areas (pNHAs) including Lough Conn which is also a Special Protection Area (SPA)
- seven Special Areas of Conservation (SACs) including Carrowmore Lake Complex, Slieve Fyagh, Bellacorick Bog Complex – passing just north of the Owenboy National Nature Reserve, and Carrowkeel Turlough
- approximately 110 archaeological sites and complexes recorded in the Sites and Monuments Record (SMR). These include an archaeological complex at Eskeragh, ringforts and enclosure sites occupying prominent positions on drumlin hillocks and ridges in townlands such as Lahardaun and Ballinvoash and an earthwork site at Annefield. In Galway there are many ringfort sites and associated souterrains as well as unclassified earthworks in the townland of Kilshanvy and Caltragh and an important battlefield as well as ringforts in the townland of Knockdoebeg West.

4 Pipeline Construction

Timing

The main construction activities will take place during the summer seasons of 2002 and 2003. Some advance ground works may commence earlier where authorisations and conditions allow and some reinstatement works may be undertaken later.

Site Preparation

Construction activities will be undertaken within a fenced strip of land, known as the working width. This will generally be approximately 30m wide. Where prevailing conditions dictate, the working width may be reduced or widened, as appropriate. Reductions in the working width will be imposed to reduce the potential impact upon features such as hedgerows, woodlands and ecologically sensitive areas. Full use will be made of existing gaps in hedgerows and mature trees will be avoided where possible.

The working width preparation is anticipated to commence in the spring of 2002. During normal construction, the topsoil will be stripped and stored separately to one side inside of the working width in a low bund not exceeding 3m in height. It will be kept free from disturbance to reduce the risk of physical damage and compaction.

Pipe Laying

Pipe lengths will be positioned along the route and welded together. A trench will be excavated that will allow for a cover of a minimum of 1.2 m subsoil to be placed on top of the pipeline in agricultural land and 1.6 m below rivers. The welded lengths of pipe will then be carefully lowered into the trench.

Reinstatement

The pipe trench will be backfilled with the material taken from the trench in the reverse order in which it was excavated. If necessary, subsoil forming the working width on which vehicles have run will be ripped to alleviate compaction. Field drainage will be reinstated, as necessary, at this time. The topsoil will then be spread over the working area and the land re-seeded according to the landowners/occupiers requirements.

Particular care will be paid to the reinstatement of field boundaries so as to reduce visual impact associated with construction. Hedgerow sections will be replanted in the autumn using stored material and a suitable mix of native species.

Dry-stone wall boundaries, which characterise the landscape along the route, will also have to be appropriately reinstated after the placement of the pipeline.

Testing

On completion of construction, the pipeline will be cleaned and pressure tested with water in excess of operating pressure. Each section will then be dried before being filled with gas.

Special Crossings

Railway lines and some roads may be crossed using a trenchless construction technique that minimises traffic disruption. Various other sites along the proposed route may also be crossed in this way where necessary and technically feasible. Pits will be excavated on either side of these features to accommodate the necessary machinery.

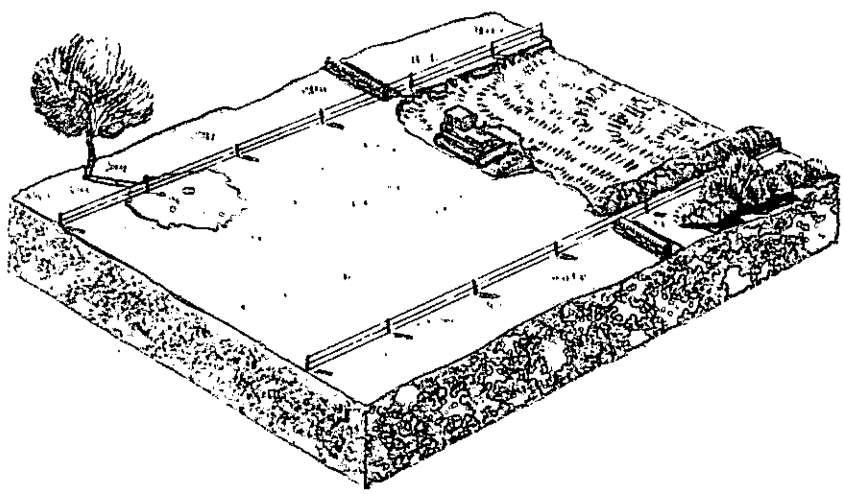
Watercourse Crossings

The status of these watercourses with regard to fisheries will be determined in advance. The construction method and timing will be agreed with the NorthWestern Regional Fisheries Board (NWRFB) and the Western Regional Fisheries Board (WRFB) as appropriate.

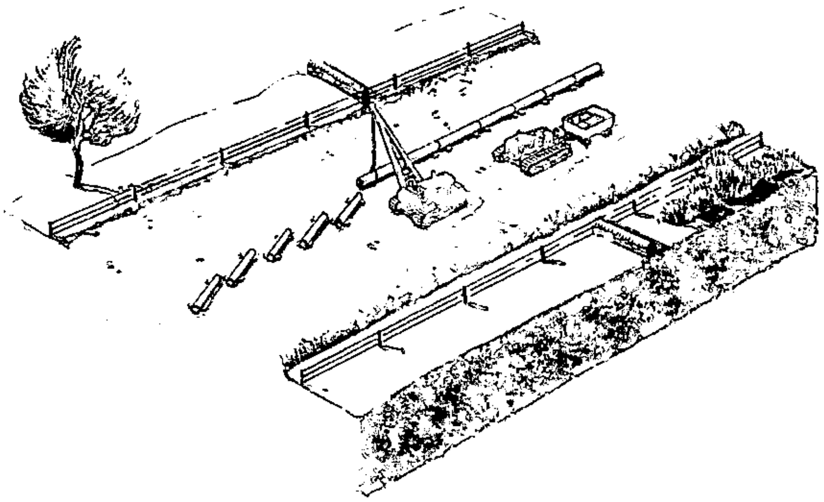
Generally watercourses will be open-cut. The water will either be diverted through a temporary pipe to maintain its flow, or the channel will be dammed and the water pumped around the dam. The trench will then be excavated through the dry channel. After laying the pipe, the trench will be backfilled and normal water flow will be restored. The banks of all watercourses will be reinstated to their original form. Care will be taken in order to minimise siltation and strict site management will be in place with respect to spill prevention.

The proposed pipeline route will cross eight significant watercourses and thirteen medium to minor ones on its way through County Mayo and County Galway traversing two fisheries board regions. The principal catchments traversed are the Lough Carrowmore – Owenmore System of northwest Mayo, Lough Conn / River Moy Catchment, which drains northeastern and central Co. Mayo and the River Clare / Lough Corrib System which drains central and southern County Galway.

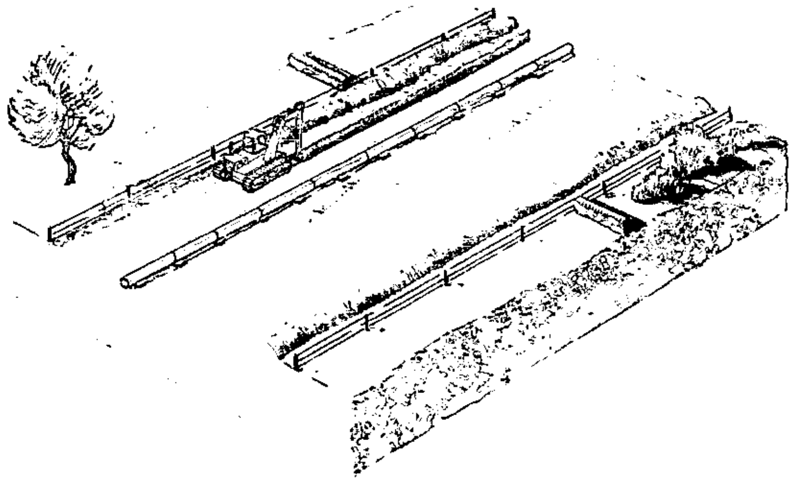
The typical sequence of construction activities is presented schematically below:



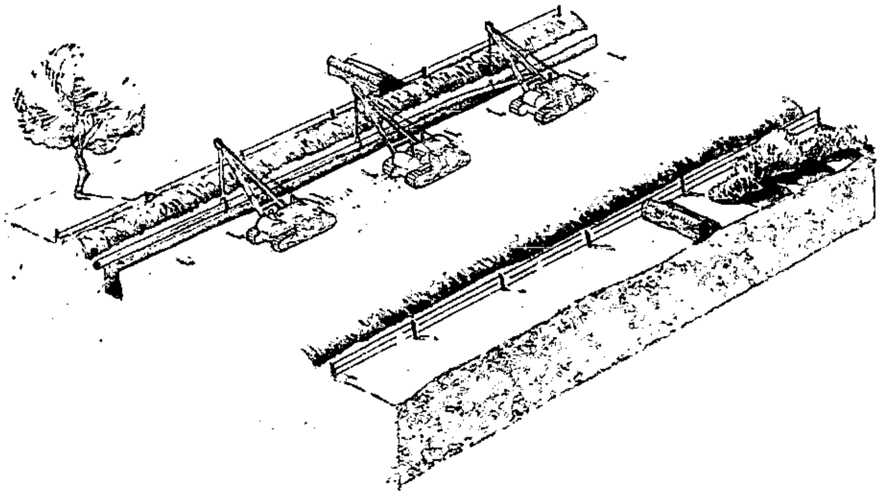
Topsoil Stripping



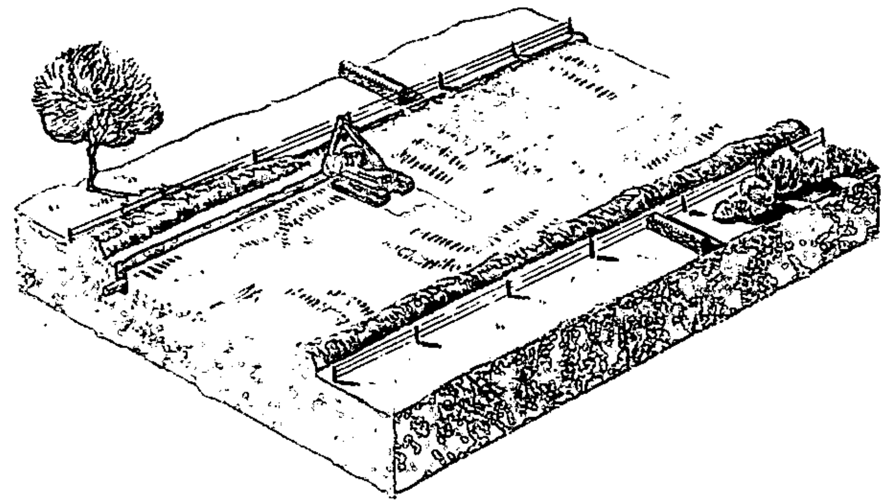
Pipe Stringing



Trench Excavation



Pipelaying



Backfilling

Above Ground Installations

There will be six above ground installations (AGI) along the pipeline route. Of these, one will be a combined block valve and pigging station and the other five will be block valve (BV) stations. BV stations will allow sections of the pipeline to be isolated, and facilitate maintenance, emergency shutdown and off-takes for spur lines. The block valve stations will also facilitate the off-take of a low-pressure gas supply to towns along the route. The pigging station will receive pigs ('pipeline integrity gauges' used for monitoring the internal condition of the pipeline) from the Bellanaboy Bridge terminal, and transmit pigs to the Craughwell installation.

The approximate pipeline distance between AGIs is as follows:

- Reception Terminal at Bellanaboy to BV1 at Bellacorick = 18.5km
- BV1 to BV2 (Ballina offtake) = 17.6km
- BV2 to BV3 (Castlebar offtake) = 22.5km
- BV3 to BV4 and pigging station (Claremorris offtake) = 21.8km
- BV4 and pigging station to BV5 (Tuam offtake) = 25.6km
- BV5 to BV6 (Galway offtake) = 25.2km
- BV6 to Craughwell AGI = 16.5km

5 Pipeline Operation And Maintenance

Once the construction process has been completed the pipeline will be inspected, tested and commissioned, leading to full operation. BGÉ will closely monitor pressures and flow rates.

Employment of a comprehensive corrosion protection system will ensure the integrity of the pipeline and will keep maintenance requirements to a minimum. The condition of the pipe will be monitored periodically using automated internal inspections. Above ground, the pipeline will be regularly inspected by helicopter with any disturbances to the ground reported immediately and investigated.

6 Potential Impacts And Proposed Mitigation Measures

Land Use and Agriculture

The proposed pipeline route passes through mainly agricultural farmland, with the remainder being taken up by forestry, semi-natural habitats, roads, railways and watercourses.

There will be some disruption to farming activities, but this is generally confined to the construction phase. In addition, the working width will be fully reinstated after construction. In order to minimise any disruption, mitigation measures such as temporary drainage systems and access provision will be agreed with those landowners and occupiers affected.

After construction, a permanent easement of 14m will be required within which BGÉ will have the right to access, repair and inspect the pipeline, but this will not affect normal agricultural operations. The only restrictions will be to activities such as tree planting or construction.

Planning and Policy Issues

Bord Gáis Éireann will comply with the relevant policies contained within the County Development Plans for Counties Mayo and Galway. The current pipeline project and the fibre optic cabling will be a considerable addition to the economic infrastructure of Counties Mayo and Galway and the Border, Midlands and Western Region. The availability of natural gas in the West will help to act as a catalyst to economic development, which in turn will help to redress regional economic imbalance, which is an objective of the current National Development Plan. There are considerable national economic benefits also arising from the security of gas supply to the national power-generating network.

Detailed routeing has taken account of planned developments.

Sites of Ecological Importance

The pipeline route will cross several sites, which have been identified by consultation, desktop and field survey, as being of ecological significance. These include SACs in northwest Mayo - Slieve Fyagh Bog and Carrowmore Lake Complex.

Detailed construction techniques and appropriate mitigation measures will be agreed with *Dúchas* - The Heritage Service (Department of Arts, Heritage, Gaeltacht and the Islands) to minimise environmental impact. To this end, a workshop was held with *Dúchas* to discuss these methods during the Environmental Impact Assessment (EIA) process.

The remaining sites, although not designated, have a species and structural diversity that make them important islands of semi-natural vegetation within the predominantly agricultural landscape and act as important refuges for wildlife. These sites include small areas of blanket bog and areas of scrub and heath.

Wildlife and Protected Plant Species

BGÉ readily acknowledges its obligation to minimise the impact of the construction, operation and decommissioning activities on wildlife and in particular protected species of flora and fauna. Mitigation measures will be discussed and agreed with *Dúchas* and any necessary licences sought (note - all species of mammal amphibian are protected under the Wildlife Act 1976).

Species that may be present along the pipeline route include badgers, bats, otters, and bird species of special note such as Golden Plover. Further surveys will be undertaken if the habitats of these species are likely to be affected and any necessary mitigation measures will be discussed and agreed with *Dúchas*. In addition, BGÉ's construction contractor(s) will develop, in consultation with *Dúchas,* mitigation measures for any hedgerow or ground nesting birds that may be affected by the pipeline construction work.

Stonewall, Hedgerows and Trees

A pipeline of this length inevitably crosses numerous field boundaries. Stonewalls will be taken down, the stone stored for reuse and the walls will be reconstructed using the style and technique of the existing walls in the area, following completion of pipeline construction.

Although the pipeline will be routed to utilise existing gaps wherever possible, removal of some hedgerow sections will be inevitable. The construction contractor(s) will endeavour to fully restore all hedgerows, primarily through a scheme of replanting. In order to ensure successful restoration, a survey of all hedgerows will be undertaken and suitable native species will be used for replanting.

Mature trees will be avoided wherever possible along the route. Where mature trees lie close to or within the working width and can be avoided during construction, a protection zone will be established around each tree to protect the roots.

Archaeology

The region crossed by the pipeline has a dense concentration of archaeological features and the avoidance of known sites has been a key factor in the routing of the pipeline. All known sites (afforded statutory protection under the National Monument Act 1930) and where possible areas identified as having a high archaeological potential, will be avoided. In order to detect the presence, and assess the extent, of both known and unknown archaeology along the proposed route, a further archaeological field walk and archaeological probing in deep bog as well as geophysical survey will be undertaken at a suitable time of year (after ploughing). This work will be accompanied by paleoenvironmental sampling in an attempt to establish the context of archaeological sites and type of environment inhabited by the people of Mayo thousands of years ago. This will be followed where appropriate by trial excavations, where necessary, prior to construction. A full archaeological presence (watching brief) will also be maintained during topsoil stripping to record any on-site finds. Contingency plans will be developed to deal with the discovery of previously unknown sites during construction.

Hydrology

The pipeline will cross eight significant watercourses and thirteen medium to minor ones. In all cases, the necessary consents will be requested from the relevant authorities. The overall water quality ranges from unpolluted to water rich in nutrients.

Generally watercourses will be open cut. However, designated rivers and watercourses may be crossed using trenchless techniques, where suitable ground conditions prevail, thus minimising direct impacts. As stated all appropriate consents will be sought from the relevant County Councils and the Regional Fisheries Boards for all crossings, abstractions from, and discharges to, watercourses. BGÉ's pipeline construction contractor(s) will prepare an Environmental Management Plan in consultation with the relevant bodies / authorities.

In order to ensure successful restoration of major watercourses and their banks a survey of existing species has been undertaken to ensure that suitable species can be used for re-instatement. Mitigation measures will be developed and agreed with the relevant County Councils and the Regional Fisheries Boards to minimise sediment discharges to watercourses.

Hydrogeology

Groundwater and its rate, direction and pathways of flow are very important elements in the development and continuation of the blanket bog habitats in the northern portion of the pipeline route and in the karst (limestone solution weathering) habitats through which the southern portion of the route passes. In the blanket bog areas the contractor will be required to adopt specialised construction techniques to minimise the impact on the ground water regime and thus on the blanket bog ecology. In the areas with karst features underlying the route or nearby, there are ongoing geophysical studies to identify any underground features. Measure will be taken to ensure the construction impacts on the groundwater flow in these areas are minimised.

Landscape

Pipeline construction will have a temporary impact upon the landscape, as the working width will be visible once vegetation and topsoil are removed. However, the area will be reinstated promptly after construction during suitable weather conditions. Hedgerow breaches will remain visible for a few years as the replacement plants grow to fill the gaps, though throughout the project hedgerow removal will be minimised. After this time there should be no residual impact. Dry stone walls will be carefully dismantled and replaced after the pipeline has been laid. The pipeline route through forestry will remain visible until the remaining trees are felled and, when the forest is replanted, the pipeline way leave will not be replanted. This will result in a clear line through the forest, which will be visible from a distance, similar to a firebreak. The above ground installations will each have a small building. These will have a minor impact until the screen planting matures.

Socio-Economic

Pipeline construction will provide a positive stimulation to the use of local services, such as catering and plant hire. Temporary local employment will be created, and accommodation will be required for much of the workforce locally. There are unlikely to be any significant socio-cultural impacts due to the numbers of workers involved.

The gas pipeline and fibre optic cable infrastructure provided by the project should have an

indirect positive impact by promoting economic activity in the towns along the route.

Noise and Vibration

Before construction begins, BGÉ's pipeline construction contractor(s) will be required to identify expected noise levels, which will be considered in relation to the location of any noise-sensitive sites. Noise will be controlled as far as reasonably practicable, in compliance with BS 5228 (Noise Control on Construction and Open Sites). Careful siting, silencing and screening of equipment will help minimise noise during construction. All such measures will be discussed with residents likely to be affected.

Traffic

There will be significant traffic generated by the transport of line pipe and other materials and construction plant from the ports of entry, or other parts of Ireland, to the pipe storage yards and construction compounds in Mayo and Galway, prior to commencement of construction. This traffic will probably use the road network. There will also be a discernible increase in traffic levels on roads close to the pipeline route during the construction period. This increase is unavoidable but will be temporary in nature and principally attributed to the delivery of pipe, other materials and construction plant. Once on the pipeline spread, traffic movements will generally be confined within the working width. Other minor increases in traffic will be experienced as a result of the movement of the workforce to and from the working areas.

To control traffic movements and restrict impacts upon minor roads in particular, a Traffic Management Plan will be developed and agreed with the local authorities prior to construction.

Emissions

All equipment used on site will be correctly adjusted and maintained to control air emissions. Most machinery will be powered by diesel engine. Any dust and mud generated by vehicle movements will be controlled by damping down using water spraying equipment, road brushes, wheel washes and imposing speed restrictions on vehicles.

Methods for disposing of accumulated trench water and water used during testing will be agreed with the relevant local authorities, and any necessary consent sought.

All waste and litter will be disposed of in accordance with the Waste Management Act 1996 and to the satisfaction of the relevant local authorities. Fuels and oils will be stored in an approved manner and in accordance with relevant pollution prevention Statutory Instruments. No refuelling of plant and machinery will be allowed within close proximity to a watercourse.

An Environmental Management Plan will be developed to minimise risks from spillage of oils or fuel. The construction contractor(s) will also produce a Waste Management Plan, which will identify potential wastes as well as appropriate handling and disposal methods.

Interactions of Effects

There are some quite significant interactions of effects in different environmental media, which will result from the construction of the pipeline.

For example, construction methodology for the route in general will determine noise and vibration emissions and traffic generation, utilisation of stone for temporary roads and of sand for pipe bedding. The construction methodology adopted in the blanket bog and karst areas will determine the interaction between soils and geology, ground water movement and flora and fauna impacts and recovery over the short and long term. The method of gaining access to the soft ground areas will determine the amount of stone required for temporary roads, which will affect traffic generation on these roads and consequent noise. Road and river crossing methodology will affect the generation and impact of traffic, surface and groundwater movement and noise emissions. The construction methods chosen in forest areas will determine the visual and landscape impact in these areas and also affect generation of traffic and waste.

7 Environmental Management

An important part of the environmental management of this project will be the ongoing liaison with both statutory and non-statutory bodies. By maintaining communications with these bodies, BGÉ intends to facilitate the smooth running of the project.

Specific issues and required working methods will be addressed in method statements prior to commencement of construction.

Residents likely to be affected by the pipeline activities will be contacted prior to the commencement of construction. This will either be by mail drop, local advertising or a personal visit. Members of the public will be able to contact Bord Gáis Éireann through the Agricultural Liaison Officers (ALO) for more information or to discuss any issues arising.

1. INTRODUCTION

1.1 The Proposed Development

Bord Gáis Éireann (BGE) proposes to develop a gas pipeline from the northwest of County Mayo to the south of County Galway. This will form part of a series of developments, the Corrib Natural Gas Field Development and the Pipeline to the West which will provide an additional source of natural gas and connect the West of Ireland to the natural gas grid.

The Corrib Development consists of subsea wellhead production facilities at the Corrib Field, an undersea pipeline from the gas field to a landfall at Dooncarton on the coast of County Mayo, a gas reception terminal near Bellanaboy Bridge and the onshore pipeline to connect to the natural gas grid near Galway. The Pipeline to the West project is the construction of a gas pipeline from Dublin to Galway and continuing onwards to Ennis and Limerick.

The Mayo - Galway natural gas pipeline will be approximately 150km in length. It will convey natural gas from the Corrib reception terminal at Bellanaboy Bridge, near Pollathomish in County Mayo, to the connection with the Pipeline to the West at the AGI at Garracloon South, near Craughwell in County Galway. The pipeline will be underground with a minimum cover of 1.2m. It will be 660mm (26 inches) in diameter and will be constructed in high strength steel. The pipeline line will have a maximum operating pressure of 85barg.

There will be six block valve stations along the route which will allow the pipeline to be isolated into sections and will facilitate off-takes for the provision of low pressure gas supplies to towns along the route. These block valve stations will be located at an above ground installation (AGI). Other above ground features along the pipeline include pipeline marker posts and cathodic protection posts.

Fibre optic cables will be laid along the pipeline during construction. These will extend from the AGI at Craughwell to Block Valve Station 2, the potential off-take point for Ballina.

It is planned to construct the pipeline in 2002 and 2003. Construction will mainly take place in the period from April to October each year, except where there are ecological or other reasons to undertake specific activities outside this time period.

The Mayo - Galway gas pipeline project was initiated by Enterprise Energy Ireland Ltd (Enterprise) as part of the Corrib Natural Gas Field Development. Initial project feasibility studies and route selection were undertaken by Enterprise. In late 2000 Enterprise signed a contract with BGE in which it was agreed that BGE would take over the project, undertake the detailed design and manage the construction of the pipeline from the Corrib reception terminal at Bellanaboy Bridge to Craughwell.

1.2 Bord Gáis Éireann

Bord Gáis Éireann (BGE) was established under the Gas Act of 1979 as the state agency responsible for the supply, transmission, distribution and sale of natural gas in Ireland. Under Section 8 of the Gas Act 1976 BGE has a duty to develop and maintain a system for the supply of natural gas, *"being a system which is both economical and efficient and which appears to the Board to be requisite for the time being."*

Production of natural gas commenced in Ireland in 1978 with the development of the Kinsale field, off the coast of Cork. At that stage the gas transmission and distribution grids were confined to a small area close to Cork City. In 1982 work commenced on construction of the Cork to Dublin pipeline and over the years the transmission grid has been extended to parts of Counties Limerick, Tipperary, Waterford, Wicklow, Kildare, Laois, Meath, Louth and Cavan.

In 1993 BGE constructed a sub-sea interconnector pipeline, from north County Dublin to the southwest of Scotland. This pipeline connects the Irish gas grid to the international gas network.

In addition to the Mayo - Galway pipeline, as part of its ongoing work to secure gas supplies and to extend the transmission grid further in Ireland, BGE plans to construct a second interconnector pipeline to Scotland and to construct a transmission pipeline from Dublin to Galway. This pipeline will extend, via Ennis, to connect to the existing grid at Limerick.

1.3 Legislative Requirements

1.3.1 The Gas Act

Section 8 (7) of the Gas Act states that BGE may not export gas or construct a pipeline without consent from 'the Minister'. The Minister may attach conditions to the consent. Currently the Minister with appropriate jurisdiction is the Minister for Public Enterprise.

1.3.2 EIA Regulations

Under Article 4(1) of European Council Directives 85/337/EEC and 97/11/EC environmental impact assessment statements must be prepared for certain developments. SI No. 93 of 1999 European Communities (Environmental Impact Assessment)(Amendment) Regulations, 1999, implements these directives in Ireland.

The developments listed in Part 1 of the First Schedule of Article 24 of SI 93, which require an environmental impact statement (EIS), include '*pipelines for the transport of gas, oil or chemicals with a diameter of more than 800mm (32inch) and a length of more than 40km*'. The Mayo-Galway pipeline has a diameter of 660mm (26inch) and thus does not fall within the scope of Part 1 of the first schedule. However, Part II states that an EIS is also necessary for '*gas pipelines and associated installations not included in Part 1 of this Schedule, where the design pressure would exceed 16bar and the length of new pipeline would exceed 40km*'. With an operating pressure of 85barg and a total length of 150km, the Mayo - Galway pipeline is of a class requiring an EIS under this part of the schedule.

SI 93 Of 1999 amended the Gas Act 1976 to require BGE to submit an EIS with its application to the Minister for consent to construct a pipeline under Section 8, where the pipeline is of a class specified in Article 24. Before deciding to give consent for the pipeline, the Minister shall have regard to all submissions made on the EIS by interested parties.

This EIS will be submitted by BGE to accompany its application for Ministerial consent, under Section 8 of the Gas Act, to construct the Mayo - Galway gas pipeline.

1.3.3 Planning Permissions

The development by BGE of an underground gas pipeline, in accordance with a consent from the Minister under Section 8 of the Gas Act, is an exempted development under the Local Government (Planning and Development) Regulations. However this applies only to the pipeline and to ancillary equipment such as marker posts and cathodic protection posts. Planning permission will be required for the above ground installations (AGI) and construction compounds associated with the pipeline. BGE will be making applications to Mayo and Galway County Councils for planning permission for these installations, in due course.

1.4 The EIS

This EIS covers the development of the natural gas pipeline from the Bellanaboy Bridge Terminal in County Mayo to the AGI at Craughwell in County Galway. It documents the environmental assessment carried out over a 12-month period, which commenced in April 2000.

The EIS is in two volumes:

Volume I: Main Report and Technical Appendices

Volume II: Figures

The scope and contents of the EIS and the methodology used in its preparation are discussed in more detail in Section 2.

Environmental assessments were undertaken for the other elements of the Corrib Natural Gas Field Development, resulting in the production by Enterprise of two EISs. These documents cover the sub-sea wellhead development, the sub-sea pipeline to the landfall and the reception terminal and connecting pipeline to it from the landfall.

2. IMPACT ASSESSMENT METHODOLOGY

Environmental impact assessment (EIA) is an important aspect of the project, evaluating the broad range of impacts that the construction and operation of the pipeline will have on its environment. In the assessment process potential impacts are identified and appropriate mitigation, avoidance or minimising of impact is proposed. This EIS summarises the relevant environmental information associated with the EIA. The Minister for Public Enterprise will assess the document, and members of the public will be invited to comment.

2.1 The Assessment Team

The Environmental Impact Assessment (EIA) was carried out in two phases. In the first phase RSK Environment Ltd were retained by Enterprise Energy Ireland to manage the assessment process, and the assessment team comprised:

- RSK Environment Ltd (Project Management, Landscape and Visual impact, Air Quality, Waste, Hydrology, Risk, Agricultural and Physical Environment assessments);
- Alan Sanders Associates (Noise assessment);
- Brian Meehan Associates (Planning);
- Margaret Gowan Associates (Archaeological assessment);
- Parkman Ltd. (Road and Traffic assessment); and
- Ecological Advisory and Consultancy Services (Flora and Fauna assessment).

Baseline studies were undertaken and a draft document, completed to Enterprise Energy Ireland requirements, was produced.

When Bord Gáis Éireann took over the project, Arup Consulting Engineers modified and completed the draft EIS, revising it to reflect the change of developer and to incorporate the impacts of subsequent route changes, and modifications to the scheme.

Arup retained Margaret Gowan Associates and Ecological Advisory and Consultancy Services for additional baseline work, and undertook the additional work on other aspects itself. The reroutes and scheme modification and development required minor additional work to the Archaeology and Flora and Fauna baseline studies. Substantial reassessment was required for the Roads and Traffic, Soils and Geology, Hydrology and Hydrogeology, and Landscape and Visual chapters.

2.2 The Environmental Impact Study Process

The principle elements of the assessment, up to submission of the EIS are described below:

Scoping - determining the issues to be part of the study, including further issues identified by Consultees, and the availability of data;

Determination of baseline conditions - determining the criteria with reference to which the likely environmental effects of the proposed development were to be evaluated;

Consultation - undertaken throughout the assessment process in order to inform interested parties and invite comment;

Evaluation of significant effects/determine mitigation - an iterative process whereby the significance of potential effects is determined and design improvements or appropriate mitigation identified in order to reduce adverse effects;

Determination of significant environmental effects - once mitigation/design improvements have been incorporated, the significance of residual environmental effects was determined;

Reporting - the findings of the assessment are reported in an EIS, which is a public document.

2.3 Scope of the EIS

The scope of the environmental assessment was set out in the Corrib Field Development Onshore Briefing Document. This document identified the main issues potentially associated with the proposal, as follows:

Flora and Fauna	The ecological assessment, which will include a field inspection, will establish baseline conditions, evaluate terrestrial and aquatic habitats along the route and identify measures to protect against adverse impacts on those habitats.
Soils and Geology	A geotechnical assessment will assess the soils and geology along the route to identify and mitigate against any potential impacts
Hydrology and Hydrogeology	In conjunction with the ecological assessment, a hydrological assessment of the entire route and more detailed assessments of potentially sensitive areas will be undertaken. Measures to avoid or mitigate potential impacts will be identified
Archaeological and Cultural Heritage	A study, which will include a field inspection, will identify the archaeological or cultural heritage significance of any sites along the route where possible; to reduce any predicted adverse impacts.
Landscape and Visual	A landscape and visual study of the route will include an assessment and description of the existing landscape context, features and vulnerable areas. It will evaluate the impact of the project on the landscape proposals and residual effects will also be described.
Roads and Traffic	A traffic study for the project will review the current traffic network and evaluate traffic impacts of the proposed pipeline on the network. Particular scrutiny will be made to construction impacts.
Air Quality and Noise	The potential impact of the development on air quality and potential noise emission will be reviewed.
Effluent and Solid Wastes	The characteristics, fate and potential impacts of the effluent and solid wastes from the reception terminal operations and from construction activities will be reviewed.

Human Impact Issues The socio-economic study will review population and employment trends. The impact of the pipeline on existing and potential future commercial and recreational activities will be assessed and the potential of the pipeline to contribute to regional development along the pipeline route will be considered.

Material Assets The study will consider the implications of the pipeline and of construction, on existing and possible future development along the pipeline. It will also examine the use or sterilisation of any natural resources.

The Briefing Document was issued and a number of submissions were received from numerous statutory consultees.

This scope was further revised and updated throughout the study period to ensure that all the likely significant environmental affects were considered in line with the requirements of the relevant legislation.

2.4 Consultation

Consultation with government departments and other agencies took place during the environmental assessment. The main organisations contacted were:

- Dúchas (Parks and Wildlife Section);
- Birdwatch Ireland;
- Irish Peatland Conservation Council;
- Department of Zoology, TCD;
- Dúchas (Research, Bogs and Wetlands)
- Dúchas (Archaeological Section);
- National Museum of Ireland;
- Western, Central and NorthWestern Regional Fisheries Boards;
- Office of Public Works;
- Bord na Mona;
- Coillte;
- ESB;
- Eircom;
- Mayo and Galway County Councils; and the
- Geological Survey of Ireland.

Ecological Consultees:

- Dr. Andrew Bleasedale, Dúchas (West Regional Ecologist)
- Dr. Alan Craig, Dúchas (Principle Officer)
- Dr. Tom Curtis, Dúchas (Rare and Protected Plant Species)
- Mr. Bob Cussen, Dúchas (Conservation Ranger, N. Mayo)

- Ms. Caitriona Douglas, Dúchas - Research (Blanket Bogs)
- Dr. Peter Foss, Irish Peatland Conservation Council (IPCC) Mr Paul Galvin, Chief Planning Officer, Birdwatch Ireland
- Ms. Jackie Hunt, Birdwatch Ireland
- Dr. Noel Kirby, Dúchas (Regional Manager)
- Anne-Marie McKee (Rare Plants data Co. Mayo)
- Mr. Oscar Merne, Dúchas
- Mr Jim Moore, Dúchas (Asst. Regional Manager for Mayo)
- Mr. Tony Murray, Dúchas (Conservation Ranger, N. Mayo)
- Mr. Stephen Newton, Birdwatch Ireland
- Mr. Tim O'Connell, Dúchas (Regional Manager)
- Mr. Gerry O'Sullivan, Dúchas – Waterways Ireland
- Professor Julian Reynolds, Dept. Zoology, TCD (Crayfish information)
- Mr. Jim Ryan, Dúchas – Research (Bogs & Wetlands)
- Mr. Denis Strong, Dúchas (District Officer, N. Mayo)
- Mr. Michael Sweeney, Dúchas (Western Region)

North Western Regional Fisheries Boards

- Dr. John Conneely
- Mr. Michael Lennon & Peter Collins (Fisheries Inspectors)

Western Regional Fisheries Board

- Mr. Michael Kennedy,

Central Fisheries Board

- Dr. Martin O'Grady

Archaeological Consultees:

- Brian Duffy, Dúchas - Senior Archaeologist
- Greta Byrne - Director of the Céide Field Centre.
- Jane O'Shaugnessy, Dúchas - Archaeological Survey Unit of Co. Mayo
- Margaret Keane, Dúchas - Archaeologist
- Sue Zajac, Licensed archaeologist, Margaret Gowen & Co Ltd
- Professor Seamus Caulfield, Belderrig Research Centre

General Consultees:

- Jane Brogan - Environmental Protection Agency

- Donal Daly - Geological Survey of Ireland
- Ray Norton - Mayo County Council
- Jo Beirn - Mayo County Council
- Siobhan Shields - North West Fisheries
- Geoff Wright - Geological Survey of Ireland (GSI) (Senior Hydrologist)
- Conner McDermott - GSI(Bedrock Geologist)
- Donal Daly - GSI (Head of Groundwater Section)
- Rebecca Kelly - GSI (Groundwater Section Assistant)
- Pat O'Connor - GSI (Principal Ecologist)
- Michael Sheeby - GSI (Quaternary Section)
- Sally Watson - University College London

Public Exhibitions

As part of the initial scoping process Public Exhibitions were held in June 2000 at the following locations:

- Pollatomish;
- Ballina;
- Castlebar; and
- Galway.

The public responses were collected, by way of questionnaires, and key issues highlighted as part of the EIA process.

2.5 Surveys and Predictive Techniques

A combination of field surveys, desktop surveys (including consultation) and modelling techniques was used to assess the potential impacts of the proposed pipeline.

The principal surveys/predictive techniques undertaken were:

- Phase I Habitat, protected flora and fauna species and breeding/migratory bird field surveys;
- archaeological desk based assessment and field visits;
- aerial video flown along the length of the proposed route and viewed alongside digital mapping through a system known as Geofilm.

2.6 Assumptions

The initial assessment was based on detailed data provided by Enterprise Energy Ireland Ltd., their front-end engineering design contractors, and data from various feasibility studies carried out on behalf of Enterprise. Best practice techniques, using latest software programs (where applicable) have been applied in conjunction with detailed consultations with statutory and non-statutory consultees. Assessments assume that all relevant Irish and relevant European legislation will be adhered to.

Where technical information is still under review or detailed information not available, this has been highlighted and appropriate assumptions made based on previous experience.

2.7 Difficulties Encountered in the Study

The compilation of an EIS is affected by such a diversity of factors that it is unusual to avoid some difficulty in the process. In this study the following issues had an effect on the progress of the assessment:

- *Reroutes*: The route was being refined on an on-going basis during the assessment period, which had repercussions on many of the chapters. This was often an iterative process, with the reroutes having broader impacts, resulting in further constraints.
- *Planning Applications*: There were a number of applications for planning permission along the route made during the study period, and the assessment team had to respond to these as they came to light.
- *New Road Schemes*: Preferred realignments for the N17 and the N6 emerged quite late in the pipeline routing process, but, although the routes cross close to a major road interchange near Athenry, no major rerouting was required.
- *Incomplete Aerial Photography*: The entire route was photographed early in the assessment period, and subsequent to this, there were major reroutes – particularly towards the south. A combination of poor weather conditions and the unavailability of suitable aerial photographers meant that some of the route remained unphotographed. This made some of the fieldwork planning and desktop study more difficult than would otherwise have been the case.
- *Unavailability of 1/2500 Mapping*: Towards the northern end of the pipeline route the only available Ordnance Survey mapping was quite outdated 1/10560 (6"). By the time a set of up to date 1/2500 maps had been created from the aerial photos much of the fieldwork was complete.
- *Foot and Mouth Precautions*: The national foot and mouth prevention guidelines, drawn up by the Department of Agriculture Food and Rural Development in response to the threat of infection, initially required that access the countryside and entering upon farmland was avoided unless absolutely essential. While the restrictions were relaxed somewhat, final assessment of some of the re-routed areas and AGI sites was postponed until the restrictions are fully withdrawn. In addition, in consultation with Dúchas, some more detailed studies of mammal habitats, for example, were deferred. These studies will be undertaken before construction commences.

3. SCHEME CONTEXT

3.1 Need for the Scheme

At present Ireland is experiencing high economic growth accompanied by expectations for a higher standard of living. These factors, amongst others, drive the demand for greater use of power and energy. Gas is also predicted to become a greater provider for the power industry. This combined with the current liberalisation of the energy market will lead to increased gas consumption in Ireland. Infrastructural investments, of which this development is part, will cater for the predicted increased demand in gas, contributing to the long-term economic well being of Ireland.

With gas use increasing annually and predicted to rise in the future, demand for energy has outstripped Ireland's home production and domestic infrastructural capacity. Ireland is no longer self-sufficient and requires imports of gas from abroad.

Consultants on behalf of Bord Gáis Éireann have evaluated the required strategic investment in gas transmission throughout Ireland until the year 2025 and examined infrastructural solutions based on various gas demand scenarios.

3.2 Energy Sources in Ireland

Ireland uses coal, oil, gas, peat, hydro and wind as sources of energy. As the demand for energy increases it is expected that gas will have increasing importance because of the efficiency of combined cycle gas turbine generators and the relatively benign environmental impact of emissions from gas combustion.

3.2.1 The National Climate Change Strategy

The energy sector is the largest producer of Ireland's CO_2 emissions from fossil fuel combustion in the production of electricity. The National Climate Change Strategy (2000) records that 24.6% of all greenhouse gases was emitted from this source in 1998, and outlines two key sector-specific domestic policy options to help meet our commitments to limit growth in greenhouse gas emissions:

- Fuel switching towards less carbon intensive fuels without affecting overall levels of electricity generation or use
- Improving the efficiency of energy transformation

In considering substituting for coal, the strategy document notes the following: *"fuel switching from coal has already contributed significantly to reduced greenhouse gas emissions in other countries and is expected also to be an important factor for many countries in meeting their Kyoto targets. Fuel switching to gas and to renewables for electricity generation will be supported by this strategy. The developments of electricity and gas interconnectors (East/West and North/South as appropriate) will assist in addressing the security of supply issue and offer opportunities to access additional energy sources with reduced greenhouse gas emissions. Continuing support will be given to the exploration for indigenous supplies of gas, and appropriate arrangements made for its early recovery and exploitation."*

Closure of the coal-fired power station at Moneypoint, with the required new capacity provided by combined cycle gas turbine plant, would make the largest single contribution to reduce greenhouse gas emissions (3.4 Mt CO_2 per annum). Dependence on gas for electricity generation would increase to around 80% in this case, *and "it would be necessary to ensure the security of energy and electricity supply in the conversion of the plant output to gas".*

Peat is the least carbon-efficient fossil fuel used for electricity generation in Ireland, and the strategy document refers to the progressive replacement of all remaining low-efficiency peat power stations. Bellacorick peat-fired power station (which is located on the Mayo-Galway Gas Pipeline route) is one of these older plants.

Under the heading "Gas Supply and Network Expansion" the document refers to the sourcing of additional gas supplies as *"a vital supporting element of the Strategy".* A locally sourced gas supply such as the Corrib Field will help to meet the aims of the Strategy.

3.2.2 Sustainable Development

In "Sustainable Development, a Strategy for Ireland" (1997) an action programme is outlined towards achieving sustainable energy use. This incorporates:

- Securing energy supplies
- Making energy infrastructure efficient
- Developing indigenous resources to the maximum possible
- Using energy sources which minimise damage to the environment

To achieve these aims *"it is vital that Ireland vigorously promote its offshore oil and gas exploration programme".* The Corrib field development, and Mayo-Galway pipeline is in line with these policy objectives.

3.3 Need for the Pipeline

In the Bord Gáis Review of Natural Gas Transmission – Capacity Requirements to Year 2025 (1999) various future gas supply options are presented:

- A new interconnector parallel to the existing Scotland-Ireland system (which might include a south-north link to provide additional gas supplies and security of supply to Northern Ireland)
- A new interconnector parallel to the existing Scotland-Northern Ireland system with implementation of a north-south link between Ireland and Northern Ireland
- An interconnector from North Wales to the Dublin area
- An interconnector from South Wales to the Wexford area
- An interconnector from Brittany (France) to the Cork area
- Construction of a liquefied natural gas terminal at Cork or Shannon estuary to import liquefied gas, by ship, from Africa
- Reinforcement of the existing interconnector with an intermediate compressor station
- Indigenous gas finds

In April 2001, Bord Gáis gave the go-ahead for the duplicate Scotland-Ireland interconnector, and as a result, implementation of the other gas supply options has become less urgent from a continuity of supply perspective. However, the report acknowledges that Corrib gas will have significant commercial and strategic benefits for the Irish gas industry.

The existing BGÉ national gas grid is concentrated in the south and east of the country. An east-west pipeline, connecting Dublin to Galway, is scheduled for construction in 2002. This 'Pipeline to the West' will combine with the Mayo-Galway pipeline to form a significant

expansion to gas transmission infrastructure in Ireland.

The Corrib gas field will be the first gas discovery to be developed offshore from the west of Ireland. In order to facilitate gas production, onshore and offshore infrastructure is required. The proposed pipeline is required to distribute gas from the Bellanaboy Bridge Terminal in County Mayo to the national gas grid connection near Craughwell in County Galway.

3.4 Summary

Ireland is using increasing quantities of natural gas which, due to it low emissions, is a preferred fuel, particularly for power generation.

National policy, as stated in major policy documents, is to promote the development and use of indigenous gas sources. The construction of the Mayo-Galway natural gas pipeline is an essential component to help meet the demand for natural gas and to allow the development of the Corrib Field.

4. BACKGROUND TO THE PROJECT

4.1 Outline of Proposed Development, Planning and Phasing

This section explains the background and origins of the Mayo - Galway gas pipeline project and the development options considered by BGE and Enterprise.

4.2 Alternatives Considered

A number of alternatives have been assessed for the project, with consideration given to the implications of:

- No pipeline development
- Use of alternative sources of energy
- Alternative gas transport options
- Various gas pipeline routes.

A do-nothing strategy would leave Ireland fully dependent on imported gas in the medium term. The only domestic sources of natural gas - the Kinsale Gas Field and the small Ballycotton field - are nearly depleted, and the Corrib Field is the only readily available replacement. Gas is currently being imported to Ireland via a subsea interconnector from Scotland, and a second interconnector will be laid in parallel to this in 2002.

Dependency on continuity of supply of gas from the international market would result in an increased exposure to fluctuations in price and availability. This would provide an economic incentive for consumers to change to alternative fossil fuels as energy sources; demand for coal, oil and peat would increase – all less desirable from an environmental perspective. Demand on the national peat reserves would increase, as would imports of oil and coal. These fuels are also greater producers of the gases which contribute to the enhanced greenhouse effect, and potentially to global warming.

The resultant decrease in domestic energy supply would also encourage exploitation of renewable sources of energy, such as wind, hydro, wave, and solar. While this would be environmentally positive, the required infrastructure and technology is at an early stage of development, and these sources will not realistically generate the amount of energy that will be required to meet demands in the immediate future.

The option of transporting the natural gas in a liquid form in road tankers from the reception terminal at Bellanaboy Bridge was found to be impractical on economic and infrastructural grounds, and would have had major environmental impacts.

A comprehensive study of the field development alternatives and pipeline routing alternatives were undertaken by Enterprise. These are summarised below.

4.3 Routing Options for the Pipeline

4.3.1 Enterprise Energy Ireland Ltd pre-feasibility and feasibility studies

A series of concept and options screening exercises were undertaken by Enterprise in order to select and define the preferred subsea development strategy. The option selected was a subsea tieback to shore, incorporating subsea well completions, infield infrastructure, a subsea control umbilical link from shore and a gas export pipeline.

Once the decision was made to development the Corrib field by using a pipeline to bring the gas ashore and to convey it on land, a series of inter-dependent components had to be optimised. The Corrib field, the starting point for the pipeline, was reasonably well defined. The end point, the connection point to the existing gas grid, could be in the north Dublin area or the Limerick/North Cork area. The choice of landfall, routing of the sub-sea pipeline to the landfall and routing of the pipeline from landfall to grid connection gave rise to a huge range of options.

In a pre-feasibility study undertaken in March 1999, Enterprise identified potential sub-sea pipeline routes, landfall locations, reception terminal sites and indicative pipeline route corridors, based on a combination of preliminary environmental screening, preliminary offshore sea-floor surveys, and commercial and strategic considerations.

4.3.2 Sub-sea Pipeline and Landfall Options

Results of the 1999 offshore route survey indicated significant areas of rocky seabed for all routes south of, and including, Blacksod Bay. There appeared to be no pipeline corridor through this area without the need for substantial rockdumping, rock cutting and/or blasting. This suggested that sub-sea routes south of Broadhaven Bay would not be feasible and that further studies should concentrate on the coastline from Broadhaven Bay to Killala Bay.

4.3.3 Onshore Pipeline Routes

A number of broad route corridors were identified at the pre-feasibility stage. These were:

- A route from the landfall directly to Dublin, which would give the shortest, and probably the least expensive onshore pipeline;
- A route from the landfall to Dublin via Athlone or Galway, which would be longer and more expensive than the direct route, but may be more desirable, forming part of the proposed BGÉ ring main.
- A west-coast route, from north Mayo to Galway, and then across the Shannon estuary to connect to the Cork-Dublin pipeline at Mitchelstown. This would be substantially longer and more expensive than the direct route. However, it would be of considerable strategic advantage to BGÉ in terms of security of supply. It would also form a substantial part of the Pipeline to the West.

4.3.4 Arup onshore pipeline feasibility study

Following from the pre-feasibility study, in July 1999 Arup Consulting Engineers were appointed to carry out a detailed feasibility study to identify and select suitable landfall locations, reception terminal sites and onshore pipeline routes. The criteria for the selection of routes and landfall locations were environmental impact, safety, cost and construction schedule.

Landfall options from Broadhaven Bay to of Killala Bay were examined in detail. The locations considered were Brandy Point and Dooncartoon, at the entrance to the Sruwaddacon estuary on the east side of Broadhaven Bay, two locations at Bunatrahir Bay near Ballycastle, and four locations on the western side and two locations on the eastern side of Killala Bay. Sites for the reception terminal, close to each of the landfalls, were also identified.

The broad route corridors, identified in the pre-feasibility study and listed above, were refined and actual routes identified on 1:50,000 scale mapping. In addition, a route to Galway from a landfall near Clifden, County Galway, was also examined. It quickly became apparent that ground conditions along this route were very difficult and that there were numerous environmental constraints that could not be avoided.

A comparison of the route options was presented in the feasibility study report, together with a

ranking based on the study criteria.

Other studies

Enterprise commissioned a series of feasibility studies on the technology for the field development, the sub-sea pipeline technology and routing, and the reception terminal. These studies were undertaken concurrently with the onshore pipeline feasibility study.

4.3.5 BGE Gas 2025 Study

The Bord Gáis Éireann commissioned a study 'Review of Natural Gas Transmission *Gas 2025*'. The study was published in August 1999. It highlighted two route schemes to connect the Corrib gas pipeline from landfall to the existing network. These were a connection directly to northwest Dublin, and one to tie in with the proposed Pipeline to the West, near Galway. The tie-in near Craughwell in County Galway was considered to be strategically more desirable and is now part of the route which was assessed for this EIS.

4.3.6 Landfall Selection

The onshore pipeline feasibility study identified a number of routes and landfalls which were practicable and had reasonably similar impacts. The route finally chosen was dictated by the requirements of the technology to be used for the wellhead development and the sub-sea pipeline.

Broadhaven Bay was selected by Enterprise as the preferred option as a result of the consideration of the following factors:

- The export pipeline between the proposed subsea facilities and the terminal will operate in a multiphase regime (i.e. gas, water and condensate may be present in the fluid flow). Due to the separation of phases in this line and the potential for liquid slugging, the pipeline flow will have to be operated within a constrained operating envelope. The longer the offshore pipeline, the greater the operating constraints would be. Corrib to Broadhaven offers the shortest of the northern offshore routes.
- It is proposed to operate the Corrib subsea facilities remotely, from the reception terminal. The integrity of the proposed umbilical control link between the terminal and subsea facilities is crucial to maximising the operational availability of the system. The most reliable umbilical system minimises the number of in-line joints. In addition, the shorter the umbilical, the less opportunity for communication disruption. Corrib to Broadhaven offers the shortest of the northern offshore routes.
- The landfalls at Bunatrahir Bay is exposed to wind and wave action and is characterised by large areas of rock close to the shoreline, requiring considerable construction work to create a pipeline corridor. In contrast Killala and the Dooncarton landfall at Broadhaven offer the opportunity for beach landfalls with reasonable soils coverage.
- Land behind Dooncarton landfall at Broadhaven Bay provides the opportunity for a terminal location with good natural screening, thereby minimising the visual impact of this installation.
- The estimated cost of offshore pipelines to landfall and the onshore routing of pipelines in the area under consideration are very similar. The cost of an onshore terminal is not significantly impacted by the terminal location. Accordingly cost does not influence the selection of the preferred landfall location.

4.4 Routing Strategy

The strategy adopted to selecting and refine the pipeline route is described below.

Pipeline routing is an iterative process, the route being continually refined and adjusted, taking into account various constraints, and minimising any potential negative impact on environmentally sensitive areas. Starting at Bellanaboy Bridge in County Mayo, and ending at the proposed above ground installation (AGI) near Craughwell in County Galway, a hierarchy of constraints was drawn up to guide and inform the routing process. These are:

a) Designated special area of conservation (SAC) or special protection area (SPA) or national heritage areas (NHA)

b) Areas of other environmental or archaeological significance

c) Areas designated in County Development Plans as requiring special consideration

d) Areas with geology, geomorphology and topography which would present difficulties for construction and increase costs

e) Areas of potential mineral resource and/or areas of existing or future extraction

f) Densely populated areas

g) Areas of forestry

h) Crossings of motorways, roads, railways, rivers and pipelines

i) Major developments planned along the route

j) Minimising the overall length of the pipeline corridor

Applying these criteria, a route was developed which avoids all known archaeological artefacts, and minimises impact on special areas of conservation (SAC). Dúchas (the Heritage Service) were consulted, and a number of route refinements were undertaken in response to their recommendations, these include:

- A major re-route south and west of Slieve Fyagh, towards the northern end of the route
- A further refinement of this re-route to minimise the impact on the blanket bog at Glenturk
- Avoiding some base-rich fen near Eskeragh on the Crossmolina to Bangor road
- Adjustments to the route near Caherlistrane to avoid the nearby Turlogh O'Gall SAC and Greaghan's Turlogh NHA

The route maps in Volume II, Figures 4.1 to 4.8, indicates many of the route alternatives considered for the pipeline during the route selection process. The design engineer may make further minor changes to the route during detailed design to take into account specific constraints and land owner requirements and further to minimise impacts.

5. DESCRIPTION OF THE PROPOSED PIPELINE

5.1 Introduction

The proposed pipeline route, from Bellanaboy Bridge County Mayo to near Craughwell in County Galway is described in this section. The route is illustrated in **Volume II**, figures 4.1 to 4.8.

5.2 Main features of the Proposed Route

Upon leaving the Bellanaboy Bridge Reception Terminal (Grid Reference 0862 3329), at approximately 30 metres Above Ordnance Datum (AOD), the route runs on the western flanks of Slieve Fyagh, traverses Glenturk More and Glenturk Beg, before moving into the Glencullin River valley. The R314, two minor roads and three small watercourses that feed Carrowmore Lake are crossed.

The route runs on the north side of the valley, parallel to the Glencullin River, for approximately 6km towards Tawnaghmore, before passing through an area of coniferous forest for approximately 1.5km. Turning southwards the route crosses the Western Way walking path and into an extensive area of industrial peat workings.

The moorland, near Tawnaghmore, is gently undulating and divided up by small streams. The route turns southeast close to Ballymonnelly Bridge and passes Bellacorick Bridge and the Bellacorick Power Station, following the course of the N59 road, for approximately 9km up to Dooleeg. A tributary of the River Owenmore - the Oweniny River, and the River Muing are all crossed by the proposed route in this section.

The route continues parallel to the N59 for 5 km, heading in an easterly direction, passing Eskeragh and remaining almost 1km north of the Owenboy nature Reserve. It crosses the N59 three times, to avoid an area of base-rich fen near Eskeragh, until, 7 km west of Crossmolina, the route bears southeasterly towards Lough Conn, crossing the Shanvolahan River in two places.

The main topographical feature visible between Eskeragh and Lough Conn is Nephin Mountain. The route passes to the north and east of Nephin. Proceeding generally southeastwards, the pipeline crosses the R316 road and several minor roads, and skirts to the south of small hills at both Knockfarnaght and Tonacrock. Lower-lying land is encountered as the proposed route moves to within 0.5 km of Lough Conn, while remaining to the west of the R315 road. The Castlehill River, the Addergoole River and three minor watercourses are traversed in this section.

To the southwest of Lough Conn, the route climbs into the foothills of Farbreiga. Over a 5km length, steeply sloping ground is present. The proposed route then departs from this hilly region into gently rolling topography from Cunnagher North to Ross West, continuing south to Tawnylaheen. Numerous minor roads and small watercourses are traversed in this region. The R310 road is also crossed and the route continues in a southeasterly direction.

Approximately 4km northwest of Castlebar, just to the north of Clogher, the pipeline route crosses the Castlebar River and the N5 road. Continuing towards Ballinvoash, rolling countryside is encountered, with a rise at Drumdoogh. Undulating countryside and a number of minor roads and farm tracks are encountered from Drumcorrabaun to Manulla. At Manulla, crossings of the Manulla River, the railway line to Ballina and the N60 road are necessary.

Continuing in a southeasterly direction from Manulla, the route crosses slightly more low-lying land, with wet and boggy areas noticeable. The route then proceeds through rolling countryside

towards Portagh. Just to the north of Needham's Lough a small river is crossed and field ponds are in evidence in the area of Loughbunnaun. The route passes to the east of Mayo village, from where it adopts an almost southerly direction, and descends marginally from Gortaphuntaun to Barreel, travelling parallel to a minor road and crossing numerous tracks.

The route passes approximately 5km to the west of Claremorris, and after crossing the R331 road, the Robe River is crossed at Tagheen. Undulating topography is common from this area as far south as Davros. The proposed route crosses a dismantled railway at Lehinch, and climbs a gentle hill to the east of Bushfield. Several minor roads are crossed as the route continues over undulating ground past Annefield. Low-lying and occasionally waterlogged areas of ground are noted close to Carras Lough.

Passing approximately 10km to the east of Ballinrobe, adjacent to Cloonanaff, the pipeline route adopts a southeasterly orientation for approximately 3km, prior to rejoining its original southerly direction. Undulating ground is once again encountered from Ballyweela towards Nettle Hill, with several road (including the R332) and river crossings (including the Kilshanvy River twice) in this area. The pipeline crosses Togher River, followed by occasional minor roads and farm tracks. Flat to gently undulating ground is found from this area as far as Beagh More. The route follows a more southsoutheasterly direction to the north of Caherlistrane.

Tuam lies approximately 15km to the east of the route as it crosses the R333 road, succeeded by a 4-5 km section of undulating topography, as the pipeline route passes just beneath a small but steep-sided hill, Knockmaa (167 m). The route continues to Biggera Beg, returning to flatter, more gently undulating ground. Several minor roads are traversed as the route approaches Bunoghanaun. The N17 road is bisected at Racoona, from where the route continues southwards, skirting a small hill and crossing the N63 road at Knockdoemore. An area of low-lying, wet land in the flood plain of the Clare River is encountered just north of Cregmore as the route follows a southeasterly direction from the N63. The River Clare is crossed in this section.

Three kilometres after crossing the River Clare the route crosses the R339 road. The route then climbs from low land over a small rise of 73m (AOD) at Knocknabreeva. A slower descent occurs onto more gently undulating ground around Ballygarraun West, 3km southwest of Athenry where it crosses the Galway-Dublin railway line and the R348 road.

Low land is traversed in the approach to Templemartin, with many minor roads. The Eiscir River is traversed near Willmount Bridge. The proposed route then crosses the Athenry-Limerick railway line and the R347 road near Pollnabanny Bridge, 6 km south of Athenry. Finally the route runs in an eastsoutheasterly direction, crossing three minor roads and the Craughwell River before terminating at the AGI in the townland of Cappagh South, near Craughwell.

5.3 Pipeline Description

The onshore pipeline will convey gas from the Bellanaboy Bridge Terminal in County Mayo to the gas grid connection near Craughwell in County Galway. The pipeline will be constructed of high strength carbon steel. It will also have an external corrosion protective coating and a cathodic protection system. The pipe will be 660 mm (26") in diameter and approximately 150 km long. It will be buried in the ground, to a minimum depth of 1.2m below top of subsoil. The depth of cover will be increased where the pipeline will require additional protection such as at road and river crossings.

The pipeline will be designed in accordance with IS 328 'Code of Practice for Design and Installation of Gas Transmission Pipelines' 1989. All pipelines in Ireland are built in accordance with this design standard which sets down the requirements for the design, construction and operation for steel pipelines transporting gas. This standard specifies both the minimum safety factor for the pipeline and the minimum permissible distance of the pipeline from occupied buildings.

The proposed pipeline will be constructed of 9.52mm thick steel; rising to 19.1 mm along sections that are required to be heavy walled. Heavy walled pipe is used at locations where additional protection is required, such as at road and rail crossings, and in close proximity to dwellings. It will have a maximum operating design pressure of 85 barg.

For sections of the route, the pipeline traverses wet ground. To counteract the buoyancy pressures imposed by the water, the pipe will be coated with approximately 85mm of concrete in these areas.

In certain locations along the route, concrete slabs will be placed above the pipeline to protect it from damage. Typically this will be carried out at drainage ditches and watercourses.

Communication ducting will also be laid in parallel with the pipeline for most of the route. Three 50mm ducts will extend from Block Valve 2 (BV2) to the connection near Craughwell.

The proposed pipeline has been routed to avoid centres of population. The proposed route also minimises the number of major crossings and avoids areas liable to landslip, subsidence or other instability, as far as possible. For the whole of the pipeline, the materials used and the thickness of the pipeline walls, will be selected so as to ensure that the design factor (safety factor) specified by the design standards are not exceeded. By maintaining the building proximity distance (70 m), using appropriate materials and selecting thick walled pipe where required, the risks to any particular individual will be insignificant.

These design considerations will be further augmented by various measures, for example increased depth of cover especially at major crossings. In addition, the whole of the proposed pipeline route will be inspected (flown and/or walked), supplemented by the use of a Pipeline Integrity Monitoring System (PIMS) and a cathodic protection system.

Natural gas is non-corrosive, so internal corrosion of the pipeline is extremely unlikely. However, the steel pipe will require external protection, which will be provided by external coating supplemented by cathodic protection.

Firstly, the pipe will be coated in the factory with a three-coat polyethylene coating system. After testing of the welds, they are field-coated to an equivalent standard by a specialist field team, using a mobile coating rig.

Cathodic protection (CP) reverses corrosion currents present in the soil by creation of a pipe to soil negative potential. This will be achieved by using an impressed current system and anode ground beds. The design of the cathodic protection system will be to IS 328 'Code of Practice for Design and Installation of Gas Transmission Pipelines' 1989.

The exact configuration of anode ground bed numbers, size and location will be determined by the results of a resistivity survey. This will be carried out prior to construction to determine the corrosiveness and conductivity of the soils along the route, and it will also record corrosion hazards from soils and other sources, and potential interference from existing power cables and other buried services. In order to monitor the system, test point connections will be mounted on CP marker posts.

A close interval electrical potential survey of the pipeline will be undertaken as soon as possible after commissioning of the cathodic protection system, in order to validate and provide a 'finger print' of the cathodic protection system. The system will be revalidated at intervals not exceeding ten years.

IS 328 requires that the pipeline *'shall be tested at least every six months and the results recorded, to ensure that pipe to soil potentials are within specified limits and to detect any significant changes.'*

5.3.1 Control and Interface

The Corrib terminal near Bellanaboy Bridge is outside the scope of this EIS. Its function will be to regulate, condition and odorise the incoming gas from the Corrib Field, and transmit it at a maximum operating pressure of 85 barg to the Mayo-Galway pipeline. A pig trap, which will allow pipeline integrity gauges to be launched, providing feedback on various parameters in the linepipe, will form part of the main pipeline contract. At the interface between the terminal complex and the pipeline the outlet valve may be closed for emergency reasons by terminal staff. The status of the valve will be relayed by an electronic (SCADA) link to a BGÉ control room in Cork, and this valve will not be actuated without the agreement of BGÉ.

BGÉ will also maintain a control cabinet at the terminal, which will contain information gathering and transmitting equipment, such as modems, routers and computers, for interrogation of the Corrib Terminal Control System. BGÉ will have access to this equipment at all times, to ensure continuity of information and data flow. Communication between the control cabinet and BGÉ will primarily be by Eircom leased-line, but a backup radio link will also be provided.

The following information will be transmitted:

- Outlet Valve Status
- Outlet Gas Temperature
- Outlet Gas Pressure
- Station Gas Flow Rate
- Station Energy Flow Rate (the energy flow will be a function of the calorific value of the gas, and not just its volume)
- Station Energy Accumulated Flow
- Dry Gas Calorific Value at 15°C
- Relative Density at 15°C
- Odourant Injection Flow Rate
- Moisture Content

5.3.2 Above Ground Installations

The block valve stations along the route ensure that sections of the pipeline can be isolated for emergency containment or periodic maintenance. The number and location of these installations is influenced by the following criteria:

- Maximum allowable operating pressure
- Diameter of pipe
- The location of branches or off-takes with existing valves
- Emergency response
- The need for valves for operational purposes
- Local conditions

The site areas required vary between 3600 sq. m and 14400 sq. m; in general, if pressure

reduction and/or pigging is to be carried out at a particular AGI, a larger site area is required. They are usually located close to roads, for ease of access. They require planning permission for construction, and generally comprise a small single-storey control building within a fenced compound.

BV1 and BV2, located near Bellacorick power station and Castlehill respectively, will provide isolation facilities for the first two sections of the linepipe. There will also be provision for future connection with another pipe at these installations.

From BV2 southwards to the AGI near Craughwell, three fibreoptic ducts will be laid in the trench in parallel with the pipeline, to provide future communications flexibility. These ducts will be 50mm in diameter, and will require access chambers at intervals of approximately 2km (generally at road crossings).

BV3 is located near Clydagh Bridge and will facilitate offtake for Castlebar, as well as isolation of this section of the pipeline.

BV4 combines with a pigging station at an AGI south of Mayo village, a location approximately halfway along the route. There will be provision for a Claremorris offtake at this installation. Pigs that have been launched at the terminal near Bellanaboy Bridge will be received here, and the southern portion of the route will be pigged by launching here and receiving near Craughwell.

BV5 and BV6, the Tuam and Galway offtakes, are located near Cloonsheen and Grange West respectively. Again, their primary role is to allow portions of the pipeline to be isolated, for routine maintenance or in the case of an emergency.

The AGI near Craughwell forms part of the Gas Pipeline to the West project, and is generally outside the scope of this EIS. However, the pig trap and associated tie-in pipework will form part of the Mayo-Galway project. This will receive pigs launched from BV4, to clean and investigate the southern portion of the pipeline.

The locations of the block valves are shown in **Volume II**, Figure 5.1. Schematic diagrams of the combined block valve station and a pig trap station, and block valve station with provision for pressure reduction are shown in Figures 5.2 and 5.3.

In order to locate the pipeline and provide adequate warning for those working overground after reinstatement, permanent marking is necessary along the route. Bord Gáis Éireann require four different marker types, details of which are contained in their standard specification and drawings. The markers are:

- Marker Posts – located at every road, rail, ditch and river, to indicate the pipeline position
- Cathodic Protection Test Posts – located at every road, to allow the cathodic protection system to be checked
- Aerial Markers – located at every third ditch, to facilitate aerial monitoring along the pipeline route
- Aerial Dish Marker – located at major changes in pipeline direction, to facilitate aerial monitoring along the pipeline route.

6. CONSTRUCTION

Typical pipeline construction methods and sequences are outlined in this section.

6.1 Construction Strategy

The construction work is scheduled for the two-year period 2002-2003. Advanced preparatory work will be carried out first, on difficult terrain such as rock and bog. This may involve blasting and regrading rock, and constructing a road along the pipeline route in wet areas using aggregate or bog-mats. Then construction work will commence on other special locations and crossings, the full pipeline spread(s) being mobilised when the preparatory work is complete.

Prior to commencement of work, the contractor(s) will prepare method statements and works programs that will provide a more detailed breakdown of the phasing of the construction.

For the purposes of construction and supervision of construction, the pipeline will be divided into two parts with the dividing line located approximately 100m south of the N5 road near Castlebar.

The appointed construction contractor will develop a series of detailed construction method statements for the pipeline. This will incorporate the requirements of third parties; the mitigation measures outlined in this Environmental Impact Statement and the results of the site investigation surveys undertaken for the scheme. The construction methodology given in this EIS should therefore be regarded as indicative rather than absolute, unless stated otherwise.

The contractor will produce detailed method statements covering the construction of crossing of each river, stream, road and any archaeological and ecologically sensitive areas that may be identified as requiring a Method Statement. Each Method Statement will be agreed with the appropriate consenting authority. The contractor, in consultation with BGÉ, will also develop a Pollution Control Plan, a Contingency Plan and an Environmental Management Plan to control and monitor environmental performance throughout the project. A draft scope for these method statements was included in the contract document and is included in Appendix 6.1.

A construction management team will be employed by BGÉ to monitor the construction of the pipeline and audit against the method statements and other procedures. Agricultural Liaison Officers (ALO) have been employed for the duration of the project. Their function is to liaise with the landowners along the route and to ensure that their requirements are met. The entire workforce will be briefed about relevant environmental issues, including pollution control, before work begins.

Construction of the pipeline is planned for the years 2002 and 2003. Landowners/occupiers will be consulted on all relevant land drainage matters. Some reinstatement operations (e.g. hedgerow planting) may continue beyond October 2003, depending on weather and ground conditions.

6.2 Pipeline Construction Activities

Pipeline construction is a sequential process and comprises a number of distinct operations, which are described below. The rate of progress of each operation is dependent on a number of factors, including the ground conditions, the nature of the task and the weather.

6.2.1 Pre-construction Works

Ahead of construction, the route will be surveyed and pegged out in consultation with the landowner/occupier. This will establish the precise alignment, particularly in relation to field boundaries, mature trees and environmentally sensitive sites. Wherever practical and where there are no other overriding considerations, full use will be made of existing gaps in hedgerows and mature trees. Springs and seepage lines etc. will be avoided. Water supplies fed by springs or wells used for farming processes will be surveyed and monitored.

Where necessary, and subject to agreement with the landowner/occupier, new field drains will be installed either within the proposed working width or just outside it to:

- prevent possible waterlogging of the working width;
- enable the farmer's current drainage system to continue working throughout the period of pipeline construction;
- help prevent damage to the soil structure;
- aid recovery from construction activity.

The design of these drainage schemes will be agreed between BGÉ, the pipeline construction contractor and the land owners/occupiers. A specialist drainage contractor will carry out the work. Permanent records of the land drain locations will be made and passed to the landowner/occupier and at all times the works will be supervised by qualified, competent personnel.

6.2.2 Working Width Preparation

All construction activities will normally be undertaken within a fenced strip of land, known as the working width. This will generally be 30 m wide. The contractor may adopt a wider working width at road, rail, river, ditch, and service crossings to facilitate safe working and manoeuvring. An extended working width of 35 - 40m may also be utilised for the sections of the pipe line that cross areas of peat or moorland where this does not conflict with ecological considerations. Removal of hedges adjacent to roads will be determined by the need to gain safe access to the pipeline by vehicles carrying heavy plant, equipment and materials.

Existing third-party services will be located and marked. Warning posts will be erected for overhead cables and temporary crossing points indicated.

Drainage ditches will be flumed by the installation of temporary pipes and ramped over to create a continuous running track for construction vehicles and allow continuous flow of water within the ditch. Where necessary, a running track will be constructed of imported stone, which will be laid on geotextile sheet to facilitate its removal at the end of construction.

6.2.3 Fencing

The temporary working width will be clearly marked and stock proof fencing will be erected in areas grazed by livestock. The type of fencing will be agreed with the landowner/occupier and special arrangements, such as for horse fencing, will be made following consultation. Stiles or gates will be incorporated into the temporary fencing to maintain access to public rights of way and farm tracks. Where necessary, additional access points will be provided to allow landowners/occupiers access across the pipeline and thereby mitigate field severance.

The standard amount of dry-stone wall or hedge that will be removed at field boundaries will be a maximum of 30m, unless agreed and authorised otherwise. At mature hedge lines a maximum of 10-15m of the hedge will be removed. At road and track crossings a maximum of 30m of hedge will be removed and the crossing will be at right angles to the pipeline, wherever possible.

Where hedge lines are removed, particularly at road crossings, temporary, secure gates will be installed to prevent unauthorised vehicle access to the working area. These gates will be maintained by the contractor throughout the construction period and will only be open for access. They will be closed when there is no activity proceeding in that section and outside the normal working hours.

Temporary water supplies will be provided for livestock as necessary.

6.2.4 Topsoil Stripping

The topsoil will be stripped across the working width by appropriate earth moving equipment and stored carefully at one side of it (**Plate 6.1**). The topsoil stack will be typically 8m wide and up to 3m high. It will be kept free from disturbance to reduce the risk of physical damage and compaction. Generally, vehicle movements will be confined to the 'running track' on underlying subsoil.

Before topsoil stripping takes place, growing crops will normally first be removed. Following topsoil stripping, some areas of the working width may be benched or graded to enable safe working.

In areas of peat larger working widths may be required for the temporary storage of peat.

6.2.5 Temporary Access Roads

Temporary access roads between public roads and the working width may be required along the proposed pipeline route to aid the movement of machinery and materials, particularly where the ground is soft. Typically a temporary access road may consist of a thickness of crushed stone or sand overlaying a geotextile membrane.

6.2.6 Pipe Delivery, Stringing and Bending

Pipe will be shipped to Ireland, and delivered to pipeline storage depots by road. These depots will be located near Bellacorick Peat Power Station, close to Castlebar, and close to the N17 road.

The pre-coated pipe will be delivered to the working width from the depot by lorry and off-loaded with mobile cranes. Where the ground is suitable, pipe sections will be delivered to their final location along the working width to be stored on wooden skids along a line parallel to the trench line (**Plate 6.2**). If ground conditions are soft or rough the pipe will be off-loaded at designated crossings, and transported along the working width by specialised plant.

Where severe changes in direction take place, factory-manufactured bends will be installed. Wherever the bends are less severe, bending will be accomplished through the use of a pipe-bending machine at the pipe storage area or on site.

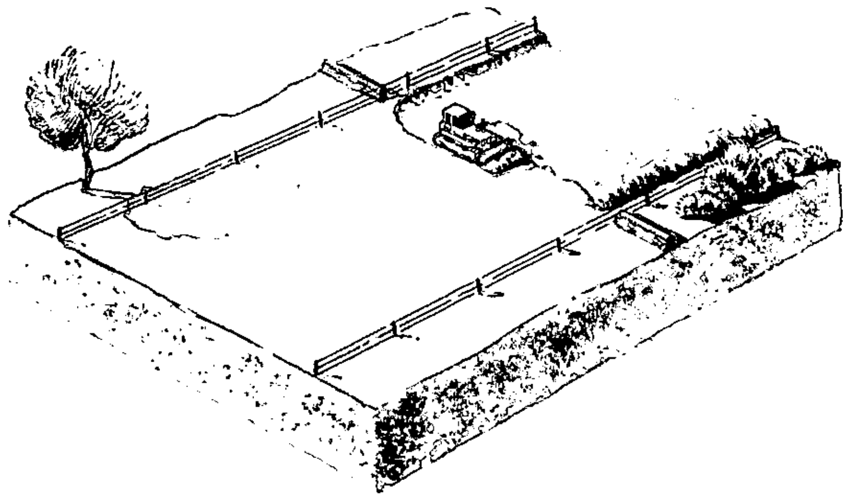


Plate 6.1: Topsoil Stripping

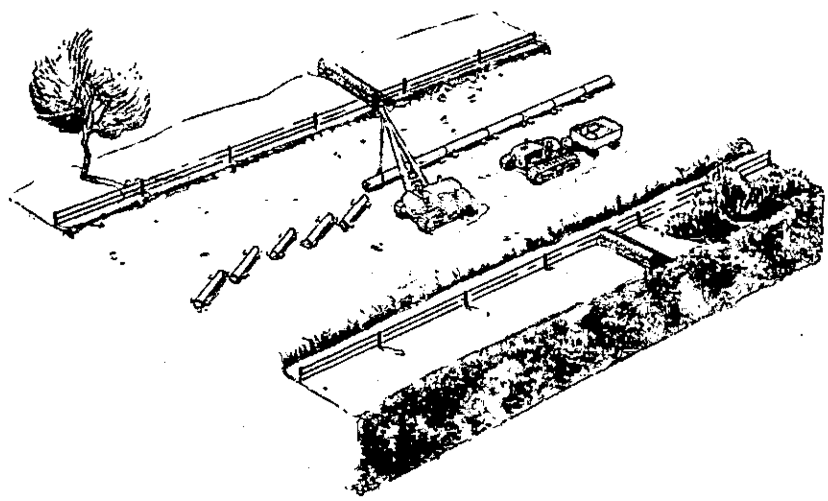


Plate 6.2: Pipe Stringing

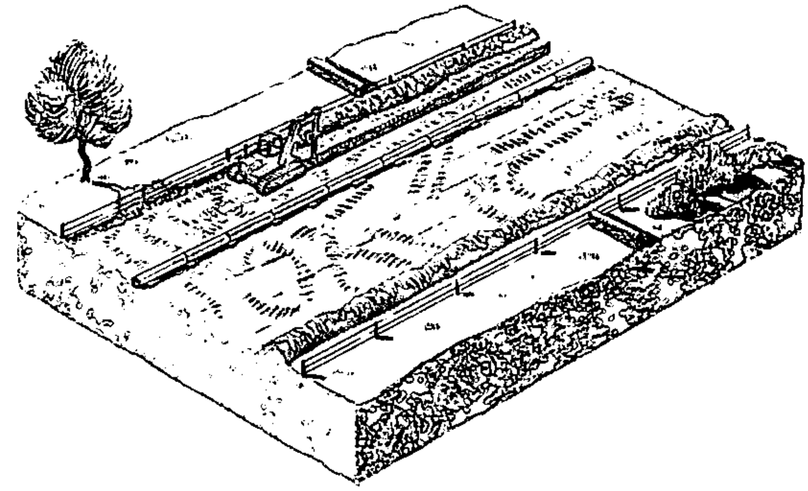


Plate 6.3: Trench Excavation

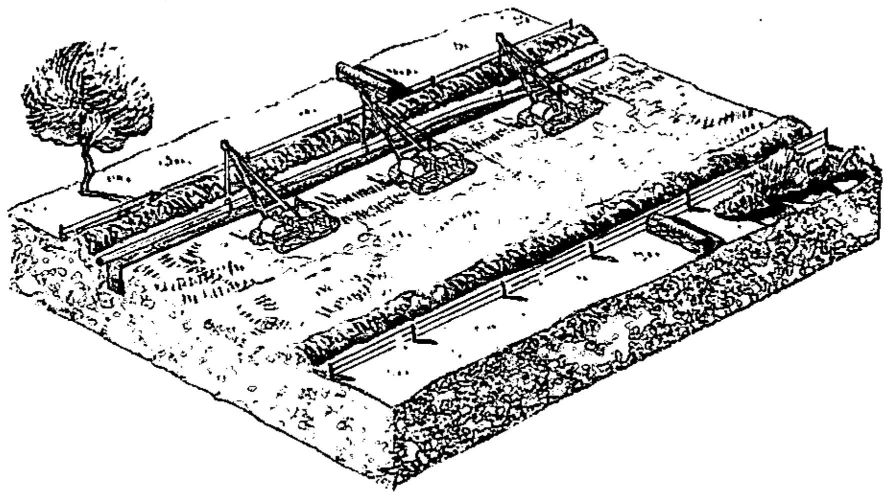


Plate 6.4: Pipelaying

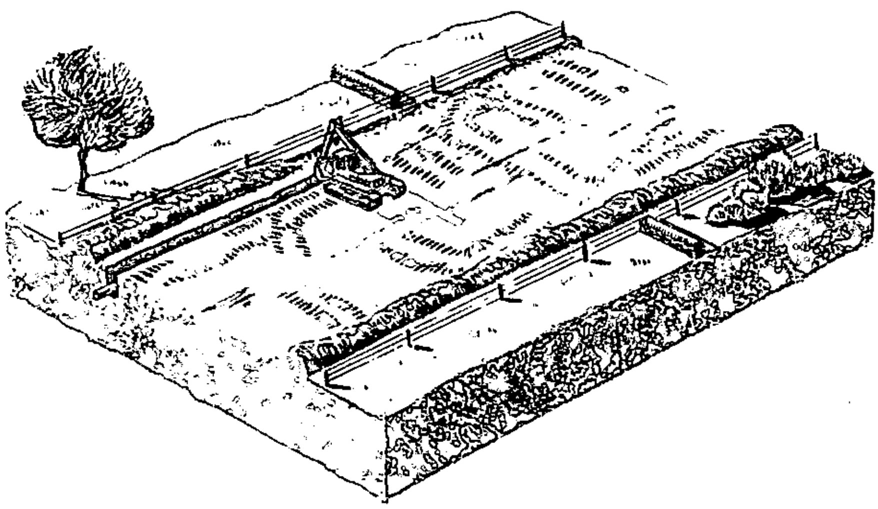


Plate 6.5: Backfilling

6.2.7 Welding, Non-destructive Testing and Coating

The pipe lengths will be delivered pre-coated externally with a 4mm polyethylene three-layer coating system. Following stringing, the pipeline sections will be welded together. All the welds will be radiographically tested and approved before an approved coating is applied on site to the weld area.

Only qualified and approved staff will undertake welding and testing.

6.2.8 Trench Excavation

In general, the pipe trench will be dug either with mechanical excavators straddling or running alongside the pipeline trench or using a specialised trenching machine (**Plate 6.3**). The depth will be variable but will allow a minimum reinstated cover of 1.2m over the top of the pipeline in agricultural land and 1.6m below the clean bed of streams and ditches.

In areas where rock is at or close to the surface, the trench will be excavated by blasting or using mechanical rock-breaking plant.

The material excavated from the pipe trench will be stored on the opposite side of the working width from the topsoil to prevent mixing of subsoil and topsoil, which might hinder reinstatement. In any areas of rock, the pipe may be bedded on, and surrounded by sand.

6.2.8.1 Excavation in Peat

Excavation in bog and peat areas presents particular challenges, the soft ground making conventional trenching methods impractical. Contractors typically adopt one of three methods:

- Self-Weight
- Pull Section
- Drill Through

The self-weight method would be carried out as follows: the bog is churned up and trenched along the route, and additional water pumped into the trench to stabilise the sides. The linepipe is then strung and welded over the centreline of the trench, laid on mats and skids. The skids and mats are then slowly removed, and the pipe filled with water. This will cause the pipe to sink to the bottom of the trench/churned up bog.

Pull section construction involves laying a cable along the route at the desired depth, and winching the pipe through. The first pipe length has a v-plate deflector to reduce friction, and additional sections of pipe are welded on as the pipe is winched forward. This is similar to the method used to construct a long crossing or landfall in water.

The third option, drill-through, is similar to pull-section in that a cable is laid along the route, and the pipe is winched through; but in this case, the cable route is pre-drilled.

The pipeline contractor will decide on construction methods for the wet areas, but will be required to prepare method statements for all such sections, demonstrating both the feasibility and the environmental suitability of the chosen method.

6.2.9 Pipe Lowering

Following trench excavation the welded pipe will be carefully lowered into the trench in a continuous operation (**Plate 6.4**). In rock or stony ground, the pipe will need protection from damage; either with heavy-duty polyethylene coating or sand bedding. In bog areas, a pipe-lowering method as described in 1.3.8.1 may be used.

6.2.10 Backfilling

The pipe trench will then be backfilled, where possible with the material taken from the trench in the reverse order in which it was excavated (**Plate 6.5**). Sand padding and surround may be used to protect the pipe if the backfill material is particularly stony and in areas of rock.

The backfilled materials will be consolidated by tamping or rolling. Any surplus material from trench excavation is normally spread within the working width. Any surplus is the property of the landowner/occupier who will be consulted together with the relevant County Council as appropriate before any offsite disposal is carried out.

Land drains will be reinstalled at this stage, prior to topsoil reinstatement, permanent fencing and the removal of flume pipes and bridges. All land drainage works will conform to the relevant local authority requirements and will be installed using specialist machinery.

6.2.11 Crossing of Rivers and Streams

The trenching methodology described above will be modified for road, railway, river, ditch, and service crossings. Typical methods of construction fall into two categories, open cut and non-open cut.

The adopted methods of construction will depend on the results of the site investigation and on the requirements of the appropriate authorities. The contractor's method will be subject to BGÉ's approval. On the basis of current assessments, the preferred method is open-cut techniques subject to agreements with the relevant County Council and Fisheries Board, suitability of ground conditions, and the implementation of stringent environmental controls.

6.2.11.1 Open Cut Crossings

One or other of the following two open-cut techniques may be employed for watercourse crossings.

Method 1

Most watercourses will be crossed using 'in river' works by means of an open cut trench, employing hydraulic excavators. Details of this method are outlined below:

- The site will be prepared by stripping the topsoil from all areas adjacent to the riverbanks and ramping the banks down to riverbed level. The stripped topsoil will be stacked separately from the subsoil within the working area.
- Excavation of the riverbed will then proceed and the excavated material stored adjacent to the trench, within the working area. The prefabricated pipeline section will then be installed in the trench and checked to ensure that a minimum cover of 1.6m exists below the clean hard bed of the river and the top of the pipe.
- Initial backfilling and final reinstatement will take place using the excavated sediment.
- The riverbanks are then reformed to their original profile to the satisfaction of the relevant County Council and Fisheries Board and the landowner/occupier. Any surplus excavated material will be removed from the site to an approved disposal facility.

Method 2

The alternative to in-river work is 'dry' open cut trench methodology. Water flow is maintained by diverting the stream away from the proposed crossing location. Details of this method are outlined below:

- The site will be prepared by stripping the topsoil from areas adjacent to the river crossing and storing it within the working area. Suitably sized flume pipes (size to be selected by the contractor in consultation with the relevant County Council and Fisheries Board) will be

- installed in the watercourse close to the proposed crossing, ensuring continuity of running strip.
- The temporary watercourse diversion is then excavated to the positive side of the pipeline spread, and flumed if necessary. De-watering and/or trench supports may be used to facilitate safe excavation. If pumps are used, the discharge hose will be directed through a filtering medium to limit silt carry over, before the pumped water is allowed to percolate back into the watercourse.
- The original watercourse is then dammed at both sides of the proposed crossing, creating a dry zone for trenching operations. The watercourse bed is trenched as described in section 6.3.8.
- The prefabricated pipeline section will then be installed in the trench and checked to ensure that a minimum cover of 1.6 m exists below the clean hard bed of the watercourse and the top of the pipe. The pipeline will then either be encased by a minimum of 150mm thickness of mass concrete or be protected by 150mm thick concrete protection slabs.
- Initial backfilling will take place using excavated subsoil free of large stones or other deleterious material. Final reinstatement will use the stored river bed materials.
- The riverbanks will then be reformed to their original profile to the satisfaction of both the relevant County Council and Fisheries Board and the landowner/occupier. Final riverbank reinstatement may require importation of locally sourced large stones or rocks to stabilise the banks and prevent erosion. Any surplus excavated material will be removed from the site to an approved disposal facility.

To ensure environmental protection of all the watercourses within the preferred corridor, all mechanical plant and equipment will be fuelled and serviced at locations remote from the watercourse. Pumps and other mechanical plant will be fitted with drip trays and absorbent material will be available to mop up any spillages. In the event of a spillage, all contaminated material will be removed from the site to an approved disposal facility.

6.2.11.2 Non-open Cut Crossings -Optional

Auger boring, pipe jacks and concrete tunnels require deep excavations on either side of the crossing to aid the installation of the pipeline. De-watering, sheet piling and other techniques are generally used to enable excavations and construction techniques to be carried out in accordance with the relevant health and safety regulations.

Horizontal Directional Drilling (HDD)

With horizontal directional drilling (HDD), the pipeline is bored under the crossing (i.e. river crossings) to emerge at a target point on the opposite bank. This is a method that has been used on many pipelines to cross beneath areas where conventional construction methods may cause damage, or where access is severely restricted.

The first stage is to drill a pilot hole using drilling rods. As the drilling proceeds, a drilling fluid comprising water and bentonite (a naturally occurring clay mineral) is pumped down the centre of the hollow drill rods. This will lubricate the drilling rods, balance the groundwater and earth pressures and pick up cuttings, before returning to the surface, via the drill hole. The drill fluid is then filtered to remove the cuttings and returned to temporary mud storage tanks for reuse. The position and progress of the drill head is monitored and controlled from the surface using electromagnetic detection equipment.

Drill fluid usage will be monitored at the surface to confirm no significant losses are occurring. Bentonite mud is normally recommended for drilling through groundwater, because it is non-toxic. The composition of the bentonite, the use of any additives and its disposal, will be agreed with the relevant authorities prior to construction.

After the pilot hole is drilled, reaming devices are attached and pulled back through the borehole to enlarge it to the required diameter. Bentonite is injected around the reamer to coat the borehole. It is a thixotropic material and will support the sides of the hole ready for the pipe

to be pulled through.

Finally sections of pipeline are laid out on the opposite bank ('strung') in a straight line, and welded together and coated before being pulled back through the borehole in one continuous length. This minimises the risk of it becoming stuck during the pull.

There is a technical requirement for the drilling mud to be returned from the stringing side to the drilling side during reaming and pullback operations for reprocessing and re-injection. The options for undertaking this operation are:

- option 1: laying a small diameter temporary pipeline (welded steel or polyethylene) across the river bed;
- option 2: using vacuum trucks, to tanker the mud from one side of the river to the other;
- option 3: drilling a second pilot hole and pulling the mud return line through it.

Provided it is technically possible, option 1 is preferred.

Microtunnelling

Microtunnelling may be required for some of the crossings. This is a method that has been used on many other pipelines to cross beneath difficult areas for construction.

Pre-cast concrete jacking pipes are placed behind a microtunnelling machine with the excavated material being removed via the tunnel entrance.

The method involves the use of a cutting head lubricated with water. Small quantities of bentonite may also be used to reduce friction. The composition of the bentonite will be agreed with the relevant authorities prior to construction. The drill fluid is returned to the surface where it will be filtered to remove the cuttings and returned to temporary mud storage tanks for re-use.

Equipment associated with microtunnelling will include a power unit, one or two storage tanks for cuttings, separation plant and an operation board.

Used drilling fluids will be sampled, analysed and disposed off-site to a licensed waste disposal facility.

Auger Boring

This requires deep excavations on either side of the crossing to aid the installation of the pipeline where required. De-watering, sheet piling and other techniques are generally used to enable excavations and construction techniques to be carried out in accordance with Health and Safety Regulations.

A combination of rotation of the auger drill within the pipe string and a winch located on the front of the power unit installs the pipe string with the excavated material being drawn from the cutting head, down the auger drill flutes exit from the rear of the pipe string. Additional land will be required on both sides of the crossing to accommodate the additional excavated material from the pits and the auger.

However, the actual design will be submitted to the appropriate body for approval prior to construction.

Concrete Tunnel

There are two principal methods of installing a concrete tunnel:

Pre-cast concrete segments can be installed behind a protective shield, in which the tunnel is driven forward either by normal mining techniques or a tunnel boring machine, with the excavated material being removed via the tunnel entrance.

Alternatively, pre-cast concrete rings can be installed behind a protective shield and driven forward by a combination of normal mining techniques and hydraulic jacks, with the excavated material being removed via the tunnel entrance.

Surveyors check the line and level of the tunnel to ensure correct location and depth. The concrete tunnel will be of a larger diameter than the pipe, which is welded up and then installed on supports in the tunnel either as a pipe-string or one pipe at a time. After installing the pipe the annulus between the carrier pipe and the tunnel will be filled with grout and the tunnel sealed.

Pipe Jack (carrier pipe)

This construction method is generally used on large diameter pipes and involves the carrier pipe itself being installed behind a protective shield using a combination of normal mining techniques and hydraulic jacks to drive the pipe forward, with the excavated material being removed via the exposed end of the pipe. As each pipe progresses forward then another is welded on and in this manner the pipe is installed.

It should be noted that all of the construction techniques briefly described above will be subject to suitable ground conditions, a site investigation, the requirements of the consenting authority for each crossing and the appropriate health and safety and environmental legislation.

6.3 Pipeline Way Leave Reinstatement Proposal

The effective reinstatement of the 'way leave' following the temporary disturbance caused by the construction process will ensure that the environment will be returned to its natural state as quickly as possible.

After reinstallation of the land drains and regrading of the working width to reflect the original profile, suitable surplus subsoil will be spread on a field by field basis, ripped where necessary and stones and debris will be removed prior to topsoil replacement. After replacement, the topsoil will be stone picked and cultivated as necessary.

The working width fencing will be removed to suit the landowners/occupiers requirements. Generally on arable land the fences are taken down to allow the cultivation of the field as a whole, whereas on permanent pasture the fences are retained in order to restrict access to livestock until the reseeded sward has sufficiently recovered to withstand grazing pressures. These procedures will be agreed with the landowner/occupier before work begins.

All materials related to the construction work, including imported fill, temporary culverts and geotextile membrane will be removed on completion of the work.

Where necessary, additional or replacement land drains will be installed in the working width. In some places, this work may be carried out following topsoil replacement.

Particular attention will be paid to the careful replacement of field boundaries to reduce the visual impact (**Section 15**). Fences will be reinstated to meet the landowner/occupier's requirement using materials that match the existing fence where appropriate. Dry stone wall and earth bank field boundaries will be reinstated to match the existing boundaries. Hedgerow sections that are removed will be replanted using a suitable mix of native species. Replanting will be undertaken using either container grown stock or quality open grown stock, and followed by good maintenance and weed control. All replanted hedgerows will be protected with either rabbit-proof fencing or individual guards to protect the new growth from grazing and browsing animals. Detailed mitigation measures for hedgerows are discussed in **Section 15.5**.

River corridor vegetation will be reinstated according to the requirements of the relevant County Council and Fisheries Boards. If necessary, vegetation will be transplanted and stored prior to reinstatement (**Section 10**).

6.4 Health and Safety Aspects

The Health and Safety Authority (HSA) is the governmental agency responsible for implementation of the Health and Safety Regulations in Ireland. These Regulations require that Project Supervisors be nominated for the Design and Construction Stages. On completion of design and construction BGÉ will have responsibility for implementing a strict health and safety policy for the operation of the gas transmission system.

Arup Consulting Engineers are the nominated Project Supervisor (Design Stage). This role is defined under the 1995 Safety, Health and Welfare at Work (Construction) Regulations, and requires the designer to:

- Design to avoid risks to health and safety
- Tackle the causes of risks at source, or if that is not possible
- Reduce and control the effects of risks by means aimed at protecting anyone at work and the general public who might be affected by the risks and so yielding the greatest benefit.

On award of the construction contract(s) the Project Supervisor (Construction Stage) will be nominated. The responsibilities of the Project Supervisor during construction include the co-ordination of the features listed below to ensure no compromises are made which might jeopardise the safety of employees, contractors, or the public:

- construction work on site;
- hazardous materials and chemicals;
- operating procedures;
- work permits;
- emergency response.

The health and safety performance of the contractors will be the subject of regular reviews by BGÉ.

The contractor will be required to ensure that the fibre optic cable is stored, handled and laid in accordance with best practice.

6.5 Pipeline Testing

6.5.1 Pressure Testing Procedure

On completion of the construction of the pipeline, a 'proof test' of the pipeline will be carried out to demonstrate fitness for purpose. This will take the form of a hydrostatic test, which involves filling the pipeline completely with water and raising the pressure to 150% of its maximum operating pressure for a 24-hour period.

The pipeline may be tested in a number of separate sections, which will be determined by the topography of the pipeline route and sources of water for the hydrostatic test. The number of sections requiring testing and the source of the water will be considered further at the detailed design stage.

Before hydrostatic testing, the pipeline will be cleaned and internally checked using air or water-driven pipeline integrity gauges (PIG).

6.5.2 Solid Emissions

Typical solid wastes arising from the pigging operation will be mill scale, weld splatter, rust and other such debris. Arrangements will be made at the test locations to contain and collect this waste for subsequent disposal to an appropriately licensed facility, (**Section 18**).

6.5.3 Liquid Emissions

After successful cleaning, the pipeline will be filled with water and pressurised for the designated test period. The pipeline is then depressurised under controlled conditions and the water discharged. All abstractions and discharges of water will be subject to consent from the relevant authority. Prior to discharge, the water will be analysed to check quality. Filters and break tanks will be used to control the rate of discharge and remove any solids.

6.5.4 Noise

Noise from pipeline testing is mainly associated with the pumps and compressors needed to fill and pressurise the pipeline at the test ends. Typical noise values for testing equipment are given in **Section 17**. The noise from testing operations shall not exceed a limit of 70dB(A) at a distance of 1m from source.

The venting of air from the pipeline during pigging operations will also generate noise. At various stages of the testing operation it will be necessary to vent air from the pipeline. Venting will take place over relatively short periods of time, but it can give rise to high noise levels. In order to minimise disturbance, whenever possible venting will only be carried out during normal working hours or through silencers. The contractor will consult local residents prior to venting taking place.

6.6 Commissioning

On completion of hydrostatic testing and the discharge of test water, the test sections will be swabbed to remove residual water by passing through specially designed pigs propelled by compressed air. The separate test sections can then be welded together to form a complete length of pipeline.

It is important at this stage to remove all traces of water to ensure dry gas is transported on commissioning. A process called vacuum drying, which will be carried out by a specialist contractor, achieves this. It involves reducing the pressure within the pipeline by gradual removal of air using a vacuum pump. This lowers the boiling point of the residual water causing it to vaporise and hence be removed.

When this is achieved, the pressure in the pipeline can be equalised by the use of dry air or nitrogen. After drying, the pipeline will be filled with nitrogen prior to being commissioned with natural gas.

It is anticipated that testing and commissioning of the entire pipeline and facilities will be completed by late autumn 2003.

7 PIPELINE OPERATIONAL ASPECTS

7.1 Operation Regulations

This section describes BGE's standard procedures for operating their transmission system which will be followed for operating the Mayo - Galway pipeline.

7.2 Operating Procedures

BGE's standard operating procedures comply with the requirements of IS 328 'Code of Practice for Design and Installation of Gas Transmission Pipelines' 1989. The operating procedures will include the following:

- an administrative system covering legal considerations, work control and safety;
- clear and effective emergency procedures and operating instructions;
- adequate and regular training of all personnel involved in operational and maintenance matters;
- a comprehensive system for monitoring, recording and continually updating the state of the pipeline and auxiliary equipment;
- a Permit to Work system to control all work adjacent to the pipeline or work which might interfere with gas flow;
- a schedule for the regular inspection and maintenance of pressure regulating equipment, pipework and ancillary devices to promote a high level of reliability and safety in operation;
- effective corrosion control and pipeline condition monitoring;
- a system to collect and collate information on third party activities to reduce the risk of pipeline damage;
- regular contact with owners and occupiers of the land through which the pipeline passes;
- monitoring of land restoration and crop losses, and the undertaking of remedial land drainage works where necessary.

7.3 Condition Monitoring

7.3.1 Pipeline Integrity Monitoring System (PIMS)

BGÉ will also be responsible for the operation, maintenance and condition monitoring for the pipeline. The integrity monitoring system will be provided in order to minimise the consequences both to the population and the environment in the event of a pipeline failure. In the design of the system, due consideration is given to the nature of natural gas, the variability of the operating conditions and the availability and suitability of modern systems to detect pipeline problems.

The system provides a modern computer-based pipeline integrity system, which will continuously monitor the pipeline and provide an indication of a gas release based on Transient Wave Analysis or mass balance.

The computer will continuously run a dynamic mathematical model of the pipeline and compare it with the actual measurements obtained from the pipeline. The mathematical model will compute the amount of gas that is contained within the pipeline by reference to its pressures, temperatures and the gas flow into and out of the pipeline. It will be caused by changes in the operating conditions and those created by any abnormal gas release. The model will also provide validation of all instrumentation inputs to prevent mal-operation caused by erroneous information.

Detection of a validated gas release will be indicated to the operator in the control room via an alarm. In line with written procedures, BGÉ will then isolate the pipeline at suitable locations. Once isolated the gas pressure decay checks will confirm in which section of the pipeline the leak is occurring. The pipeline will remain isolated until the cause of the gas leak is fully investigated by operational staff and the corrective action has been implemented.

7.3.2 Corrosion Protection

As described in Section 5, the pipeline will be provided with a cathodic protection system. A close interval electrical potential survey of the pipeline will be undertaken as soon as possible after commissioning of the cathodic protection system, in order to validate and provide a 'finger print' of the cathodic protection system. The system will be revalidated at intervals not exceeding ten years.

IS 328 requires that the pipeline 'shall be tested at least every six months and the results recorded, to ensure that pipe to soil potentials are within specified limits and to detect any significant changes.' BGE's standard procedure comply with this requirement.

7.3.3 On-line Inspection

On-line inspection involves passing an inspection device, known as an intelligent pig, through the length of the pipeline. This device records, describes and sizes any pipeline defects and locates them with a high and consistent degree of accuracy.

As soon as possible after commissioning, there will be a complete run through the pipeline by an intelligent pig in order to produce a 'finger print' record of the initial condition. Subsequent runs, which will take place at regular intervals, will compare the information recorded against the 'finger print' to give an indication of deterioration.

During operation, on-line inspection will highlight deterioration in pipeline integrity, and if deterioration is observed appropriate action will be taken in order to maintain security of supply and adequate levels of safety.

7.4 Maintenance Requirements

In order to operate the pipeline with the minimum of disruption to the environment through which it passes, a BGÉ representative will act as a long-term contact with the farmers along the route. This will ensure that changes of ownership or occupancy are recorded, that the occupier is aware of the presence of the pipeline and that discussions can take place with regard to any work which might affect the pipeline. The BGE liaison officer will also consult with other contractors or utility companies working in the vicinity of the pipeline.

7.4.1 Basic Records

Work programs and maintenance schedules will be substantially completed at the time of commissioning, which will incorporate:

- production records and certification of all pipeline materials
- grade and wall thickness of linepipe, carrierpipe, sleevepipes and heavywall pipe where used
- protective materials used
- logging of soil strata
- precise line and depth at frequent intervals, particularly at road, rail, river and service crossings

- location, type and depth of land drains
- location of underground services
- crossings of streams, ditches and any other relevant information that is not readily obtainable by surface inspection
- longitudinal profile of the pipeline
- archaeological details
- names and addresses of landowners and tenants and their easement boundaries
- details of surface installation, cathodic protection, test posts, area markers, etc.
- detailed drawings of all BVIs, AGIs, special crossings and locations of other services where required for special consideration.
- a schematic drawing showing off-takes, identification of valves and the volumetric capacity of sections between BVIs.
- a record of all air and hydrostatic tests carried out together with any certificates
- maps showing location and details of all CP installations (locations of test stations, rectifiers, ground beds, galvanic anodes, isolation joints, automatic switches, and anodes)
- design criteria
- quality assurance of materials to IS 300 or equivalent

7.4.2 Organisation

BGÉ will expand its operations and maintenance organisation to cover the operations and maintenance of the pipeline.

Typically, BGE operate a 'Permit to Work' system for all pipeline operations that may interfere with gas flow or create hazardous conditions. The number of persons authorised is kept to a minimum. BGÉ also operates a 'Master Key' system for locking valves, gates, site buildings and instrument panels.

The pipeline will also be subject to routine surveillance. The route will be flown at regular intervals to check on any possible third party interference or for work being carried out in close proximity to the pipeline. The surveillance can also be used to check on the condition of the reinstatement of land affected by the pipeline.

The route will be walked periodically to enable close inspection of the pipeline, corrosion protectors and marker posts and to identify any problems with reinstatement such as failed hedge planting or drainage problems.

7.5 Risk Assessment/Pipeline Safety

The pipeline will be designed, constructed and operated in accordance with the IS 328 'Code of Practice for Design and Installation of Gas Transmission Pipelines' 1989. The Code defines minimum distances for the pipeline from normally occupied buildings, based on operating pressure and pipewall thickness. The proximity requirements for the Mayo-Galway pipeline are 70m for standard pipeline, and 3m for heavywall pipeline. Safety during construction of the proposed pipeline is dealt with further in Section 6.5.

7.6 Decommissioning Methods

At the end of its useful life, the pipeline and associated facilities will be decommissioned safely, with due regard to environmental protection. The pipeline will be decommissioned, emptied of natural gas, purged (usually with nitrogen) and left capped and cathodically protected. Where the need arises, sections will be solidly grouted or removed.

8 PLANNING, POLICY AND LAND USE

8.1 Introduction

This section considers the proposed pipeline development in the context of relevant regional and national policy guidelines and plans and the policies and objectives of the statutory development plans for Counties Mayo and Galway, through which the pipeline passes. The section also considers the likely land use impacts of the proposed pipeline.

8.2 National and Regional Planning Context

8.2.1 Government Guidelines

Current planning philosophy generally places strong emphasis on the need for 'sustainable planning and development' and in this regard, an increasing volume of Government policy directives, guidelines and European Union policy is informing planning policies.

The National Sustainable Development Strategy – 'Sustainable Development – A Strategy for Ireland' issued by the Department of the Environment and Local Government in 1997 sets out the Government policy of encouraging more sustainable development in all sectors. This document is referred to further in Section 3.

The National Climate Change Strategy was published by the Government in 2000. This strategy supports the development of indigenous gas supplies. Refer to Section 3 for a discussion of this issue.

The Department of Public Enterprise published the 'Green Paper on Sustainable Energy' in September 1999. The report predicts:

'a dramatic increase in the contribution of natural gas to the electricity supply mix'

From a base of 30% in 1998, natural gas is projected by 2010 to account for 56% of the fuel mix for electricity generation. In the context of increasing dependency on natural gas in power generation, the Government's Green Paper concludes that measures such as liquid natural gas storage and pipeline construction will be required to protect the security of supply to the national gas network.

8.2.2 European NUTS II Regions - Objective 1 and Objective 2

The Republic of Ireland is divided down into two regions – the Southern and Eastern Region (S&E region) and Border, Midland and Western Region (BMW region) – NUTS (nomenclature of territorial units for statistics) II Regions, for EU structural Fund purposes. The BMW Region contains Counties Mayo, Galway, Sligo, Roscommon, Leitrim, Donegal, Monaghan, Cavan, Longford, Westmeath, Laois, Offaly and Louth and is classified as an Objective 1 region within the European Union. This means that development in the area is considered to be lagging behind in terms of social and physical infrastructure, and qualifies for the maximum allocation of Structural and Cohesion funds from the EU.

As illustrated in **Figure 8.1 (Volume II)**, the existing gas network does not extend to the midlands or the west of the country and is almost exclusively within the south and east region. Only a small part of the network, which serves Dundalk and Drogheda in County Louth with a spur to Baileborough in County Cavan, is in the BMW region.

The current proposal and other planned extensions to the national network as outlined above will provide an opportunity for many areas in the BMW region to be connected to the national gas network. In addition the installation of fibre optic cabling with the pipeline will extend the

broadband data network to the BMW Region.

8.2.3 The National Development Plan 2000-2006

The National Development Plan 2000-2006 proposes an investment of over £40 billion in the period 2000-2006. This investment is broken down by region in line with the NUTS II Region designation of Ireland as outlined above. The National Development Plan investment strategy places a strong emphasis on underpinning the economic success of recent years and seeks to redress the regional disparities in economic wealth between and within the regions.

A total of £13.562 billion is to be spent in the BMW region through the various sectoral programmes, with almost £6 billion to be devoted to Economic and Social Infrastructure. No specific mention of natural gas infrastructure is made.

Development of advanced telecommunications is an objective of the plan, to support the accelaration of the information society and e-commerce. Provision of fibre-optic cable in the pipeline trench will help achieve this objective in the BMW region.

8.2.4 'National Investment Priorities for the period 2000-2006'(ESRI)

As part of the preparations for the National Development Plan, the Economic and Social Research Institute (ESRI) produced a report entitled: 'National Investment Priorities for the period 2000-2006'.

In general terms, the report recognises that commercial pressures, combined with the need to meet environmental standards, have raised the dependence on gas which in turn has raised issues concerning security of supply and delivery of gas and electricity in Ireland.

This report identifies that the rapid growth in the economy will require considerable investment in the electricity and gas industries over the coming decade.

The ESRI report also recognises the importance of the Corrib Gas Field and specifically in relation to the proposed new gas field states:

> *'In the case of gas major investment in transmission will be needed in the next planning period. This new investment will be needed to cater for increased demand, especially from the electricity sector. However, the potential gas find off the West Coast gives rise to considerable uncertainty as to what is the best way to proceed.*
>
> *While it had been proposed to possibly extend the availability of gas into the West it is clearly inappropriate to do so at present. As mentioned above, the prospect of a gas find off the West Coast leaves open the possibility that such an extension could be carried out quite cheaply. In the absence of such a find it would appear that such an extension would not be justified on cost grounds, as it would absorb scarce resources which would be better spent in promoting regional development in other ways. Certainly the prospect of a new find makes the option value of delaying any decision on a further extension very high.*
>
> *Depending on the outcome of exploration off the West coast there is likely to be a need for further pipe-lines to the north and to Britain (or even the continent) to ensure adequate supplies in the future...(page 250)*

The proposed Mayo-Galway pipeline will have clear benefits in terms of:

(a) meeting the national demand for gas and electricity and reducing the need to import natural gas;

(b) supplying natural gas to the west of Ireland where this would otherwise not be an economically viable option.

8.3 Regional Planning Context

8.3.1 'The Border, Midlands and Western Region - Development Strategy 2000-2006'

'The Border, Midlands and Western Region - Development Strategy 2000-2006' Report (April 1999) was prepared for the Regional Authorities as '*a single prioritised strategic plan*' for the BMW region as an input to the proposed National Spatial Strategy.

Section 5.7.2 of this report - Regional Priorities - refers to major natural gas projects including extending the natural gas network to the Midlands and West.

The Report states:

Major Extension to the Midlands and West.

One of the key priorities for the energy sector in the Programme for Government 'Action for the Millennium' is to extend natural gas as far as practicable to major towns and cities. Bord Gáis has a statutory obligation to develop and maintain a system for the supply of natural gas on a commercial basis. Any proposals for the extension of the gas network are to be assessed by Bord Gáis in light of that obligation. The Proposed extension would provide gas to Mullingar, Athlone, Ballinasloe and Galway (and to Ennis and Shannon). Studies by Bord Gáis have indicated that the extension of the network into many towns would not provide a positive return on investment. However, the extension of the network would give residents, industry and enterprise the same choice of fuels as is now available in the areas served by the existing network.

The location of the proposed pipeline makes the introduction of gas supply to areas in the west of Ireland a more feasible proposition. It will be significant in terms of its impacts on the economic and social development of the west of Ireland and County Mayo, in particular.

The National Spatial Strategy will form the central thrust of Government policy to achieve more balanced regional development. It will highlight a number of options and choices with regard to broadband communications. The provision of fibreoptic cabling in parallel with the pipeline will help rebalance the regional disparity in this area.

8.4 Impact of the proposed Pipeline on Strategic National Planning and Regional Development

The west of Ireland has a clear infrastructure deficit at present, in terms of energy infrastructure as well as in other areas.

As outlined in the ESRI report - '*National Investment Priorities for the period 2000-2006*' - the current proposal to construct a pipeline to bring natural gas from the landfall at Broadhaven increases the economic feasibility of extending the gas network into the west and particularly into areas such as County Mayo which are otherwise unlikely to benefit from this resource.

The introduction of natural gas may contribute to the regional development of the western region and County Mayo, in particular, by acting as a catalyst to economic development and encouraging investment in industry and commerce by providing a greater choice of fuel.

In line with the '*National Development Plan 2000-2006*', the upcoming National Spatial Plan is likely to emphasise the need for greater equality between the regions by promoting the development of strategic infrastructure in the 'Objective 1' areas.

The proposed pipeline will facilitate a natural gas connection to the 'Regional Growth Centres' of Galway and Sligo as well as the proposed 'Smaller Growth Centre' of Castlebar (in line with '*The Border, Midlands and Western Region - Development Strategy 2000-2006*' report). The economic competitiveness of these centres will be significantly improved by the provision of a natural gas supply.

Other urban centres such as Ballina, Westport, Claremorris, Ballinrobe, Tuam and Athenry could

also benefit and there would inevitably be spin-off benefits for the associated rural hinterland areas. There would be indirect benefits to areas outside the corridor of the current pipeline, which are currently on the network or which are proposed for connection, through an increased security or supply to the national grid from the Corrib Field.

In the event of further natural gas finds off the west coast, the proposed pipeline could facilitate the connection of these supplies to the national network bringing further benefits of regional and national significance.

8.5 Local Statutory Development Plan Context

The route runs through the administrative areas of Counties Mayo and Galway.

The pipeline route has been assessed in the context of the county development plans of these counties to determine the likely impact of the development on Local Authority planning policies and development control objectives generally, on specific policies or objectives and on the proper planning and development of the area.

The assessment of the Development Plans reviews the Development Objectives outlined in the Plans and identifies where impacts on these objectives are likely or possible. Various environmental impacts (e.g. cultural heritage, flora and fauna, air, climate and the landscape) are considered elsewhere in this Environmental Impact Statement.

8.5.1 Mayo County Development Plan, 1992

The Mayo County Development Plan, 1992 is the current statutory Development Plan for County Mayo.

A series of maps contained in the 1992 Mayo County Development Plan illustrate a number of Development Objectives relating to areas to be protected, preserved, enhanced or developed for various uses.

Table 8.1 below summarises the likely impact of the proposed pipeline on these elements of the Plan.

Table 8.1: Mayo County Development Plan 1992 - Maps 1 -12, Infrastructure, Resources and Development Control Objectives

Development Objective	Map	Impact
Physical and Administrative Boundaries	1	None
Road Classification	2A 2B	Temporary impact on use of secondary and third class roads during construction phase may occur. Not significant.
Transport Services	3	Possible impact on transport services as a result of road crossing construction may occur. Not significant.
State Forests	4	The pipeline traverses some state forests, particularly at the northern end of the route. Not significant.
Commercial Turf and Sand and Gravel	5	The pipeline crosses worked-out areas of bog at Bellacorick. No significant impacts anticipated
Minerals Prospecting	6	None
Aquaculture Areas	7	None
Forest and Wildlife Areas	8	Refer to Section 9. No significant impacts anticipated
Scenic Views	9	Impact on 'Scenic Views' is possible from some minor roads (R315, R310, R312) during construction and reinstatement phases. No impact on 'Highly Scenic Views' identified or from 'Viewing points' shown on Map 9. No long term impact.
Areas of Special Scenic Importance	10	Minor impact on views during construction and reinstatement phases is possible where the pipeline route traverses Areas of Special Scenic Importance to the west of Lough Conn. No long term impact.
Areas of Special Recreational Importance	11	No significant impacts anticipated.
Controlled Roads	12	Temporary impact on use of Controlled roads during construction of the road crossings may occur. Not significant

As the above assessment illustrates the only potential impact in the current context relates to '*Scenic Views*' and '*Areas of Special Scenic Importance*' and impacts associated with road crossings.

These are moderate temporary impacts, confined to the construction and reinstatement phases and will cease once reinstatement is complete.

8.5.2 *Galway County Development Plan*

The Galway County Development Plan, 1997-2002 is the current statutory Development Plan for County Galway. **Table 8.2** below summarises the likely impact of the proposed pipeline on elements of the Plan outlined in the 'Extract of Maps' Volume of the Galway County Development Plan.

Table 8.2: Galway County Development Plan 1997 - Impact on Development Objectives as outlined in 'Extract of Maps'

Description	Maps	Impact
Land Use and Development Control Objectives for: Oughterard, Spiddal, Moycullen, Barna, Oranmore, Claregalway, eastern Environs and Portumna	1-9	Pipeline Route not affected
Specific Roads Objectives	10	Pipeline Route not affected
Village Plan Boundaries	11	Pipeline Route not affected
Areas of Recreational Amenity - Galway West	11a	Pipeline Route not affected
Areas of Recreational Amenity - Galway South	11b	Pipeline Route not affected
Galway City Environs	12	Pipeline Route not affected
Gaeltacht Areas	13	Pipeline Route not affected
Areas with vulnerable aquifers	14	Pipeline Route not affected
Natural Heritage Areas Proposed and Candidate Special Areas of Conservation - an Overview	15a	Pipeline Route not affected
Natural Heritage Areas Proposed - Detailed Map	15b	Pipeline Route not affected
Areas of Scenic Amenity - Galway West (Part 1)	16a	Pipeline Route not affected
Areas of Scenic Amenity - Galway West (Part II)	16b	Pipeline Route not affected
Areas of Scenic Amenity - Galway South (Landscape Classifications) - Outstanding Scenic Amenity Areas (OSAA) - High Scenic Amenity Areas (HSAA)	16c	Pipeline Route not affected

As **Table 8.2** illustrates, there will be no significant impact on any of the above objectives of the Galway County Development Plan.

8.6 Summary

The existing Bord Gáis Éireann network is confined to the more urbanised and industrialised areas in the south and east of the country; however there are proposals to extend the existing network to Galway, Ennis and Limerick. The less developed urban / industrial base in the west, however, means that in the absence of the Corrib reserves coming ashore at Broadhaven, it is unlikely that there would be sufficient demand to justify an extension to serve County Mayo.

The current pipeline proposal will be a considerable addition to the economic infrastructure of Counties Mayo and Galway and the Border, Midlands and Western Region. The availability of natural gas and fibre optic broadband data links in the West will help to act as a catalyst to economic development, which in turn will help to redress regional economic imbalance, which is an objective of the current National Development Plan. There are considerable national economic benefits also arising from the security of gas supply to the national power-generating network.

The pipeline has been routed so as to avoid built-up areas and features of amenity, ecological, scientific or archaeological interest and is consistent with the policies and objectives set out in the statutory Development Plans for County Galway and County Mayo.

9 TERRESTRIAL HABITATS & SPECIES

9.1 Introduction

This section presents the results of a desk study and field surveys of the route of the proposed pipeline from the Bellanaboy Bridge reception facility in north Co. Mayo to Craughwell, Co Galway. The aim of the study and surveys was to assess the likely potential impact of the proposed pipeline development on habitats and species. The study identified sites or features close to the proposed pipeline route, which are likely to be of scientific interest and/or conservation value, and investigates the presence of protected species of plants and animals along the route. These findings have been used to identify mitigating measures to reduce the impacts of pipeline installation.

During the pipeline routing process, (**Section 4.2**) emphasis was placed on avoiding designated nature conservation sites and areas of semi-natural habitat wherever possible. As a consequence of this, 70% of the land crossed by the proposed route is agricultural and less than 12% comprises semi-natural habitats. Modified habitats, including agricultural lands, cutover bog, conifer plantations etc., account for over 88% of the habitats encountered on the route.

During the detailed routing of the pipeline, minor re-alignment may be necessary. Where this is the case, further surveys will be carried out to ensure that all ecological constraints are taken into account as part of the ongoing environmental impact assessment process.

9.2 Methodology

A method statement for the study was prepared at the outset, (**Appendix 9.1**). This was circulated in Dúchas for comment and approval. As a whole the level of survey achieved was more than that originally planned.

Field surveys were carried out where the route is on, adjacent to or within one kilometre of a designated conservation area. An example of a route survey card is provided in **Appendix 9.6**.

In addition, field surveys were also carried out on those sections of the route which were identified as being potentially sensitive and/or of ecological value/interest from aerial video footage (Geofilm[1]), desk study and consultations. For example the proposed pipeline route from Bellanaboy Bridge to just east of Owenboy was surveyed in the field - including the non-designated conservation areas - with the exception of short sections of impenetrable coniferous plantation.

Field surveys were carried out between June and October 2000.

The assessment of habitats occurring along the pipeline route was conducted for 50 m. on either side of the proposed centreline using aerial video (Geofilm) and, in the case of some re-routes, from high resolution vertical colour aerial photographs. The remainder of the route was subject to field checks via agreed access or key vantage points. Those sections of the route not surveyed in the field to date will require field survey prior to construction.

The fauna survey was limited to vertebrate fauna, with comment provided on the potential for invertebrates. Evaluation has been based on either Geofilm or field survey, with the habitats present providing the principal guide.

Field survey results are presented in **Appendices: 9.2 and 9.3.**

Information has been collated from statutory and non-statutory sources relating to nature conservation issues within the route corridor. This has been used to help define the route and

[1] *Geofilm* is a registered trademark. The video is filmed by a forward-facing camera, which is mounted below a helicopter, flying at an altitude of approximately 800 feet, into the navigation system of which the co-ordinates of the route have been pre-programmed.

ensure that the design and construction of the pipeline avoids or minimises adverse impacts. This has included the assimilation of information on designated wildlife sites, watercourses and protected species from statutory (Dúchas) and non-statutory bodies (e.g. BirdWatch Ireland and the Irish Peatland Conservation Council).

In addition to the above desk study, the following was also undertaken:

- detailed Phase I (JNCC 1990) equivalent habitat mapping at 1:10,000 from field survey and Geofilm - habitat types are described in Appendix 9.3;
- collation of data on presence of and/or potential habitats for protected plants species;
- collation of data on the presence of, and/or potential habitats for, protected species of fauna;
- information on the presence of birds, particularly breeding and migratory species.

Phase 1 habitat mapping for the entire length of the proposed pipeline is provided in **Maps 9 to 16 (Volume II)**.

9.3 Existing Ecology – An Overview

Principal habitats of the northwest Mayo section of the route are low-level blanket peat, coniferous plantation on blanket peat, wet rushy grassland, semi-improved and improved grasslands, and areas of scrub.

The east Mayo landscape is predominantly a wet one, dominated by bogs (blanket, raised and transitional), wet heath, lakes and rivers. The topography is that of gently rolling hills, drumlins being an obvious feature of the landscape.

Interspersed with the reclaimed agricultural fields, the prevailing landscape of east Galway is that of marshy pasture (including turloughs), vast expanses of bog, shallow lakes (on marl or peat) and areas of bare or scrub-covered limestone. In a number of areas the limestone is exposed at the surface, usually in the form of limestone pavement, although a number of limestone knolls, such as that of Knockmaa Hill occur along the route. In other areas, scrub vegetation has developed on a thin layer of soil. This is usually dominated by hazel. Another characteristic feature of these grazier-dominated limestone lowlands of east Galway is dry stone walls.

The main habitat types encountered along the proposed route are described in **Appendix 9.4.** The habitat types encountered along the proposed route are shown in **Table 9.1** where they are listed in order of their percentage occurrence along the route. **Table 9.2** compares the occurrence of semi-natural habitats with those that have been modified as a result of agricultural, forestry, and turbary practices.

TABLE 9.1: Habitat types - summary of the frequency of occurrence – shown as percentages of the total route.

Habitat Type	%
Improved/Semi improved grassland	70.02
Conifer plantation	8.44
Wet modified blanket bog (includes: cutover/overgrazed/eroded)	7.16
Intact blanket bog	3.95
Wet rushy (*Juncus*) grassland	3.31
Raised Bog (incl. transitional *Sphagnum* Bog- see text)	2.88
Industrial cutaway bog	2.73
Scrub (all types)	1.24
Fen (all types)	0.25
Broad – leaved plantation	0.018
	100%

Table 9.2: Comparison of modified and semi-natural habitats on the route

Type	Percentage of total route
Modified habitats (including improved/semi-improved grassland, conifer plantation cutover bog etc.)	88.36
Semi-natural habitats	11.63

9.4 Existing Terrestrial Habitats

9.4.1 Habitats and Flora

The following sections describe the route in terms of habitat. An account of the composition and ecology of the main habitats/vegetation types encountered along the proposed route is outlined in **Appendix 9.4**. The equivalent habitat for Phase 1 (JNCC, 1990) is given where possible, as is the international plant community classification system (phytosociological affinities) of the vegetation and the recently devised Irish habitat classification according to Fossitt (2000).

All mention of river crossings in this section should be read in conjunction with **Section 10.**

9.4.1.1 *From the Terminal site to just east of Owenboy*

A summary of sections of the route from Bellanaboy (F8634 3254) to just east of Owenboy (G 0730 1710) in habitat terms is given in **Table 9.3.** Detailed results of the habitat surveys including sections of the proposed route - and sensitive areas adjacent or near to the route – from Bellanaboy (F 8634 3254) to east of (G 0730 1710) are given in **Appendix 9.2.** Impenetrable sections of the route with dense vegetation, such as mature coniferous plantations, were not walked.

Table 9.3: Summary of habitats surveyed on the north Mayo section of the route.

From	To	Dist. (km)	Dominant habitat
F 8634 3254	F 8640 3245	0.12	Modified wet blanket bog
F 8640 3245	F 8657 3210	0.37	Improved/semi-improved grassland
F 8657 3210	F 8700 3144	1.02	Coniferous plantation
F 8700 3144	F 8704 3126	0.13	Overgrazed/eroded blanket bog and wet rushy fields by river
F 8704 3126	F 8706 3077	0.42	Blanket bog short intact and modified
F 8706 3077	F 8693 3047	0.31	Degraded blanket bog
F 8693 3047	F 8690 3007	0.40	Coniferous plantation
F 8690 3007	F 8691 2954	0.55	Wet modified blanket bog and marshy grassland
F 8691 2954	F 8698 2902	0.56	Improved/semi-improved grassland
F 8698 2902	F 8699 2892	0.10	Recently felled forestry
F 8699 2892	F 8745 2831	0.78	Coniferous plantation
F 8745 2831	F 8971 2664	2.80	Coniferous plantation and cutaway
F 8971 2664	F 9014 2641	0.48	Marshy grassland with *Juncus effusus*
F 9014 2641	F 9052 2624	0.44	Coniferous plantation
F 9052 2624	F 9074 2617	0.22	Marshy grassland with *Juncus effusus*
F 9070 2617	F 9104 2603	0.37	Coniferous plantation
F 9104 2603	F 9160 2570	0.61	Marshy grassland with *Juncus effusus*
F 9160 2570	F 9296 2464	1.70	Intact blanket bog
F 9296 2464	F 9419 2405	1.35	Coniferous plantation
F 9419 2405	F 9418 2275	1.25	Industrial cutaway blanket bog
F 9418 2275	F 9470 2175	1.05	Intact blanket bog
F 9470 2175	F 9713 2045	2.75	Industrial cutaway blanket bog
F 9713 2045	F 9721 2040	0.09	Improved/semi-improved grassland

F 9721 2040	F 9724 2039	0.03	River
F 9724 2039	F 9760 2019	0.40	Marshy grassland with *Juncus effusus*
F 9760 2019	F 9805 1995	0.45	Industrial cutaway blanket bog
F 9805 1995	F 9889 1956	0.91	Coniferous plantation
F 9889 1956	F 9897 1951	0.12	Improved/semi-improved grassland
F 9897 1951	F 9952 1934	0.58	Coniferous plantation
F 9952 1934	G 0010 1898	1.55	Cutaway blanket bog
G 0010 1898	G 0148 1880	0.50	Improved/semi-improved grassland
G 0148 1880	G 0189 1873	0.41	Cutaway blanket bog
G 0189 1873	G 0219 1865	0.30	Coniferous plantation
G 0219 1865	G 0235 1857	0.18	Intact blanket bog
G 0235 1857	G 0261 1843	0.28	Marshy grassland with *Juncus effusus*
G 0261 1843	G 0274 1850	0.14	Improved/semi-improved grassland
G 0274 1850	G 0322 1861	0.47	Overgrazed/eroded blanket bog
G 0322 1861	G 0362 1872	0.52	Coniferous plantation
G 0362 1872	G 0386 1880	0.21	Improved/semi-improved grassland
G 0386 1880	G 0404 1880	0.17	Overgrazed/eroded blanket bog
G 0404 1880	G 0436 1877	0.30	Improved/semi-improved grassland
G 0436 1877	G 0515 1862	0.83	Improved/semi-improved grassland
G 0515 1862	G 0591 1822	0.99	Improved/semi-improved grassland
G 0591 1822	G 0616 1801	0.31	Coniferous plantation
G 0616 1801	G 0662 1768	0.54	Marshy grassland with *Juncus effusus*

9.4.1.2 *East of Owenboy to Massbrook Lower*

Table 9.4: Summary of habitats surveyed on the section of the route from east of Owenboy to Massbrook Lower.

From	To	Dist. (km)	Dominant habitat(s)
G 0662 1768	G 0696 1715	0.64	Improved/semi-improved grassland
G 0696 1715	G0718 1588	1.36	Conifer plantation
G 0718 1588	G 0738 1547	0.46	Blanket bog
G 0738 1547	G 0874 1281	3.16	Mix of improved and wet grassland
G 0874 1281	G 0889 1277	0.17	Conifer plantation
G 0889 1277	G 0909 1261	0.26	Wet modified /cutover blanket bog
G 0909 1261	G 0913 1254	0.09	Improved grassland
G 0913 1254	G 0944 1206	0.54	Wet modified /cutover blanket bog
G 0944 1206	G 0960 1184	0.29	Improved/semi-improved grassland
G 0960 1184	G 0996 1164	0.41	Cutover blanket bog and conifer plantation
G 0996 1164	G 1463 0829	6.49	Mostly improved/semi-improved grassland and low hedges with Ulex, with low hedges and small trees
G 1463 0829	G 1502 0813	0.42	Modified/cutover blanket bog either side of the Addergoole River
G 1502 0813	G 1551 0706	1.25	Mostly improved/semi-improved grassland with some unimproved marshy grassland, small areas of Ulex heath and a very small conifer plantation
G 1551 0706	G 1608 0535	1.76	Mix of: Cut-over blanket bog; Ulex scrub; some reclaimed fields with improved grassland; wet rushy grassland, scattered willow scrub and some conifer plantation.

9.4.1.3 *Massbrook Lower to south of Gort townland*

Along this section of the proposed route the pipeline is routed through areas of agricultural pasture, blanket bog, and young coniferous plantations on blanket bog. From an ecological point of view, the blanket bog habitats are the most interesting and these pre-dominate in areas above an altitude of 100m. The blanket bog, though cutaway in places, is relatively intact and is dominated by *Molinia caerulea, Myrica gale* and *Erica tetralix*. On the shallower peat, which covers more the steeply sloping terrain, dry heath vegetation dominated by *Calluna vulgaris* is well developed. Although these blanket bog/dry heath areas do not lie within a protected area such as a National Heritage Areas (NHA) or Special Areas of Conservation (SAC) the habitats are of relatively high ecological interest and thus it is essential that damage is minimised during pipeline construction (**Table 9.5**).

Table 9.5: Details of sections the route from road at Massbrook Lower to south of Gort townland.

From	To	Dist. (km)	Main habitat
G 1608 0535	G 1620 0520	0.20	Marshy grassland with *Juncus effusus*
G 1620 0520	G 1632 0502	0.22	Cutaway blanket bog
G 1632 0502	G 1704 0433	0.82	Improved/semi-improved grassland
G 1704 0433	G 1728 0404	0.38	Overgrazed/eroded blanket bog
G 1728 0404	G 1752 0375	0.40	Marshy grassland with *Juncus effusus*
G 1752 0375	G 1795 0271	1.44	Intact blanket bog
G 1795 0271	G 1800 0223	0.50	Coniferous forestry
G 1800 0223	G 1796 0212	0.14	Marshy grassland with *Juncus effusus*
G 1796 0212	G 1807 0092	1.18	Eroded blanket bog with improved/semi-improved grassland

9.4.1.4 *South of Gort townland via Cunnagher North to Sranalee*

This section of the route (**Table 9.6**) contains a varied range of habitats including cutaway blanket bog, conifer plantation, wet *Juncus* pasture, and improved grassland. It avoids a small area of raised bog, which is included in the field survey results, the details of which are given in **Appendix 9.2.**

Table 9.6: Details of sections from south of Gort townland via Cunnagher north to Sranalee

From	To	Distance (km)	Main habitat
G 1807 0092	G 1799 0053	0.41	Conifer plantation
G 1799 0053	M 1792 9795	2.85	Eroded and cutover blanket bog with some semi-improved and marshy grassland.
M 1792 9795	M 1789 9475	0.56	Improved grassland
M 1789 9745	M 1779 9725	0.21	Wet *Juncus effusus* grassland
M 1779 9725	M 1762 9698	0.31	Improved grassland
M 1762 9698	M 1715 9591	1.16	Cutaway blanket bog

9.4.1.5 *Sranalee to NW of Rockfield*

Wet marshy grassland and forestry, with some improved fields dominate the section of the route (Table 9.7) which runs parallel to the Clydagh River. The southern part of this section runs through forestry and across cutover blanket bog. Both sides of the river crossing are dominated by improved grassland.

Table 9.7: Summary of habitats from Sranalee to NW of Rockfield

From	To	Dist. (km)	Main habitat
M 1715 9591	M 1717 9572	0.31	Improved grassland
M 1717 9572	M 1719 9540	0.32	Improved/ Semi-improved grassland
M 1719 9540	M 1725 9509	0.30	Conifer plantation
M 1725 9509	M 1747 9482	0.37	Wet rushy grassland
M 1747 9482	M 1767 9466	0.26	Conifer plantation
M 1767 9466	M 1803 9432	0.63	Cut-over blanket bog
M 1803 9432	M 1813 9409	0.24	Improved grassland
M 1813 9409			River
M 1813 9407	M 1855 9358	0.66	Improved grassland
M 1855 9358	M 1877 9332	0.33	Forestry – some felled

9.4.1.6 *Rockfield to southeast of Manulla Junction*

This length of pipeline extends from Rockfield (M 1877 9332), west of the village of Turlough, to southeast of Manulla Junction (M 2207 8673). The general landscape of this part of the country is very wet, as evidenced by the abundance of bog, rivers and small lakes and the topography is gently undulating, due to the presence of drumlins. Most of the land traversed, however, is comprised of reclaimed agricultural fields, which are of low conservation value (**Table 9.8**). Most of these are small and many support well developed hedgerows. Other habitats crossed include wet, marshy grassland, small stretches of coniferous forestry blanket bog and fen. The pipeline route generally keeps to the low-lying areas. There are two main river crossings, the Castlebar and the Manulla Rivers, along with several minor watercourses. The detailed results of the habitat surveys for this section of the proposed route are given in **Appendix 9.2.**

Table 9.8: Summary of habitats from Rockfield to S.E. of Manulla Junction

From	To	Dist. (km)	Main habitat
M 1877 9332	M 1907 9279	0.62	Improved/semi-improved grassland and marshy grassland
M1907 9279			River
M1907 9279	M 1904 9200	0.81	Improved/semi-improved grassland
M 1904 9200	M 1904 9196	0.04	Wet/marshy grassland
M 1904 9196	M 1904 9191	0.04	Improved/semi-improved grassland
M 1904 9191	M 1904 9177	0.14	Wet/marshy grassland
M 1904 9177	M 1912 9154	0.23	Improved/semi-improved grassland
M 1912 9154	M 1915 9150	0.65	Blanket bog
M 1915 9150	M 1924 9137	0.15	Improved/semi-improved grassland
M 1924 9137	M 1940 9110	0.32	Blanket bog
M 1940 9110	M 1943 9097	0.13	Improved/semi-improved grassland
M1943 9097	M 1942 9074	0.24	Fen
M 1942 9074	M 1942 9067	0.07	Wet/marshy grassland
M 1942 9067	M 1964 9017	0.59	Improved/semi-improved grassland
M 1964 9017	M 1975 9005	0.17	Fen
M 1975 9005	M 2007 8983	0.40	Improved/semi-improved grassland
M 2007 8983	M 2017 8976	0.12	Wet/marshy grassland
M 2017 8976	M 2072 8875	1.18	Improved/semi-improved grassland
M 2072 8875	M 2088 8859	0.23	Wet modified bog
M 2088 8859	M 2147 8805	0.82	Improved/semi-improved grassland and river crossing
M 2147 8805	M 2177 8780	0.40	Blanket bog
M 2177 8780	M 2207 8673	1.14	Improved/semi-improved grassland

9.4.1.7 *Manulla Junction to Shinganagh, on the Plains of Mayo*

This length of pipeline extends from southeast of Manulla Junction (M22078673) to Shinganagh, on the Plains of Mayo (M26808040). The general landscape remains wet in character, with plenty of rivers and lakes. A landscape of low rolling hills is caused by the presence of drumlins. Land traversed is predominantly covered in agriculturally improved fields, which is of low conservation value, with some small areas of bog and wet, marshy grassland (**Table 9.9**). Many of these wet areas are associated with nearby lakes. There are several minor water crossings to be negotiated. There are some good examples of hedgerow communities present, although this habitat has been significantly reduced by the removal of field boundaries to create larger fields.

Table 9.9: Summary of habitats from Manulla Junction to Shinganagh, on the Plains of Mayo

From	To	Dist. (km)	Main habitat
M 2207 8673	M 2221 8658	2.7	*Sphagnum* bog
M 2221 8658	M 2328 8445	2.47	Improved/semi-improved grassland
M 2328 8445	M 2336 8427	0.18	Wet modified bog
M 2336 8427	M 2341 8414	0.15	*Sphagnum* bog
M 2341 8414	M 2430 8244	1.90	Improved/semi-improved grassland
M 2430 8244	M 2450 8232	0.22	Wet/marshy grassland
M 2450 8232	M 2680 8040	3.04	Improved/semi-improved grassland

9.4.1.8 *Shinganagh to the townland of Carrowkeel*

This length of pipeline extends from Shinganagh, on the Plains of Mayo (M26808040) to the townland of Carrowkeel, north of the Robe River (M28897241). The general landscape remains highly wet in character, although there is a reduction in the number of rivers and lakes present. The general topography is more even and drumlins are no longer an obvious feature. The land traversed is predominantly covered in agriculturally improved fields, which are of low conservation value, with some small areas of bog and wet, marshy grassland. Much of these wet areas are associated with nearby lakes. There are several minor water crossings to consider along this section of pipeline. There are some good examples of hedgerow communities present. Many of the fields have been further subdivided to create a greater number of smaller fields, (**Table 9.10**).

Table 9.10: Summary of habitats from Shinganagh to the townland of Carrowkeel

From	To	Dist. (km)	Main habitat
M 2680 8040	M 2777 7850	2.14	Improved/semi-improved grassland
M27777850	M27802835	0.16	*Sphagnum* bog
M 2780 2835	M 2808 7703	1.35	Improved/semi-improved grassland
M 2808 7703	M 2809 2698	0.06	Wet/marshy grassland
M 2809 2698	M 2853 7597	1.12	Improved/semi-improved grassland
M 2853 7597	M 2855 7594	0.03	*Sphagnum* bog
M 2855 7594	M 2861 7526	0.70	Improved/semi-improved grassland
M 2861 7526	M 2864 7499	0.27	Wet modified bog
M 2864 7499	M 2889 7241	2.65	Improved/semi-improved grassland

9.4.1.9 *Carrowkeel to Roos*

This length of pipeline extends from the townland of Carrowkeel, north of the Robe

River (M28897241) to the townland of Roos (M 2985 6453). Despite the presence of large areas of peat (most of which has been extensively modified) in the area, the pipeline route avoids these and is confined to agricultural land for its entire length, with the exception of where it crosses the Robe River (M28997136). There is some wet, marshy grassland associated with the floodplain of the river. The topography of the area is gently undulating, with very little variation in altitude. Hedgerows are not well represented and the field boundaries are generally marked with stone walls and fences (**Table 9.11**).

Table 9.11: Summary of habitats from Carrowkeel to Roos

From	To	Dist. (km)	Main habitat
M 2889 7241	M 2900 7141	1.02	Improved/semi-improved grassland
M 2900 7141	M 2896 7126	0.16	Wet/marshy grassland
M 2899 7136			River
M 2896 7126	M 2985 6453	11.00	Improved/semi-improved grassland

9.4.1.10 *Roos to northeast of Cloonsheen*

This length of pipeline extends from the townland of Roos (M29856453) to northeast of the townland of Cloonsheen (M32305653). There are a number of minor water crossings to negotiate, including two crossings of the Kilshanvy River. The topography of the area is gently undulating, with very little variation in altitude. The general topography is that of gently rolling hills, covered by a patchwork of agriculturally improved fields. Most of the land traversed is agricultural, with the exception of a few wet and peaty areas. Hedgerows are not well represented and the field boundaries are generally marked with fences and some stone walls (**Table 9.12**).

Table 9.12: Summary of habitats from Roos to Cloonsheen

From	To	Dist. (km)	Main habitat
M 2985 6453	M 1357 6228	2.62	Improved/semi-improved grassland
M 13576228	M 3130 6170	0.93	*Sphagnum* bog
M 3130 6170	M 3150 6160	0.21	Wet modified bog
M 3150 6160	M 3203 5882	3.12	Improved/semi-improved grassland
M 3203 5882	M 3199 5876	0.06	Wet/marshy grassland
M 3199 5876	M 3245 5726	1.66	Improved/semi-improved grassland
M 3245 5726	M 3244 5710	0.14	*Sphagnum* bog
M 3244 5710	M 3232 6577	0.47	Improved/semi-improved grassland
M 3232 6577	M 3230 5653	0.12	Wet/marshy grassland

9.4.1.11 *North east of Cloonsheen to west of Knockmaa Hill*

This length of pipeline extends from north east of the townland of Cloonsheen (M32305653) to west of Knockmaa Hill (M34484855). There is one main river crossing, the Togher River. The general landscape is low-lying and gently undulating. The underlying rock is limestone, which can be seen outcropping in a number of fields. The 6" O.S. Map highlights the occurrence of a number of turloughs in the area. Large areas of land are prone to flooding. The route passes through an extensive network of reclaimed and improved agricultural fields. The only other obvious habitat is an area of peat that has developed along the Togher River. There are some well-developed hedgerows present along the route (**Table 9.13**).

Table 9.13: Summary of habitats from NE of Cloonsheen to west of Knockmaa Hill

From	To	Dist. (km)	Main habitat
M 3230 5653	M 3275 5471	1.97	Improved/semi-improved grassland
M 3274 5471	M 3276 5423	0.39	*Sphagnum* bog (Raised bog)
M 3276 5423	M 3276 5425	0.11	Improved grassland
M 3276 5425	M 3276 5406	0.20	*Sphagnum* bog (Raised bog)
M 3273 5425			River
M 3276 5406	M 3448 4855	6.42	Improved/semi-improved grassland

9.4.1.12 *West of Knockmaa Hill to the townland of Bunoghanaun*

This length of pipeline extends from west of Knockmaa Hill (M34484855) to the townland of Bunoghanaun (M 3740 4122). The general landscape is of limestone bedrock covered in till of varying depths. The route passes through an extensive stretch of small agricultural fields. Hedgerow development is extremely poor or absent. Most of the surrounding area consists of bare limestone. Limestone boulders occur as surface outcrops in a number of fields (**Table 9.14**).

Table 9.14: Summary of habitats from west of Knockmaa Hill to Bunoghanaun

From	To	Dist. (km)	Main habitat
M 3448 4855	M 3740 4122	8.08	Improved/semi-improved grassland

9.4.1.13 *Bunoghanaun to the townland of Cahernashilleeny, north of the Clare River*

This length of pipeline extends from the townland of Bunoghanaun (M 3740 4122) to the townland of Cahernashilleeny, north of the Clare River (M 4128 3412). Hedgerow development is extremely poor or absent. Most of the surrounding area consists of bare limestone. There is a large quarry to the east of the pipeline route. The route passes through an extensive stretch of small agricultural fields. Limestone boulders occur as surface outcrops in a number of fields (**Table 9.15**).

Table 9.15: Summary of habitats from Bunoghanaun to the townland of Cahernashilleeny, north of the Clare River

From	To	Dist. (km)	Main habitat
M 3740 4122	M 4000 3702	5.37	Improved/semi-improved grassland
M 4000 3702	M 4006 3670	0.34	Scattered scrub
M 4006 3670	M 4128 3412	2.92	Improved/semi-improved grassland

9.4.1.14 *Cahernashilleeny just north of the River Clare, to Carraunduff*

This length of pipeline extends from Cahernashilleeny (M 4128 3412), just north of the River Clare, to Carraunduff (M 4608 2798). The proposed route moves in a southeasterly direction, through predominantly agricultural land (**Table 9.16**). Other habitats traversed include wet, marshy grassland associated with the River Clare and patches of hazel scrub over limestone pavement. Dry stone walls increasingly mark field boundaries, typical of East Galway.

Table 9.16: Summary of habitats from Cahernashilleeny, just north of the River Clare, to Carraunduff

From	To	Dist. (km)	Main habitat
M 4128 3412	M 4166 3375	0.5	Improved/semi-improved grassland
M 4167 3374			River
M 4166 3373	M 4173 3364	0.12	Wet lowland/marshy grassland
M 4173 3364	M 4472 2937	5.21	Improved/semi-improved grassland
M 4472 2937	M 4476 2930	0.10	Dense scrub
M 4476 2930	M 4575 2812	1.53	Improved/semi-improved grassland
M 4575 2812	M 4608 2798	0.36	Dense scrub

9.4.1.15 *Carraunduff to Templemartin*

This length of pipeline extends from Carraunduff (M 4608 2798) to Templemartin (M 5037 2222). The proposed route traverses gently rolling countryside, predominantly consisting of a patchwork of small, irregularly shaped, agriculturally improved fields. There is some evidence that many of these fields have decreased in size through the erection of fences within some of the larger fields to subdivide the field into a number of subsections. Where hedgerows are found, they are not as well developed as those further south, although there are some exceptions. The 6" O.S. map and the Geofilm suggest that the soil depth is relatively shallow over much of this section of the route. This is evidenced by the frequent occurrence of rock outcrops within many of the fields. Areas of patchy scrub, dominated by *Coryllus avellana, Ulex europaeus* and/or *Crataegus monogyna*, are found in this situation. There is some low-lying land that is liable to flooding, some of which may represent turlough habitat. The pipeline passes close to Turloughakin (M48502340). The pipeline also crosses two rivers, the Graigabbey and the Eiscir. The bank vegetation, in both cases, appears to be well developed. The fields directly adjacent to the river edge are wet in character as a result of periodic episodes of flooding (**Table 9.17**).

Table 9.17: Summary of habitats from Carraunduff to Templemartin

From	To	Dist. (km)	Main habitat
M 4608 2798	M 4624 2791	0.17	Improved/semi-improved grassland
M 4624 2791	M 4642 2781	0.25	Scattered scrub
M 4642 2781	M 4678 2740	0.54	Improved/semi-improved grassland
M 4678 2740	M4695 2720	0.25	Scattered scrub
M 4695 2720	M 4750 2650	0.87	Improved/semi-improved grassland
M 4750 2650	M 4752 2647	0.03	Broadleaf plantation
M 4752 2647	M 4770 2620	0.32	Improved/semi-improved grassland
M 4770 2620	M 4777 2609	0.13	Scattered scrub
M 4777 2609	M 4803 2572	0.45	Improved/semi-improved grassland
M 4803 2572			River
M 4803 2572	M 4825 2591	0.84	Improved grassland
M 4825 2591	M 4824 2472	0.21	Dense/continuous scrub
M 4825 2472			River
M 4804 2472	M 5037 2222	4.49	Improved/semi-improved grassland

9.4.1.16 *Templemartin to Cappagh South*

This length of pipeline extends from Templemartin (M50372222) to Cappagh South (M53162121), close to the village of Craughwell. The general topography is that of gently rolling hills, covered by a patchwork of small, irregularly shaped, agriculturally

improved fields. There is little or no evidence that many of these fields have increased in size through the removal of hedgerows and other boundaries. As a result, the hedgerows separating the fields are very well developed. They are often up to 5m wide in places. The proposed pipeline route traverses the River Dooyertha. The banks of this watercourse are covered in dense scrub-like vegetation, while the lands immediately adjacent are subject to periodic flooding. These fields, as a result, are marshy in character and support species such as *Agrostis stolonifera, Potentilla anserina* and *Juncus articulatus.* Another interesting feature of the area is the occurrence of patches of standing water within a number of the fields. The available information suggests that there are turloughs in the surrounding area (e.g. Turloughmartin, M50702240) and that many of the fields are subject to periods of flooding. It is likely that many of the turloughs have been modified through drainage schemes. There are also patches of mature trees, though these are concentrated around dwellings, where they provide shelter, (**Table 9.18**).

Table 9.18: Summary of habitats from Templemartin to Cappagh South

From	To	Dist. (km)	Main habitat
M 5037 2222	M 5205 2156	1.87	Improved/semi-improved grassland
M 5205 2156	M 5217 2148	0.15	Wet/marshy grassland
M 5210 2152			River
M 5217 2148	M 5316 2121	10.75	Improved/semi-improved grassland

9.4.2 Fauna

The potential for fauna along the route sections was firstly assessed by means of examination of Geofilm. This examination allows for an initial assessment of the habitats present and the wildlife potential.

Field surveys were conducted in August and October 2000, in generally good weather conditions. Ideally bird surveys should be undertaken over an entire year to identify summer and winter breeding birds. With this in mind additional information on bird species present in the general geographical area of the pipeline was obtained from the Countryside Bird Survey (BirdWatch Ireland).

Because of the limitation on time available for field surveys it was decided to use an evaluation of habitat potential for mammals as a first stage assessment of impacts. Field surveys were then carried out in sections of, and near/adjacent to, the route where important habitats were identified. Field survey and desk study results, along with additional information are presented in **Appendix 9.3.**

9.4.2.1 *Fauna potential of the habitats encountered on the route*

Upland habitats tend to be poor in distribution and abundance of mammalian species. Species present include hedgehog, pygmy shrew, bats, rabbit, Irish hare, field mouse, house mouse, brown rat, fox and badger. Species such as red squirrel and American mink are occasional. Of particular interest are the pine marten, widely distributed in Co. Mayo, and the otter, also commonly found on river systems. The frog and the common lizard are found frequently. Deer and feral goat may occur occasionally.

Upland and blanket bog areas support a relatively limited diversity of birds, but in conjunction with adjoining conifer plantations, farmland, hedgerow, scrub and woodland, the species count is as high as it is in lowland. Several species are of note. These include birds of prey, such as the sparrowhawk, kestrel, merlin, and potentially the hen harrier. Other species of interest are the golden plover and, in north Mayo, the crossbill, which favours mature cone-bearing spruce plantations. Freshwater lakes and pools are frequent in upland areas, providing refuge for wildfowl.

Lowland improved grasslands form the major part of the eastern sections of the route and it is relatively poor as a habitat for wildlife. Within these landscapes, the abundance and distribution of vertebrates is largely related to the presence and distribution of scrub, woodland, and boundaries of scrub, hedgerow and treeline. Most mammalian species are to be found in the area, except those with localised distribution (such as black rat, bank vole and deer species). Most bat species are also likely to occur. Frog distribution may be limited in drier limestone areas where breeding habitat is scarce. The common lizard occurs in a wide range of habitats in Ireland.

Lowland landscapes in the eastern sections harbour a range of common avian species, the abundance and distribution of many species again being largely related to presence of particular habitat types (e.g. wet grassland) and areas of scrub and woodland in particular. Of note is the kingfisher, which may be present on larger rivers and watercourses. It is probable that many of the hedgerows along the route are host to common passerine birds and mammals.

Bird species recorded at selected sites along the proposed pipeline route during mid-August 2000 are listed in **Appendix 9.3.** It should be noted that this is a minimum species list. Species of mammal recorded at selected sites along the route between the Terminal and Galway together with additional information is also given in **Appendix 9.3.**

9.5 Terrestrial Habitats Evaluation

9.5.1 Designations and Legislation

The following is a short summary of the designations and legislation which currently apply to sites and species in Ireland - included here in order to put the sites mentioned below, in **Table 9.19** and **Appendix 9.5** in context.

9.5.1.1 *Special Areas of Conservation*

The Natural Habitat Regulations (1997) enabled the designation of Special Areas of Conservation (SACs) under Article 3 of the Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive), as part of the Natura 2000 network. This network comprises Annex I habitats - "natural habitat types of community interest whose conservation requires the designation of Special Areas of Conservation" and the habitats of Annex II species - "animal and plant species of community interest whose conservation requires the designation of Special Areas of Conservation". In addition, the directive states that: "The Natura 2000 network shall include the special protection areas classified by the Member States pursuant to Directive 79/409/EEC." They will be referred to simply as SACs with their appropriate Site Codes hereafter.

9.5.1.2 Proposed Natural Heritage Areas

Legal protection for Natural Heritage Areas (NHAs) under the legislation enacted in the Wildlife (Amendment) Act 2000. A commencement date for this is awaited. Proposed NHAs were established following the review survey of Areas of Scientific Interest (ASIs), and they form the basic site network for habitat conservation. They will be referred to simply as NHAs with their appropriate Site Codes hereafter.

9.5.1.3 *Special Protection Areas*

Special Protection Areas (SPAs) are designated under Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds (the Birds Directive). Under the directive Ireland is obliged to protect the habitats of birds which are vulnerable to habitat change or to their low population numbers. Aspects of habitat protection are in the context of pollution, deterioration of habitat and disturbance. This directive is implemented in Ireland under Statutory Instrument (1985). The Wildlife Acts 1976 and 2000 encompasses this designation. They will be referred to simply as SPAs with their appropriate Site Codes

hereafter.

9.5.1.4 Other designations and protection measures under the Wildlife Act 1976 and Wildlife (Amendment) Act 2000.

- statutory nature reserves;
- wildfowl sanctuaries;
- refuges for fauna;
- Flora Protection Order – the current FPO was issued by Statutory Instrument in 1999.

The Wildlife Act 1976 and 2000, their associated statutory instruments and Natural Habitat Regulations (for SACs) are implemented and controlled by Dúchas, Department of Arts, Heritage, Gaeltacht & the Islands. Dúchas is also responsible for the designation of sites.

9.5.2 Habitats and Flora

General

The following is an evaluation of the proposed route which highlights particular sites of note, designated and otherwise. For convenience the route is divided into the same sections as **Section 9.4** above. **Table 9.19** lists the designated conservation areas (SAC and NHA) which occur on, adjacent to, or within 1 kilometre of the proposed pipeline route. A description and explanation of their scientific value is given in **Appendix 9.5.**

Table 9.19: Designated sites, which are on, adjacent to, or within 1 km. of the proposed pipeline route.

Site Name	No.	Proximity
Carrowmore Lake Complex	SAC 476/SPA	on & adjacent to
Slieve Fyagh	SAC 542	on & adjacent to
Bellacorick Bog Complex	SAC 1922	on & adjacent to
Lough Conn & Lough Cullen	NHA 519/SPA	< 1 km.
Carrowmore Lough Shore	NHA 1492	c. 1 km
Carrowkeel Turlough	SAC 475	adjacent to
Greaghan's Turlough	SAC 503	< 1 km.
Turlough O'Gall	SAC 331	c. 1 km
Knockmaa Hill	NHA 1288	c. 1 km.

Rare and Protected Plant Species

Information was requested from Dúchas regarding the possible presence of protected plants species along the proposed pipeline route. Grid references supplied by Dúchas have been checked against the route and no rare or protected plant species were found to occur on or adjacent to the route. Notes on a few significant species that are known to occur in areas near the route are given below in **Table 9.20.**

Non-designated wetland sites of potential conservation value

Information on the Irish Fen Inventory of non-designated sites considered conservation-worthy (Crushell, 2000) was supplied by the Irish Peatland Conservation Council (IPCC). The location of sites on this list was checked against the pipeline route and none were found to be on the proposed route.

Table 9.20: Habitats and flora of importance identified along the proposed pipeline route

Location	Key Habitats and Flora	Conservation Value
Terminal site to Owenboy	Dominated by coniferous forestry, cutaway blanket bog with marshy and improved/semi-improved grasslands.	Low
	Short stretches of relatively intact blanket bog including plateau bog at the south-eastern end of Glencullin at junction of SACs 476 & 542;	High

Location	Key Habitats and Flora	Conservation Value
East of Owenboy to Massbrook Lower	First part of this section is dominated by cutover blanket bog and conifer plantation. From the Deel River Crossing onwards improved and semi-improved grassland alternate with small areas of cutover bog and wet marshy grassland.	Low Low
Massbrook Lower to 0.5 km south of Gort townland	Blanket bog habitats pre-dominate in areas above an altitude of 100m. Bogs dominated by *Molinia caerulea, Myrica gale* and *Erica tetralix* On the shallower peat, on steeply sloping terrain, *Calluna* dominated vegetation. Eroded and overgrazed blanket bog.	High High Low
Gort townland to Sranalee	Varied range of habitats including eroded and cutover blanket bog, wet Juncus pasture, improved grassland.	Low
Sranalee to NW of Rockfield	Mix of improved grassland, conifer plantation and wet rushy grassland.	Low
Rockfield to southeast of Manulla Junction	Well-developed hedgerows, dominated by *Crataegus monogyna* with conspicuous trees of *Fraxinus excelsior* present. Improved semi/improved and wet marshy grassland Areas of fen	Medium Low High
Manulla Junction to Shinganagh, on the Plains of Mayo	Improved semi/improved and wet marshy grassland. Cutover bog	Low Low
Shinganagh to the townland of Carrowkeel	Improved semi/improved and wet marshy grassland. Cutover bog	Low Low
Carrowkeel townland to Roos	Improved semi/improved pasture. Pipeline route is close to Carrowkeel Turlough SAC (Site Code: 475).	Low High
Roos to northeast of the townland of Cloonsheen	Improved pasture, wet rushy grassland and cutover bog.	Low
North east of Cloonsheen to west of Knockmaa Hill	Improved pasture. Geology and hydrology of the region is associated with turloughs. During the assessment process the route was re-aligned to avoid the nearby Turlough O'Gall SAC (Site code: 331) and Greaghan's Turlough NHA (Site code: 503).	Low High
West of Knockmaa Hill to the townland of Bunoghanaun	Improved pasture. Knockmaa Hill NHA (Site code: 1288) lies	Low High

	within 1 km of the proposed route.	
Location	**Key Habitats and Flora**	**Conservation Value**
Bunoghanaun to Cahernashilleeny, north of the Clare River	Generally improved grassland except for an area of Patchy hazel scrub over limestone.	Low Medium
Cahernashilleeny, north of the River Clare, to Carraunduff	Generally Improved pasture, wet rushy grassland except for an area of Patchy hazel scrub over limestone.	Low Medium
Carraunduff to Templemartin	Improved pasture. Most field boundaries are comprised of dry stone walls with scattered individual trees and/or shrubs.	Low Low
Templemartin to Cappagh South	Improved pasture. Well-developed hedgerows act as wildlife corridors and refuges. Sensitive local hydrology associated with nearby Turloughs	Low High High

9.5.3 Fauna

9.5.3.1 *Species of note*

Birds

- Most birds are protected under the Wildlife Acts 1976 and 2000. The only exceptions are species regarded as pests, vermin or game species;
- principal species of interest referred to in this report are birds of prey, principally merlin, and hen harrier (Annex I species);
- other birds of interest include golden plover and kingfisher (Annex I species).

Bats

- All bat species are protected under the Wildlife Acts 1976 and 2000; the lesser horseshoe bat is protected under EU Birds Directive (Annex II species).

Otters

- Otters are protected under the Wildlife Acts 1976 and 2000, and EU Habitats Directive (Annex II species).

Badgers

- Badgers are protected under the Wildlife Acts 1976 and 2000.

Particular attention has been paid to species listed in Annex I of the Birds Directive and Annex II of the Habitats Directive. Of note is the presence of otters on most of the rivers, and potential presence of lesser horseshoe bats as the proposed route traverses south. Kingfishers may also be present on some of the watercourses; blanket bog and other upland habitats may harbour hen harrier, merlin and golden plover. Merlin are known to nest in some of the mature conifer plantations of north Mayo (information from Dúchas). The pine marten is associated with scrub and woodland and is certain to be present in the hazel-ash scrub woodlands on limestone areas.

The principal habitats of interest that have moderate to high conservation value include areas of relatively undisturbed modified blanket bog (wet heath and dry heath), raised bog, bare limestone pavement, scrub and woodland on limestone and major watercourses. Also of interest are other scrub woodlands and hedgerows; mature deciduous trees may harbour bat roosts. Invertebrate diversity is also associated with

some of these semi-natural habitats. Sections of the route are discussed below in the context of their scientific interest in terms of fauna.

Table 9.21: Fauna of importance identified along the proposed pipeline route

Location	Key Fauna	Conservation Value
North Mayo section of the route	Large tracts of blanket bog hold species such as golden plover and kestrel. The habitat has the potential to host rare species such as merlin and hen harrier. Conifer plantations- nesting Merlin and crossbill. Freshwater lakes and blanket bog hold nationally and internationally important populations of birds, including greenland white-fronted geese, overwintering waterfowl and wildfowl, merlin, golden plover and gulls.	High High High
Gort to Sranalee	Vertebrate species present or likely to occur would be typical of many parts of Co. Mayo and the West. Undisturbed areas of heath and the raised bog areas provide feeding areas and refuges for a variety of vertebrates, particularly birds, and may also harbour invertebrate species of interest. Open heath provides a habitat for scarce birds of prey such as merlin and hen harrier and also golden plover.	Low Moderate to High High
North west of Rockfield to Derrynacross	Principal habitats of interest that serve as wildlife refuges include the ash-hazel woodland, the willow scrub woodland and in particular the two major rivers. Otters are certainly present along the river systems, and pine marten are likely in scrub woodland. Badgers are also present. Kingfisher may be present.	Moderate to High
South of Ballinvoash to Manulla	Hedgerow and scrub boundaries provide refuge and wildlife corridors. Principal habitat is the Manulla River and tributary streams, with otters likely to be present, and potentially kingfisher.	Moderate High
Carrowkeel Turlough, Greaghan's Turlough and Turlough O'Gall	These sites attract over-wintering birds and Greaghan's Turlough in particular is known to hold whooper swans. The small meadows around Turlough O'Gall have potential for corncrake. Lapwing were recorded at Carrowmore Turlough.	High
Cloonsheen to Caltragh	Uniform grassland landscape and some limited wet grassland and scrub in the vicinity of the River Togher. There is potential for lesser horseshoe bats in this area.	Low High

Location	Key Fauna	Conservation Value
Kilgill to Cahernashilleeny	Uniform grassland landscape bounded by bare stone walls. Limestone pavement at Knockdoe supports Pine martin and there is potential for lesser horseshoe bats	Low High
Cregmore to Craughwell (Garracloon South)	Uniform grassland landscape bounded by bare stone walls. Principal areas of wildlife interest are 4 rivers and also the larger areas of scrub and scrub woodland. Semi-improved calcareous grassland at Garracloon South. All provide a refuge for vertebrates and invertebrates. Otter and kingfisher are likely to occur.	Low High

9.5.4 Impacts And Mitigation Measures

9.5.5 Impacts

In view of the sensitive nature of the designated conservation areas which the proposed pipeline route crosses, is adjacent to or passes within 1 km, it is essential that specialised construction methods are used to suit the particular habitats in order to minimise any potential impact. This is particularly important in relation to blanket and raised bogs, and other wetland sites. **Table 9.22** lists the designated areas and highlights the potential risk associated with the proposed pipeline development. The water regime for each site is the key issue here. Thus anything which interferes with the hydrological integrity of bog and wetland (including turlough) sites is a potentially serious threat to the whole ecology of these areas.

Potential impacts on fauna include loss of habitat and wildlife refuge, disturbance to feeding, breeding or overwintering birds, loss of bat roosting sites, destruction of badger setts, and impacts on watercourses (sedimentation and pollution). **Table 9.23** lists the potential impact on fauna in designated areas.

9.5.5.1 *Bellanaboy to Owenboy*

It has been shown above that there are, in particular, two highly sensitive and potentially highly vulnerable (in ecological terms) sites between the Bellanaboy and Owenboy which are either transversed by or close to the proposed route. It is essential that damage to the hydrology of these high-quality blanket bog areas is either avoided or minimised. These critical route sections are:

Glencullin Upper

The area of plateau bog at the southeastern end of Glencullin where *SAC 476 & SAC 542* join has to some extent been degraded as a result of overgrazing and subsequent erosion. However there are intact areas that are potentially at risk particularly during the construction phase. In addition to terrestrial ecological concerns, the area at Glencullin is also sensitive in view of the potential threat to the headwaters of the Glencullin River (see **Section 10**).

Eskeragh

The blanket bog/base-rich fen, south of the road near Eskeragh *SAC 1922*, is adjacent to the proposed route.

Any disturbance to this base-rich fen at Eskeragh would be severely damaging. It is a small fen with preferential flows and it is vital that these are not interfered with or cut off. For this reason during consultations Dúchas have requested that the hydrology of the wider area be investigated to ascertain the direction of flows including water shed effects. In this regard, and in order to avoid focussing flows, the position of streams, feeder heads, and water flow directions will be considered.

9.5.5.2 *Rockfield to southeast of Manulla Junction*

This section of pipeline that runs closest to Carrowmore Lough Shore NHA (Site code: 1492). Although the lough itself lies a considerable distance from the proposed pipeline route and will not be impacted on directly, indirect impacts may result from crossings of various minor watercourses feeding into the lake. The wetland habitats west of Manulla and in the vicinity of Manulla Bridge will be checked by field visit.

9.5.5.3 *Manulla Junction to the townland of Carrowkeel*

The proposed pipeline route through this section of Mayo is confined to areas of land that have been improved for agricultural purposes and bog that has been man-modified. This land is of low conservation value.

9.5.5.4 *Carrowkeel to Roos*

A potential problem along this section of pipeline is the proximity of Carrowkeel Turlough SAC (Site Code: 475). This proposed pipeline route passes within 250m of the boundary of the site. The proximity of the pipeline has potentially serious implications for the local hydrology, which is crucial to the conservation and management of this turlough, an Annex I priority habitat type in Ireland, under the EU Habitats Directive. Discussions have been held with Dúchas personnel who are concerned about the impact the pipeline construction may have on the local hydrology. The depth of the surrounding till may be crucial. It is felt that should there be a need to blast the underlying bedrock, that there is a real danger of creating artificial drainage channels, which could impact negatively on the stability and functioning of the turlough. Special mitigation measures need to be put in place in this instance.

9.5.5.5 *Roos to north east of Cloonsheen*

The proposed pipeline route through this section of Mayo and Galway is confined to areas of land that have been improved for agricultural purposes and bog that has been man-modified. This land is of low conservation value.

9.5.5.6 *North east of Cloonsheen to west of Knockmaa Hill*

Although this length of pipeline in Co. Galway passes through habitat of low conservation value, the complex hydrology of the region is a potential problem. The route has already been adjusted to avoid Turlough O'Gall SAC (Site code: 331). There is potential for indirect impact on Greaghan's Turlough NHA (Site code: 503), to the west of the route, if there is an underground channel link between these two systems..

9.5.5.7 *West of Knockmaa Hill to the townland of Bunoghanaun*

Knockmaa Hill NHA (Site code: 1288) lies within 1km of the proposed pipeline route. The

proposed construction will not have a direct impact on this limestone knoll, the highest point in the locality.

9.5.5.8 *Bunoghanaun to Templemartin*

It has been stated above that the habitats of interest on this stretch are areas of patchy hazel scrub over limestone where the rock is at the surface and there is a very thin soil cover. While this habitat is not considered of particularly high conservation value, it is becoming increasingly rare in Ireland and it is recommended that measures are taken to ensure that the impact is minimal on the best examples of this habitat type.

9.5.5.9 *Templemartin to Cappagh South*

The well-developed hedgerows are of ecological importance, serving as wildlife corridors and refuges and it is important that they be further assessed and maintained wherever possible.

It is recommended that the local hydrology of this area is investigated, although it appears that the adjacent turloughs have already been damaged through drainage schemes with the exception of the internationally important Rahasane Turlough (W847531). Rahasane Turlough itself lies a considerable distance from the proposed pipeline route and will not be impacted on directly. Indirect impacts may result from the crossing of the River Dooyertha, which feeds into the turlough basin (**Section 10**).

Table 9.22: Designated sites, which may be subject to impact from the proposed pipeline route development.

Site Name	No.	Proximity	Comment/Concern
Carrowmore Lake Complex	SAC 476/SPA	on & adjacent to	East of Glencullin the route crosses the watershed where 476 & 542 meet.
Slieve Fyagh	SAC 542	on & adjacent to	ditto
Bellacorick Bog Complex	SAC1922	on & adjacent to	Of particular concern is the section near Eskeragh where the route is near the base-rich fen – potential impacts on feeder streams.
Lough Conn & Lough Cullen	NHA 519/SPA		See sections 9.5. & 9.7
Carrowmore Lough Shore	NHA 1492	c. 1 km	There should be no impact on this NHA as the pipeline in routed to the west of Manulla.
Carrowkeel Turlough	SAC 475	adjacent to	The proximity of the pipeline has potentially serious implications for the local hydrology, which is crucial to the conservation and management of this turlough, an Annex I priority habitat type in Ireland, under the EU Habitats Directive. Possible impacts on the local hydrology?
Greaghan's Turlough	SAC 503	< 1 km.	No direct impact.

Turlough O'Gall	SAC 331	c. 1 km	No direct impact
Knockmaa Hill	NHA 1288	c. 1 km.	No direct impact

Site Name	No.	Proximity	Comment/Concern
Rahasane Turlough	SAC 322	> 1.5 km	Indirect impacts may result from the crossing of the River Dooyertha, which feeds into the turlough basin. (Section 10)

Table 9.23: Potential impacts on fauna in designated areas

Site Name	No.	Impact
Carrowmore Lake Complex	SAC 476/SPA	Indirectly, the pipeline construction may cause some disturbance to birds utilising the protected bog bordering the lake. The envisaged speed of the construction is such that any additional disturbance in the area will be quite short. Overall development impact is considered to be low.
Slieve Fyagh	SAC 542	Whilst golden plover and kestrel have been recorded in the area, the amount of habitat to be disturbed is limited. Whilst construction may disturb these birds in the short term, they are likely to relocate to elsewhere within the protected site. Consequently, impact is considered likely to be low.
Bellacorick Bog Complex	SAC 1922	Whilst the fringes of the protected site may be additionally disturbed during construction phases, such disturbances are not considered likely to have a significant impact on fauna, especially birds. Where the pipeline traverses the protected site, this again is close to the road, is a relatively narrow development and will be completed in a short time period. The pipeline will be at least a kilometre from the Owenboy Nature Reserve and any associated disturbance effects on birds there is considered likely to be insignificant.
Lough Conn & Lough Cullen	NHA 519/SPA	Lough Conn is host to important populations of birds, but there is likely to be ample habitat within the lough to act as refuge for any birds that are temporarily disturbed by the pipeline construction.
Carrowkeel Turlough	SAC 475	In the absence of interference of the water table of the turlough, the fringes of the site may be disturbed during the construction phase. Such disturbance, if properly timed, is considered unlikely to have a significant impact on fauna.

Site Name	No.	Impact
Greaghan's Turlough	SAC 503	It is considered unlikely to have any significant effects on the associated fauna of the turlough.
Turlough O'Gall	NHA 331	A route has been chosen to avoid the pipeline being constructed close to Turlough O'Gall. As such, therefore, it is not envisaged that there will be any significant effects on the site's associated fauna.

9.5.6 Mitigation Measures for Habitats And Vegetation

9.5.6.1 General

The proposed pipeline has been routed to avoid sensitive habitats wherever possible. However, it is acknowledged that this is not always possible due to engineering and health and safety constraints. For this reason, it is essential that every effort should be made to minimise impacts where they may occur.

The Contractors will be required to provide detailed method statements for work in ecologically sensitive areas. Dúchas will be consulted with regard to the method statements.

9.5.6.2 *Blanket bogs and Raised bogs*

It has been shown in **Tables 9.19** and **9.22** that most of the sensitive bog sites are adjacent to the pipeline rather than being traversed – with the exception of the head of the Glencullin Valley (where two SACs meet).

Where it is necessary for blanket bog or raised bog to be crossed, special reinstatement measures and special construction techniques will need to be employed in order to minimise damage and achieve reinstatement as quickly as possible. All measures are subject to agreement with Dúchas. Prior to construction baseline studies will be undertaken. Reinstated sites will need to be monitored throughout the construction phase and at regular intervals subsequently by an experienced vegetation ecologist who has experience with these habitat types.

It is recommended that the following mitigation measures be implemented where required:

- appropriate construction materials to be used;
- where the pipeline passes through - or is in relative proximity to - any intact bog, fen etc. precautions against undermining and sub-bog drainage such as **inert plugs** should be used around the pipeline channel at distances of 50 metres and measures taken to mitigate against surface damage and compaction.
- stock proof fencing should be used and maintained after construction, so that sheep, in particular, are excluded to reduce surface impact which could lead to erosion and to give the best opportunity for re-growth of the vegetation;
- temporary roads should be constructed on geotextile or bog mats which should be in position for the shortest time possible to avoid die back under the road;
- the trench line only should be turved and the turves kept alive on site by irrigation;
- low ground pressure vehicles should be used for all operations e.g. bog crawlers,

use of floatation tyres etc. in order to minimise the impact on the surface;

- if re-seeding is to be undertaken, this seed should be collected prior to construction and stored – depending on the longevity and capacity to remain viable in storage;
- alternatively seed should be collected from adjacent areas and spread.

As part of the consultative process, a workshop on pipeline construction and habitat reinstatement techniques - with special emphasis on bog reinstatement - was organised for Dúchas personnel. The initial construction techniques addressed above were discussed and views raised taken on board.

9.5.6.3 *Turloughs*

Where the pipeline is routed in the vicinity of turloughs, a hydrological investigation should be carried out into the water regime prior to construction. There has already been a route re-alignment to avoid Turlough O'Gall NHA and its associated geological/hydrological system. The route adjacent to Carrowkeel Turlough has been similarly investigated.

9.5.6.4 *Grasslands*

Any impacts of pipeline construction on agricultural grassland will be minimised. Appropriate pipeline reinstatement techniques will be employed, such as re-seeding with a mix that closely reflects the species composition of the original sward, subject to agreement with the landowner.

Bog mats or other low ground pressure techniques will be use in areas of wet, rushy grassland to minimise disturbance and to prevent excessive compaction.

9.5.6.5 *Trees and Areas of Scrub*

The proposed pipeline has been routed to avoid, wherever possible, substantial areas of woodland and isolated large trees. The crossing of small areas of semi-natural scrub and smaller strips of woodland will need careful construction methods, detailed routing and consideration of timing of works to minimise impact on these areas. Where required, this would be undertaken in consultation with Dúchas and/or the local planning authority. Any other trees that may be affected by the pipeline will be occasional ones within field boundaries and, wherever possible, these too will be avoided by minor amendments to the route.

Any trees within the working width will be left in situ wherever practical and fenced off prior to construction. In the event that some trees need to be trimmed or felled, this will be carried out with as little disturbance to remaining trees as possible.

During pipeline positioning and trench excavation, the fact that tree roots can extend beyond the canopy will be taken into account. Root pruning during excavation can damage tree roots, and this can affect trees some distance away from the pipeline. As well as increasing the chances of a tree dying they also become unstable and more prone to windthrow.

In addition, mitigation measures will include:

- trees only to be felled where required;
- prior to Right of Way clearance, all trees to be removed will be clearly identified;
- all felling will be carried out by experienced and approved personnel;
- reduce working width;
- where it is necessary to remove limbs from trees to facilitate passage of construction traffic, this will be undertaken by experienced and approved personnel;
- where construction traffic has to pass over the roots of trees, protection will be used

to minimise compaction damage. Suitable protection would include subsoil or wooden excavation mats to the extent of the tree canopy;

- where a tree which is to be retained occurs within the topsoil or subsoil storage areas, care will be taken to prevent damage to that tree. Suitable protection shall include the erection of a temporary fence and all spoil being stored outside this fence;
- topsoil will not be stripped from the root zone of trees to the extent of the canopy;
- replace lost trees with native provenance species;
- all newly planted areas to be protected with herbivore proof fencing;
- where necessary, an aftercare programme for scrub reinstatement will be developed and implemented. This shall include replacement of any dead stock for a minimum period of two years after planting.

9.5.6.6 *Hedgerows*

Prior to construction, a field survey will identify the impact of the pipeline on hedgerows. Impacts will be minimised by, wherever possible, routing the pipeline through existing gaps, or sections that are out of character with the hedgerow or which have been poorly managed. Whenever this is not possible, the minimum width of hedgerows will be removed, consistent with safe working and good practice. If the pipeline is bored beneath a crossing e.g. road, any associated hedgerow breach will be reduced subject to access requirements. In this situation, the pipeline will be bored under the hedgerow as well as the crossing. Any length of hedgerow to be removed will be clearly marked.

Under the Wildlife (Amendments) Act 2000 there is provision for further hedgerow protection in the context of the annual protection period. The start of this will be brought forward from mid-April (currently) to 1st March.

All hedgerows removed as a result of pipeline construction will be replanted using indigenous species. Consideration will also be given to other techniques such as cutting the hedgerow flush with the existing ground level to preserve the roots and seedbed. The cut hedgerow can then be covered with a geotextile layer and soil, which is maintained throughout works. The soil and geotextile are then removed to re-expose the hedgerow roots. The only portion of the hedgerow that is totally removed is that over the trench width. However, this technique is limited in its application, as it cannot be used where there are banks associated with the hedgerow.

In addition, other measures will be adopted to reduce the extent and duration of impacts and to maintain the wildlife and landscape value of hedgerows as follows:

- damaged tree branches as appropriate will be treated by a competent tree surgeon and any damaged hedge plants will be pruned or replaced as necessary;
- hedgerow and tree protection will be included in the induction and/or briefing sessions by the contractor to his workforce;
- following soil reinstatement any hedge banks or ditches that were disturbed during construction will be reformed;
- replanting of the hedge (where necessary) will reflect, as far as possible, the original species mix and pipeline integrity requirements. Some additional hawthorn plants may be included to aid rapid establishment and thereby reduce the duration of impact. Although replanting will be undertaken immediately after reinstatement, it is likely that the newly planted sections will remain identifiable for 5 to 10 years;
- hedgerows will be replanted in an appropriate pattern so that they blend with the structure of undisturbed sections;
- all hedge reinstatement will be effected using container-grown plants or root-trained cell grown stock of native origin. All such material will be obtained from reputable

suppliers, and delivered to the site ready for planting;

- all newly planted sections of hedgerow will be protected by a double fence to prevent damage to the young plants from livestock. Rabbit proof fencing shall be installed. Such fencing will be tied into the existing hedge to ensure a stock-proof barrier is formed;
- where required, an aftercare programme for hedgerow reinstatement will be developed and implemented. This will include weed control, maintenance of fencing, scrub clearance and replacement of any dead stock for a minimum period of two years after planting.

9.5.7 Mitigation measures for Fauna

Potential impacts include loss of habitat and wildlife refuge, disturbance to feeding, breeding or overwintering birds, loss of bat roosting sites, destruction of badger setts, and impacts on watercourses (sedimentation and pollution).

Mitigation measures include habitat restoration, maintenance of water table in areas of peat, avoidance of habitats of especial interest, phasing of removal of vegetation with regard to birds and bats, and measures to maintain water quality in watercourses during construction and operational phases, (**Section 10**).

Additional field survey will be undertaken in specific areas, with more detailed survey of the route corridor for badger setts and otter holts.

9.5.7.1 *Birds*

- While pipeline construction should ideally take place *outside* of the principal breeding season for birds, it is acknowledged that is not necessarily feasible in the context of a large linear project;
- on blanket bog habitats, it is preferable to reduce disturbance to overwintering birds, avoiding the November to March period. This will be feasible.

9.5.7.2 *Bats*

- The pipeline will be routed to avoid mature trees. Where trees with the potential to be used as breeding or overwintering bat roosts will be felled, such work will need to be undertaken at an appropriate time of year. These include March, April, May, September, October or November;
- if specialised bat survey reveal any roosts, all bats must be removed by experts, under licence from Dúchas;
- the limestone area west of Caltragh will be checked for presence of bats in caves. Any roosts should be avoided by the pipeline;
- A survey will be undertaken to assess the potential impact on bat roosts in caves/crevices in limestone areas at Knockdoe and vicinity.

9.5.7.3 *Otters*

- Where construction will take place, rivers known to harbour this species will be checked prior to disturbance for presence of otter holts;
- otters, whilst relatively sensitive, will maintain territory on rivers after disturbance and there is not expected to be any long-term impacts on this species.

9.5.7.4 *Badgers*

- It is a requirement that badgers in affected setts be removed, relocated, or evacuated

prior to construction taking place;

- the pipeline route will be checked for breeding or other large setts (main, annexe setts or other active setts). Where active setts are identified the pipeline should be re-routed to ensure a distance of 30 m from the working width to the setts. Where this is not feasible the badgers must be removed under licence by experts. Smaller occasional setts will be blocked off by experts prior to construction taking place also.

9.5.8 Mitigation measures for watercourses

(see also **Section 10**)

- Measures must be taken to minimise sedimentation and pollution of watercourses during construction and operation phases to minimise impacts on scarce protected species such as otter, kingfisher, salmon and freshwater crayfish.
- where permanent or temporary access tracks have to be created during construction or for maintenance in operation phase.

9.5.9 Timing of Construction/Reinstatement

The ideal construction period in terms of minimising ecological impacts is late summer, early autumn. In such instances, the disturbance is likely to be limited and in the medium to long term, bird species are most likely to habituate and re-use previously disturbed sites.

However, with such a large project, this will not be possible and agreement will be sought with Dúchas to ensure impacts are minimised through the most sensitive habitats.

9.5.10 Residual Impacts

9.5.11 "Dry" Habitats

If the appropriate reinstatement techniques and after care are correctly applied, the long-term residual impacts on drier habitats of improved /semi-improved grassland, hedgerows, scrub etc. should be minimal.

9.5.12 Wetlands

In wetland habitats (including bogs, fen, wet heath etc.) the residual impacts will depend entirely on the success of special reinstatement measures which are put in place in order to minimise compaction, erosion, surface drying, drainage (either directly or by capillary action along the pipeline), and chemical change.

9.5.13 Fauna

The proposed pipeline should not affect habitats and vertebrate species to a substantial extent as a result of to careful routing, the limited corridor of operations and the relatively short construction timespan. Habitat reinstatement and appropriate timing should minimise impacts further on sensitive sites and species provided that the construction does not lead to long term changes in habitat quality.

At the southern end of the proposed route, residual impacts on fauna should be minimal provided that habitats of conservation interest such as limestone pavement/outcrop and woodland /scrub woodland/scrub on pavement are avoided.

9.6 Summary of surveys to be undertaken prior to construction

The following provides a summary of the additional surveys required prior to construction:

- more detailed flora and fauna studies will be required on those parts of the route not subject to field survey to date;

- baseline vegetation studies will be necessary along sections of the route specified by Dúchas prior to construction in the following areas:
  - Glencullin Valley stream crossings;
  - Upper Glencullin – at junction of SACs 476 and 542;
  - Eskeragh Fen and environs;
  - SW end of Carrowkeel Turlough
  - Greaghan's Turlough
  - wetland habitat west of Manulla and in the vicinity of Manulla Bridge
- well developed hedgerows will require detailed assessment;
- field surveys will be undertaken to identify badger activity;
- otter surveys will be undertaken along those rivers crossed by the proposed route known to support this species;
- bat surveys in limestone areas west of Caltragh and at Knockdoe;
- baseline hydrological studies will be required in sensitive wetland areas including: blanket bog, raised bog, fen, and in particular in the vicinity of turloughs (Carrowkeel).

10 EXISTING AQUATIC HABITATS

10.1 Methodology

Selection of Crossing Points

Aquatic Services Unit (ASU) were supplied with colour photocopies of 1:50,000 and 1:10,000 ordnance survey maps with the route of the proposed pipeline superimposed on them. Using these, all of the small, medium and large-sized watercourses crossed by the proposed pipeline were listed along with the 8 figure Irish National Grid Reference as measured from the maps. Almost all of these crossings were of named rivers or tributaries of named rivers. Not every crossing marked on the map was selected for assessment, some were thought to probably be too small to be of any great ecological or fisheries importance. It is accepted however that some of the small channels, which have not been selected, may be more important than others and a decision was made that during fieldwork a selection of these would be checked visually to see whether they warranted more detailed assessment.

Notification of Relevant Authorities

Once the main crossings were selected, a tabulated list was sent to the two regional fisheries boards within whose regions the proposed pipeline is due to be laid, namely the North Western Regional Fisheries Board (NWRFB) and the Western Regional Fisheries Board (WRFB). Accompanying the list were the colour maps showing the pipeline route and allowing the recipients to judge whether the selection was adequate from the fisheries standpoint. In addition, photographs of each of the crossing, taken during fieldwork, as well as general substrate and habitat descriptions were supplied for most of the listed crossings.

Meetings

Meetings were held with fisheries, environment and administrative personnel of the two regional fisheries boards to discuss the fisheries implications of the crossings.

Fieldwork

At each proposed crossing point the physical attributes of the channel and banks were measured or estimated and a description of the substrate and habitats present were obtained. A note was made of the composition of the soil in the bank and the principal vegetation type and dominant species present. Note was also taken of the adjoining land-use on each side of the crossing. A list of the main in-channel and marginal aquatic plants were recorded and a qualitative assessment of the macroinvertebrates was made either using pond net sweeps or kick-samples. The EPA macroinvertebrate-based biotic index, used to estimate water quality conditions in Irish rivers, was assigned to each site at which macroinvertebrates were collected. In the present study the index values ranged from Q3 to Q5. Q3 refers to moderately polluted water, Q 3-4 slightly polluted water, and Q4, Q4-5 and Q5 refer to unpolluted water of increasing quality, Q5 being the highest. The fisheries status of each site was gauged based on substrate, depth, velocity and general channel habitat characteristics.

10.1.1 Selected Crossings

Table 10.1 lists the names of the **22 selected** crossings, along with their national grid references, locations catchment and general habitat features. **Appendix 10.1** presents the detailed results of fieldwork at each proposed crossing point including a description of the physical characteristics of the river channel at the crossing, bankside dimensions, bankside soil composition, bankside and in-channel vegetation, fisheries habitats and estimated fisheries value based on site characteristics and macroinvertebrates. Note that the precise location of a number of crossings have been altered since fieldwork. These principally include the Castlebar River whose final crossing point is 750m further downstream of the study reach and the Manulla River, which will be crossed 1150m upstream of the study reach reported on in the detailed site descriptions. Despite these changes, however, the results of the fieldwork at the original proposed crossing points for both these rivers are considered likely to be broadly representative of that of the finally chosen crossings.

Table 10.1 Selected Principal Watercourse Crossings

No.	River Name	Catchment	Grid Ref.	Additional Info/Townland	Dimensions etc.	Substrate
1	Unnamed Tributary of Carrowmore Lake (east side)	Owenmore	F 8703 3132	Muingingaun	W 3.5m D 13cm Clear water	Riffle/ glide/pool
2	Unnamed Tributary of Carrowmore Lake (east side)	Owenmore	F 8699 2955	Glenturk More	W 1.5 m D 5-7cm	Cobbles / boulders Peat silt & algae
3	Unnamed Tributary of Carrowmore Lake (east side)	Owenmore	F 8841 2767	Glenturk Beg	W 2m Brown scum and trailing algae present on stones	Boulders, cobbles and small stones
3a	Glencullin River	Owenmore	F 8900 2702 to F 9242 2500	Glencullin Upper	Not surveyed	Not surveyed
4	Oweniny River	Owenmore	F 9722 2039	500m Upstream of Bellacorick Bridge	W 18-23m D 10-30cm Glide-riffle	Cobbles and boulders Peat silt & trailing algae in slacker flows
5	River Muing	Owenmore	G 9805 1995	1 km east of Bellacorick	W 4.5m D 30cm	Peat silt on gravel Water discoloured
6	Shanvolahan River	Lough Conn / River Moy	G 0617 1801	Downstream of Road Bridge	W 5m D <15cm Shallow glide – riffle/glide	Small stones & gravel Cloudy

No.	River Name	Catchment	Grid Ref.	Additional Info/Townland	Dimensions etc.	Substrate
7	River Deel	Lough Conn / River Moy	G 0756 1490	Carrowgarve South (NW of L. Conn)	W 18m D 50-60cm Glide (v. slack)	Boulders and cobbles on coarse gravel
8	Castlehill River	Lough Conn / River Moy	G 1142 1095	ENE of Lahardaun (W of L. Conn)	W 5-6m D 5-14cm shallow riffle glide/riffle	Cobbles, small stones and gravel Clear
9	Lecarrow River	Lough Conn / River Moy	G 1254 0995	Ballymac-redmond (Laharadaun)	W 1.5-2m D 10-24cm Riffle/pool turbulent	Boulders, cobbles, gravel Clear
10	Addergoole River	Lough Conn / River Moy	G 1492 0920	Cuilkillew (W of L. Conn)	W 6-7m D 1m Deep pool /glide, slack	Peaty
11	Clydagh River	Lough Cullin / River Moy	M 1820 9404	~1 km downstream of Clydagh Bridge	W ~11m D 30-50+cm Glide & pool (slow to mod flow)	Coarse and fine gravel and coarse sand
12	Castlebar River	Lough Cullin / River Moy	M 1903 9278	WSW of Turlough (Leckeen)	W ~8m D 50cm Pool/glide Mod-slow	Peaty mud ?
13	Manulla River	Lough Cullin / River Moy	M 2089 8831	W of Manulla Br. Kilknock	W 12-15m D 1m (+)? Dead slow	Peaty/mud ?
14	Stream to Needhams Lough	Lough Cullin / River Moy	M 2342 8413	2 km east of Ballagh	W 3.5m D 40cm Slow, mod/slow	Cobbles, small stones gravel and silt; clear

No.	River Name	Catchment	Grid Ref.	Additional Info/Townland	Dimensions etc.	Substrate
15	Robe River	Corrib (via L. Mask)	M 2905 7136	Between Hollymount and Claremorris	W 9m D 30-60cm (glide/riffle) mod/swift	Boulders on fine gravel & coarse sand
16	Black River	Corrib	M 3216 5893	Upstream of Ardour Br.	W 3m	Muddy, plant-choked
17	Kilshanvy River (upper trib. of Black River)	Corrib	M 3217 5800	Near Kilshanvy	W 4-5m D 60cm (very slack flow)	Plant -choked on silt
18	Togher River (trib of Black River which flows to Lough Corrib)	Corrib	M 3283 5430	Cloonbar	W 3.4-5m D 10-30cm (slack glide)	Peaty
19	Clare River	Corrib	M 4166 3373	0.7km upstream of Cregmore Bridge 5km ENE of Claregalway	W 15m D 20-40cm riffles; 40cm+ pools (mainly glide)	Cobbles & boulders
20	Lavally River	Clarinbridge	M 4804 2570	1.3km SW Athenry	W2.5-3.0m D 7-13cm (glide, riffle/glide)	Boulders, cobbles and small stones
21	Eiscir River	Clarinbridge	M 4931 2480	2.5km SSW Athenry	dry	Boulders and cobbles
22	Dooyertha River	Dunkellin	M 5215 2156	1.5km NE Craughwell	W 4-8m D 15cm (Very slack glide/pool & riffle) Dry downstream	Cobbles, gravel and boulders

10.1.2 Fisheries Overview of Watercourses Crossed by Pipeline

The proposed pipeline route crosses over 8 significant and 13 medium to minor watercourses ones on its way through County Mayo and County Galway traversing two fisheries board regions, NWRFB to the north and WRFB to the south. The principal catchments traversed are the Lough Carrowmore – Owenmore System of North West Mayo, Lough Conn / River Moy Catchment, which drains north eastern and central Co. Mayo and the River Clare / Lough Corrib System which drains central and southern County Galway. Notable watercourses in the list include the Oweniny which is an important spawning and nursery river in the Owenmore catchment, the Deel which is an important salmon and trout recruitment and angling water in the Lough Conn / Moy catchment, the Robe which is an important brown trout fishery in the Corrib and the Clare which is an important salmon and trout angling river in the Corrib system. Finally, the Glencullin River (crossing no. 3a) has also been listed even though the proposed route does not cross the river. Its inclusion after consultation with the North Western Regional Fisheries Board, is to highlight the fact that the proposed route passes very close to its northern bank for about 3km where several minor streams draining to it are traversed by the pipeline route. The Glencullin is the main spawning river of the entire Owenmore system and the stretch in question is the most valuable on the river. Many of the lakes and rivers in these catchments are famous for the quality of their salmon, seatrout and brown trout fishing and consequently represent and an important source of tourist revenue to the entire region.

Coarse fish or fish angling do not appear to be a feature of the crossings along the proposed route. The possible exception to this is the likely presence of some pike in the larger slow-flow waters of rivers such as the Castlebar and the Manulla. Eel (*Anguilla anguilla*) are also likely to be widespread within the system.

Lampreys, primitive jawless fish which are of no commercial or recreational value in Ireland but which are protected under European environmental legislation due to their widespread decline especially on the Continent, are likely to be widespread within the catchments in question. Lampreys are known to occur in both the Lough Conn / River Moy catchments and the Corrib System. The recorded species are *Petromyzon marinus* the Sea Lamprey and *Lampetra planeri*, the Brook Lamprey. *Lampetra fluviatilis*, the River Lamprey has not been specifically identified in these waters but may well occur there also. Lampreys are also likely to occur in the Owenmore system although they do not appear to have been recorded there to date, (Kurz &Costello 1998).

10.1.2.1 *Fisheries Status of Individual Watercourses and Crossing Points*

The following account of the fisheries status of the crossings is based firstly and principally on information supplied by the NWRFB and the WRFB in writing and during consultation. This is supported by on-site habitat evaluation undertaken as part of the Environmental Impact Assessment as well as background information supplied by Regional Fisheries Board publications and Dr. Martin O'Farrell, fisheries consultant. The 22 numbered crossings are discussed in a north - south direction. Although the list is considered to be comprehensive, it may not be exhaustive and Fisheries Board personnel will have an opportunity at any stage to point out any small crossings which may have been overlooked by the screening and fieldwork procedures and which may be of fisheries significance.

Crossings 1-3 Tributaries of Carrowmore Lake

The tributaries of the Carrowmore Lake are small spawning and nursery streams, probably mainly for seatrout but in the case of Crossing No.1 in the townland of Munigingaun, salmon are known to spawn there also. In fact there is some evidence that the crossing stretch in this small stream may be the most productive of the three in terms of salmonid recruitment. The other two are somewhat torrential, appear to suffer from significant bankside erosion and are showing strong signs of peat siltation and some nutrient enrichment

3a Glencullin River

The Glencullin River is considered the most important seatrout spawning river in the entire Carrowmore Lake / Owenmore system and therefore of prime importance from a fisheries standpoint. It was subject to catastrophic flood-related landslide siltation just three years ago, which may have temporarily reduced its recruitment capacity and it is important that the proposed development does not impact on it. Although the pipeline route will not cross the Glencullin, it is very close to it (50-200m) over a length of about 3.3km (F 8900 2702 – F 9242 2500) in the townland of Glencullin Upper. Along this stretch it also traverses 8 small streams/drains flowing directly to the Glencullin. For this reason there will be considerable opportunity for sediment from the construction to enter the spawning areas of the river. There is also a possibility that these minor side streams may be utilised for a limited amount of spawning. It is important to point out that the ground in question is steep and quite possibly prone to erosion once the topsoil layer is removed.

Crossing 4 Oweniny

The Oweniny is an important upper tributary of the Owenmore and is an important seatrout and salmon river. The wide shallow stretch of river, which will be crossed, is 500m upstream of Bellacorick Bridge. This is principally a nursery / feeding stretch and most of the principal spawning areas are further upstream. There was evidence of both peat siltation and a degree of eutrophication (trailing filamentous green algae growth) during the site visit to the proposed crossing point.

Crossing 5 River Muing

The Muing, which is part of the Owenmore catchment, has a sluggish flow and peaty bottom and does not appear to be of any fisheries significance.

Crossing 6 Shanvolahan River

The Shanvolahan River is has suffered significantly from peat siltation in the past with a consequent reduction in water quality, although in recent years it has improved somewhat. It is a spawning / nursery tributary stream of the River Deel (making it part of the Lough Conn / Moy System) and has undergone significant fisheries development / rehabilitation in recent years. The later work under the Tourist Angling Measure (TAM) was undertaken just upstream of the confluence with the Deel in the main spawning areas.

Crossing 7 River Deel (Knockbrack)

The River Deel is an important trout angling and spawning river with salmon also important. It is one of the main tributaries of Lough Conn, joining it east of Crossmolina. The stretch being crossed by the proposed pipeline is a pool/glide stretch for at least 200m, which would be suitable for fish holding and perhaps angling. However, further downstream there are important areas of spawning.

Crossing 8 Castlehill River

The Castlehill River is a western tributary of Lough Conn with excellent water quality and all along the crossing stretch holds excellent spawning and nursery habitats for salmon and trout. Furthermore, considerable EU and national funding has already been invested under the TAM in respect of fisheries enhancement works on this river.

Crossing 9 Lecarrow River

The Lecarrow River is also a western tributary of Louh Conn, situated just south of the Castlehill River, which it resembles in many respects although smaller. Although salmon spawning does not take place at the site of the proposed crossing some spawning occurs further downstream.

Crossing 10 Addergoole River

The proposed crossing point in the Addergoole is deep and slow flowing and therefore not suitable for spawning. Nevertheless the river, which is a tributary to the southern basin of Lough Conn holds salmon and trout spawning habitats upstream and downstream of the proposed crossing point.

Crossing 11 River Clydagh

The Clydagh holds stretches of salmon and trout spawning and in recent years has undergone considerable fisheries rehabilitation work, which includes the opening of an impassable falls to fish passage and spawning upstream of the proposed crossing point. There has also been a return of spring salmon in recent years. The proposed crossing stretch may not be a spawning area but very important spawning habitat is present in the stretch immediately downstream.

Crossing 12 Castlebar River

The Castlebar River holds large brown trout and pike, the latter, which are subject to culling by the fisheries board to improve the trout survival. It is an important brown trout angling river and has recently be heavily promoted by the NWRFB in a angling brochure produced by them. Spawning and nursery habitats are absent either at or downstream of the crossing.

Crossing 13 Manulla River

The Manulla is also a part of the Lough Conn / Moy system. The proposed crossing point, which is deep and canal-like, does not hold any salmonid spawning. However, the river does include some salmonid spawning and in particular, spring salmon spawning (upstream).

Crossing 14 Stream to Needhams Lough (Loughnaminoo Stream)

The Loughnaminoo stream is small and sluggish and although it may hold some small brown trout, is not believed to be of any fisheries importance. It can be crossed at any time of year.

Crossing 15 Robe River

The Robe River is the most northerly crossing in the Western Fisheries Board Region. It is an important tributary of Lough Mask contributing about 50% of the fish to that lake, as well as being an important trout fishery in its own right; pike are culled in the river and the lake (Rogers and de Barra 2000). The water quality of this hard-water river began to deteriorate in the late 1970's and early 1980's and the river reaches both upstream and downstream of the proposed crossing point have been slightly to moderately polluted for several years (EPA 1999). The catchment of the Robe is the subject of several in-depth investigations by the EPA and the Western Regional Fisheries Board into diffuse and point source pollution with particular emphasis on phosphorus sources, especially from agriculture. Eutrophication in the River has resulted in a deterioration in the brown fishery something, which is thought to be having an adverse knock-on effect in Lough Mask where trout catches have declined since 1981 (see Rogers and de Barra, 2000 for overview). The proposed pipeline crossing point is not a spawning or nursery area but probably holds larger fish. A large pool about 100m downstream may be suitable for angling, and angling certainly takes place at Hollybrook further downstream.

The Robe also holds an important riverine population of the White-Clawed Crayfish. As this is a protected (Annex II) species under the EU Habitats Directive it must also be taken into account when planning and timing the pipeline crossing.

Crossing 16 River Black (upper reaches)

The proposed route crosses the River Black at a very insignificant crossing point which at the time of the survey was virtually dry.

Crossing 17 Kilshanvy River

When monitored by the EPA in 1997 the bridge at Kilshanvy just downstream of the proposed crossing was shown to be un-polluted (Q4) but previously had been slightly polluted. The proposed crossing point of the Kilshanvy River is slow and plant-choked and more than likely of very little or no importance from a salmonid fisheries standpoint. There was a substantial population of stickleback present during sampling.

Crossing 18 Togher River

The Togher River is a small tributary of the Black River, which flows to Lough Corrib. Its water quality does not appear to be monitored by the EPA but samples taken during the present EIS indicate unpolluted conditions. The proposed crossing point is shallow and plant-choked and it is most unlikely to judge from the size of the channel and the nature of the habitats that it is of any importance from a salmonid fishery standpoint. However, some brown trout may be present.

Crossing 19 Clare River

The Clare River is an important brown trout fishing river and tributary of Lough Corrib. This is another hard-water river whose quality has deteriorated significantly since the late 1970's and much of its length is now slightly to moderately polluted. Nevertheless, the river remains a very important fishery for both brown trout and salmon. The proposed crossing-point and further downstream comprises good feeding and holding areas, and angling is carried out throughout the stretch.

Crossing 20, 21, 22 Lavally / Clarinbridge River & Dooyertha River

The most southerly part of the proposed pipeline route crosses two small upper tributaries of the Clarinbridge River which flow to Galway Bay ESE of Galway City. The first of these, Crossing No. 20, is of an unnamed river, which is an upper extension of the Lavally River also know as the Clarin or Clarinbridge River. The more southerly crossing, No. 21, is of the Eiscir River another upper tributary of the Clarin, which eventually joins up just below both crossings and flows on to become the Clarinbridge River. The crossings are SW and SSW of Athenry. The Lavally / Clarin River is a salmonid river with Salmon spawning taking place upstream and immediately downstream of Athenry and in the lower reaches upstream of Calrinbridge (pers. comm. Mr. Kevin Rogers WRFB). However, the area of the crossing (No. 20) is not noted as a spawning area. The Escir River (crossing No. 21) is a temporary watercourse and is therefore unlikely to be of great fisheries importance.

10.1.2.2 *Macroinvertebrates*

The macroinvertebrate status of the watercourse crossings was typical of riverine waters in Ireland generally and reflected the predominance of riffle-type habitats in watercourses whose quality was either unpolluted or slightly polluted. It is likely that in some cases the diversity of the insect fauna would have been more diverse in term of both mayflies and stoneflies in particular earlier in the season. Nevertheless the assemblages recorded in each case are considered to have been quite representative of the range normally occurring at the crossings. A full list of the species taken at each of the proposed crossing points is given in **Appendix 10.1** – Detailed Site Descriptions.

Frequently encountered groups were *Heptageniidae*, *Ephemerella* and *Baetis* (mayflies), *Leuctra* (stoneflies), *Rhyacophila*, *Hydropsyche* and *Sericostoma* (caddisflies), *Elmidae* (water beetles), *Simuliidae* and *Chironomidae* (midges) *Gammarus* (crustaceans), *Potamopyrgus*, *Lymnea*, *Valvata*, *Bithynia* and *Physa* (snails) and *Glossiphonia* (leeches). Harder and slower-flow water saw a greater diversity and abundance of snails (e.g. the Manulla and Togher rivers). Water

beetles other than Elmidae, were not particularly common at any site, the sole exception being the Manulla River. None of the macroinvertebrates taken in net-sweeps or kick-samples is know to be rare. One noteworthy species, is the White-clawed Crayfish (*Austropotamobius pallipes*) which is protected under EU legislation and is known to occur in many hard waters in Ireland. It was very abundant at the River Robe proposed crossing point where both adults and juveniles were very common despite the slightly polluted conditions prevailing. The young hatch out in April while still being carried underneath the female who retains them until early July when she releases them. One specimen was also taken in a kick sample in the River Deel at Knockbrack (Crossing No.7).

10.1.2.3 *Aquatic Macrophytes*

In-channel and emergent vegetation was dominated by a small range of species which included the mosses *Rhynchostegium riparioides* and *Fontinalis antipyretica*, in swift flow riffles, and *Potamogeton natans*, *Myriophyllum* cf. *alterniflorum*, *Sparganium emersum*, *Nuphar lutea*, *Lemna Minor. L. triscula* and *Callitriche* spp. in moderate to slow flow situations. Emergents tended to be dominated by *Apium nodiflorum*, *Sparganium erectum*, *Phalaris arundinacea*, and herbs such as *Valeriana officinalis*, *Mentha aquatica*, *Equisetum fluviatile* etc. Diversity at most sites was relatively low. None of the plants encountered is rare or protected. A full list for each site is given in **Appendix 10.1** (Detailed Site Descriptions).

10.2 Aquatic Habitats: Impacts and Mitigation

10.2.1 Relevant Characteristics of the Development

10.2.1.1 *Crossing Methodology in Brief*

As a preamble to a discussion of the potential impacts of the pipeline construction on the watercourses being crossed, reference should be made to **Section 6.0**.

10.2.2 Potential Impacts

10.2.2.1 *General*

Essentially, the principal impacts from the proposed pipeline construction at watercourse crossings relate to the evolution of suspended sediment from the works at crossing points. Other potential impacts include destruction of habitat, prevention of fish passage through flumes / temporary culverts and pollution caused by the accidental spillage.

10.2.2.2 *Potential Sources of Suspended Solids*

(i) Bankside excavations;
(ii) run-off from sloping bankside ramps;
(iii) installation of temporary running track and flumes in dry-cut crossings;
(iv) removal of running track;
(v) bank reinstatement;
(vi) riverbed reinstatement;
(vii) pipeline trench excavation in wet open-cut crossings;
(viii) de-watering of trenches and other excavations.

It is important to note that some soils and bankside materials may be more likely to erode and give rise to suspended solids than others, especially sandy or silty soils and these will be treated with greater care.

10.2.2.3 *Potential Impacts of Excessive Suspended Solids*

(i) smothering of fish spawning redds

Salmon and trout eggs or fry present in spawning redds may be smothered by excessive deposits of silt or spawning fish may avoid traditional spawning areas if these are covered in silt deposits. It is likely that spawning lampreys would suffer the same fate as their spawning requirements are very similar to those of salmonids. Salmonids spawn and fry hatch in the period October to the end of April. Coarse fish spawn in the period May to June

Coarse fish lay their eggs among aquatic weeds and it is reasonable to assume that these too would succumb to excessive amounts of suspended solids in the water column.

(ii) fish health damage

Fish gills are susceptible to abrasion by excessive exposure to elevated suspended solids levels, which in turn can give rise to health problems in the form of gill disease. Younger fish tend to be more susceptible. Direct fish mortality from elevated inert solids is rare.

(iii) Interference with angling

Excessively turbid waters are likely to reduce or eliminate angling success (game and coarse angling), which would be particularly problematic during periods of intense angling activity, fishing competitions and in waters where anglers are paying large fees to fish. The proposed pipeline potentially affects examples of each of these types of water.

(iv) smothering of macroinvertebrates

Aquatic macroinvertebrates including, insect larvae, molluscs (snails and bivalves), crustaceans (shrimps and crayfish), leeches and worms etc., may be smothered by excessive deposits of silt from suspended solids. Moreover, deposits of silt in otherwise stony substrate gives rise to a change in the macroinvertebrate species composition favouring less diverse assemblages.

(v) smothering or stunting of aquatic plant communities

Aquatic plant communities, especially submerged growths, are likely to be eliminated or stunted by excessive deposition of suspended sediment or a reduction in photosynthesis due to excessive water turbidity.

10.2.2.4 *Fish Passage*

If the flumes or other temporary crossing structures placed in watercourses are undersized or poorly installed they may present a barrier to fish passage either through excessive water velocity or physical obstruction. This would be particularly detrimental in certain watercourses if it occurred during the spawning season when migratory salmonids were moving upstream.

10.2.2.5 *Habitat Destruction*

The proposed pipeline will cross a number of rivers where spawning habitats are known to occur at or immediately downstream of salmonid short stretches of spawning habitat. It may not be possible to re-instate these successfully using the stockpiled excavated river material.

Pools or other in-channel fish lies may be removed or damaged by the construction of a crossing.

Certain banks-side features e.g. vegetation or bank overhangs may facilitate the temporary residence of catchable fish at a particular spot in a river. Their removal may reduce the value of such stretches for angling. In the case of the Clydagh, both banks, but especially the northern bank, are very heavily timbered with many

large deciduous trees overhanging the channel.

10.2.2.6 *Pollution from Bulk Liquid Cement and Fuel Oil*

The use of bulk liquid cement in some situations for bedding the pipe within the trench may possibly lead to spillage of liquid cement to a watercourse giving rise to a sharp increase in pH and potentially giving rise to very serious fish kills. Spillage of fuel, lubrication or hydraulic oils either from bulk storage or from construction vehicles or plant and equipment operating close to watercourses or drainage ditches which connect to watercourses may cause damage to aquatic flora and fauna communities.

10.2.3 Mitigation

In order to minimise the potential impacts of the construction on watercourses of fisheries, macroinvertebrates and aquatic plants, particularly those arising from excessive suspended solids release, a wide range of direct and indirect mitigation measures will be employed. These fall under the headings:

- Method Statements and briefing;
- appropriate crossing method;
- appropriate design & materials;
- appropriate timing of crossings;
- fish rescue;
- adequate reinstatement;
- re-routing;
- consultation and notification.

10.2.3.1 *Method Statements and Briefing*

During the detailed design phase the Operator and/or their Contractors will produce detailed Method Statements covering, among others, the crossings of watercourses. Each Method Statement will be designed to minimise the production and escapement of suspended solids to watercourses and will be agreed with the appropriate Regional Fisheries Board. The Operator will undertake to brief all site engineers and construction personnel on environmental issues, including agreed pollution prevention and control methods, before going on site.

10.2.3.2 *Appropriate Crossing Methods*

Section 6.0 outlines the three main crossing methodologies to be employed during construction and broadly the categories of watercourse for which each will be used. However final decisions on the crossing method to be used in individual cases will be agreed in consultation with the Regional Fisheries Boards and if necessary other responsible authorities as well.

10.2.3.3 *Appropriate Design & Materials*

The design of temporary crossing points and the materials used therein will be appropriate to the watercourse being traversed and the flow it is likely to hold during the construction period. The velocity of water through pipes used in flumes will not be high enough to prevent the passage of fish upstream. Nor will the presence of the flume present a physical barrier to the upstream passage of fish.

All imported fill and re-instatement material used for banks and pipeline trenches in and at watercourses will be chosen in order to reduce the potential for erosion or suspended solids creation. All fill, either imported or re-cycled from the site, which is used for re-instatement of spawning gravel or nursery areas or other in-stream habitats will be selected only after agreement with the relevant Fisheries Boards.

10.2.3.4 *Preferred Crossing Times and Crossings requiring Particular Attention*

From the fisheries point of view the timing of the crossings are considered critical by both Fisheries Boards. This includes the timing of both in-channel and bankside works. In the case of rivers and streams with prime salmonid spawning these should take place in the period May to September inclusive in order to avoid the hatching and early juvenile stages early in the year and the spawning period late in the year. Where a river has both spawning and angling interests, generally speaking, the spawning interests should still take precedence. Where a river, such as the Castlebar is more important for angling, then some effort should be made to construct such crossings during the closed season (October to January). Where rivers or streams have little or no fisheries importance, crossings can be made at any time of year. In the case of all rivers every effort should be made to minimise the time during which any bankside or in-channel works are taking place, this is particularly the case for prime angling areas such as the Deel, the Castlebar and the Clare.

In the case of the Glencullin River, it is recommended that the proposed crossing points of the tributary streams along its northern bank are carefully assessed by NWRFB personnel and the Operator and/or their Contractors prior to construction. This should if necessary allow for localised 'tweaking' of the route and agreement on final Method Statements in order to minimise opportunities for silt escapement.

The Robe is important for its healthy crayfish population as well as its fishing and should be crossed if possible in the August-September period in order to minimise possible adverse impacts on this protected invertebrate.

Although there is no spawning on the Clare River in the area of the crossing or downstream, the WRFB have expressed a preference to confine the work on the crossing to the period May to October. Certainly in terms of water depths and accessibility this would be preferable. Also, there would be less chance of heavy or prolonged rain contributing to silt run-off from the associated bank earth works. However, it would be imperative to complete the crossing as promptly as possible in order to minimise any negative impact on angling downstream. In this respect, the nature of the river bed material may be critical because it may contain some limestone pavement which might slow the progress of trench excavation.

Table 10.2 lists each of the crossings and summarises the fisheries information available for each and presents the preferred crossing window for each. The latter have been directly quoted from documentation received from the relevant Fisheries Boards personnel or inferred from discussions with them.

Table 10.2 Fisheries Summary - Pipeline River Crossings

No.	River Name	Principal Fisheries Type	Habitat type	Fisheries Status of Crossing Stretch	Recommended Crossing Window
1	Unnamed Tributary of Carrowmore Lake (east side)	salmon & seatrout	spawning and nursery	moderate	May to September
2	Unnamed Tributary of Carrowmore Lake (east side)	seatrout	spawning and nursery	minor	May to September
3	Unnamed Tributary of Carrowmore Lake (east side)	seatrout	spawning and nursery	minor	May to September
3a	Glencullin (minor tributaries)	salmon & seatrout	spawning and nursery	very important	May to September
4	Oweniny River	salmon & seatrout	nursery	moderate	June to September
5	River Muing	unknown	unknown	very low	May to September
6	Shanvolahan River	salmon and trout	nursery; spawning downstream	moderate	May to September

No.	River Name	Principal Fisheries Type	Habitat type	Status of Crossing Stretch	Recommended Crossing Window
7	River Deel (Main channel)	salmon & trout	feeding / holding area; spawning and angling downstream	moderate	May to September
8	Castlehill River	salmon & trout	spawning & nursery	important	May to September
9	Lecarrow River	salmon & trout	spawning & nursery	moderate	*May to September
10	Addergoole River	salmon & trout	holding area; spawning and nursery downstream	moderate	May to September
11	Clydagh River	salmon & trout	spawning and nursery, spawning downstream	moderate	May to September
12	Castlebar River	trout & pike	holding	moderate	**year around
13	Manulla River	trout & pike	holding	low	year around
14	Stream to Needhams Lough	small trout ?	unknown	very low	year around

* another time will be considered (NWRFB), ** an October to January timing should be considered (NWRFB).

No.	River Name	Principal Fisheries Type	Habitat type	Importance of Crossing Stretch	Recommended Crossing Window
15	Robe River	trout	feeding, holding / angling downstream	moderate	*August to September
16	Kilshanvy River (upper trib. of Black River)	unknown		very low	year around
17	Black River	unknown		very low or none	year around
18	Togher River (trib of Black River which flows to Lough Corrib)	trout	nursery	low	year around
19	Clare River	trout (mainly) and salmon	feeding / holding and angling	very important	May to September
20	Lavally River - Clarinbridge	salmon and trout	nursery-spawning	moderate	May to September
21	Eiscir River - Clarinbridge	seasonal or temporary watercourse	n/a	n/a	year around
22	Dooyertha River - Dunkellin	seasonal or temporary watercourse	n/a	n/a	year around

* This crossing window will also be one of the better summer periods for minimising the impact on the crayfish population in the Robe.

10.2.3.5 *Adequate Reinstatement*

All watercourses will be re-instated to their pre-construction condition including channel and banks. Some modification of bank materials may have to be considered in some cases to ensure greater stability. Spawning gravel will be replaced either with imported or native material if some is lost from a site or degraded during construction. Where silt is inadvertently deposited on spawning beds during construction, these will be removed by raking immediately post construction. Pools and other in-channel features damaged or altered during construction will also be reinstated. All the re-instatement designs methods and materials will be agreed in advance with the Fisheries Boards.

10.2.3.6 *Fish Rescue*

Although in most situations salmonid and coarse fish are likely to be able to avoid crossings during construction, it is likely that in certain important fishery waters or at certain times of the year, fish may have to be removed from the area immediately downstream and upstream of a crossing. The requirement for and methods of fish rescue will be decided in consultation with the Regional Fisheries Boards. This work will be undertaken by the Fisheries Boards themselves or by contractors approved by the Fisheries Boards, and the work will be supervised by Fisheries Board personnel.

10.2.3.7 *Consultation and Notification*

From the outset and throughout the planning, design and implementation phase of the project very close contact will be maintained between the project management and the statutory fisheries bodies. This will include consultation on matters such as, crossing methods to be employed, Method Statements, timing of crossings, the necessity of fish rescue, re-instatement etc. Liaison procedures / contact personnel will be agreed in advance between the project management/contractors and the Fisheries Boards in order to avoid confusions and misunderstandings in relation to notifications, Method Statements, deadlines etc. At all times the project management will provide adequate notice (to be agreed) to the Fisheries Boards when they are beginning any works at water course crossing.

10.2.3.8 *Re-Routing*

Where all other feasible mitigation methods have been examined and considered either insufficient or unemployable, then re-routing of the line will be considered in order to avoid causing damage to valuable fisheries. A minor re-route should be considered in the case of the Clydagh River to avoid unnecessary removal of the tall trees lining the channel beside the crossing. Minor re-routes in the crossings over the Glencullin River streams (on the northern bank of the river) could help to minimise the potential for silt escapement to the Glencullin itself and should therefore be explored with the NWRFB. Such minor re-routes would be the subject of further detailed design.

10.3 Residual Impacts

10.3.1 Impact on Spawning

Provided construction can be undertaken during the periods agreed and if spawning beds affected by the works are reinstated to approved specifications, then there should be no impact on the spawning capacity of any of the watercourses crossed.

10.3.2 *Impact on Angling*

It is likely that some residual impact on angling is likely to arise at some crossings for anglers. This may be the case on the Deel, the Castlebar, the Robe and the Clare in particular. However, adequate notification to Fisheries Boards as outlined, as well as a commitment to rapid completion of all in-channel works likely to result in increased water turbidity, should minimise the duration and severity of this impact. Minimisation of angling impacts may depend in some areas on the adequate reinstatement of bankside structures and vegetation and in-channel features such as pools if these have been affected by the construction work.

10.3.3 *Impact on Aquatic Macroinvertebrates*

Temporary local damage to macroinvertebrates is likely at and immediately downstream of crossing points. However, this will be minimised by the use of the crossing protocols outlined, which will reduce siltation. Furthermore, rapid replacement and re-colonisation of the affected areas is likely to be effected by drift and migration from the immediate upstream area if riverbed reinstatement has been undertaken correctly.

10.3.4 *Impact on Aquatic Flora*

Temporary local damage to aquatic plant assemblages is likely at some plant-choked crossings, at and immediately downstream of the crossing points. However, re-vegetation of the affected areas is likely to occur at the latest at the outset of the next growing season, particularly if the re-instatement process has been carried out properly.

11. SOILS AND GEOLOGY

11.1 Introduction

This chapter describes the solid geology, drift geology and soils along the proposed pipeline route. Because the pipeline follows an essentially cross-country route, natural ground features and sub-surface ground conditions are of primary importance.

A basic understanding of the ground is essential in order to appreciate the potential impacts of pipeline construction on:

- Aquatic and terrestrial habitats (direct and indirect effects)
- Economic minerals (such as natural aggregates and metaliferous ore minerals), which may be sterilised or made less accessible
- Landscape features which may derive much of their form from the underlying geology
- The safety and integrity of the pipeline
- The ease of pipeline construction and thus costs and logistics
- The ease and success of reinstatement.

The description of the physical environment presented in the first part of this chapter is followed by a summary of the impacts arising from pipeline construction and the measures proposed to mitigate those impacts.

The information contained within this section is based, primarily, on a desk study of a 1km wide corridor centred on the pipeline route. The desk study has included the examination of geological maps (both published and manuscript), geological memoirs and other geological references, as well as stereo monochrome and colour aerial photographs. Much of the desk study work was carried out as part of the route selection process.

Geological information has also been obtained from the geotechnical site investigation work carried out (and currently still in progress) along the pipeline route. The whole of the pipeline route has been driven and viewed from vantage points, and selective parts have also been walked.

11.2 Geology

For the purposes of this report, the geology has been divided into 'solid' (or bedrock) and 'superficial deposits' (which includes glacial and post-glacial soil materials).

Given the relatively shallow trenching depth employed during cross-country pipeline construction (typically around 1.8-2.0m for a 660mm diameter pipeline), it is the uppermost, mainly soil deposits, which are of most importance when considering pipeline trench excavation (and hence pipeline routing). The ability of the soil to stand up in the sides of the trench, to be able to support the weight of the pipe and to provide suitable bedding and backfill material, are key issues in this respect.

Bedrock can be important, however, if it is encountered within trenching depth, because of the extra effort required in excavating the trench. The strength of the rock, and its state of weathering

and fracture, are then key issues. The angularity of the rock, both in situ and as backfill, is also important because of the potential to damage the corrosion protection coating to the pipe.

Where non- open cut techniques, such as auger boring, thrust boring and micro-tunnelling are utilised (mainly for major road/rail crossings), the presence of rock at shallow depth is also more important; since these techniques tend to involve deeper construction, although rarely exceeding 6m.

Where horizontal directional drilling (HDD) is required (e.g. at major river crossings), drilled depths exceeding 10m may be reached and, therefore, the solid geology becomes an important (sometimes constraining) factor.

These techniques are described in Chapter 6.

11.2.1 Superficial Deposits (Drift)

There is little in the way of published information on superficial deposits along the proposed pipeline route. The Geological Survey of Ireland (GSI) has manuscript copies of 1:10,560 (6inch to the mile) drift maps that date from the early 1900s. These give a broad indication of types of drift (viz. Boulder Clay, sand and gravel, alluvium, bog) and identify areas where drift is absent (e.g. rock outcrops), but do not provide a detailed picture of the variation in type or thickness of superficial soils.

A useful summary of the superficial soils along the southern half of the route is also given on the map 'Quaternary Geology of Mid-Galway, South Mayo and North Clare' presented in Drew and Daly (1993).

However, for a detailed understanding of the superficial soil types along the route, recourse has to be made to site investigation data and to site-specific geomorphological studies (such as interpretation of stereo aerial photographs). Geomorphological studies allow near surface soil and rock conditions to be identified by virtue of their characteristic terrain and landform types.

Within the overall grouping of superficial deposits, an important distinction can be made between glacial and post-glacial materials. These are described in the following sections.

Glacial Deposits

Glacial deposits are those soil materials deposited as a result of, or in association with, the spread and decay of ice sheets. Although Ireland was completely covered by ice on a number of occasions during Pleistocene glacial period, it was during the last, so-called Midlandian Glaciation that most of the glacial soil material that we see today was deposited. The extent of ice covering and the general directions of ice movement during the Midlandian Glaciation are as indicated in Figure 11.1.

From Figure 11.1 it can be seen that the northwest corner of Mayo remained essentially un-glaciated. In terms of the pipeline route, this area covers the section between the landfall and the reception terminal. It is not, therefore, of direct relevance to the present document, but it is worth noting that (being in a periglacial region) this area experienced deep weathering of former drift deposits and shallow bedrock.

Along the remainder of the route, however, glacial deposits are associated with Midlandian ice sheets in some form or another: either deposited directly by the ice (underneath or along its margins); or dumped by the ice when it melted and/or retreated; or washed out from the ice by melt-water streams.

Given that ice, associated with the Midlandian cold stage, only fully melted about 12,000 years ago, it is not surprising that many of the landforms associated with the different types of glacial deposits are still relatively fresh and easily recognisable.

The main landform types are shown in Figure 11.2. Although Figure 11.2 is to some extent a diagrammatic representation, it provides a useful and appropriate basis for describing the different deposits and landform features along the route.

Glacial Sands and Gravels

Glacial sands and gravels, allbeit rather clayey, underlie much of the northernmost portion of the route. They are associated with an extensive outwash plain (kame terrace) that developed as the ice retreated away from the ring of hills (Maumakeogh, Slieve Fyagh, Nephin Beg Range), which had previously halted its westerly advance.

The rather irregularly hummocky surface of this plain, typical of areas experiencing wasting of dead ice, has been somewhat smoothed by the overlying development of peat. The fact that the peat is generally thicker than 3m means that the underlying sands and gravels are often only encountered at depth i.e. in boreholes, which extend through the peat. The rather clayey nature of much of the deposits is probably due to the fact that deposition occurred from ice that melted in situ, with a minimum of water sorting of the material.

Locally within this area, more distinctive landform features are evident, which can be seen to extend up through the peat. These occur either as isolated hills or as more elongate ridges, and are known as eskers. They formed under the ice, where localised melting and sub-glacial stream drainage deposited rather cleaner sands and gravels. A long train of eskers occurs along the N59 road through Eskeragh (see Figure 11.2). Both the road and the pipeline route have taken advantage of the better ground afforded by this ridge, compared to the thick bog on either side.

The sands and gravels have been worked along this ridge at Dooleeg and more recently just to the east of the Shanvolahan River, where the route heads southwards away from the N59 road. The high content of sandstone rock fragments in the sands and gravels throughout this area reflects the extensive presence of Carboniferous sandstone bedrock at depth.

Glacial sands and gravels are also present towards the southern end of the route in the area to the west of Athenry. Along the route, they occur particularly to the south of Knocknacraeeva hill as far as the Galway - Athenry railway line and at Millpark, close to the Lavally River. At the aforementioned location, esker ridges, orientated northwest-southwest, are evident at Rathmorrissy; while at Millpark, clusters of small hills are evident.

A small area of glacial sands and gravels, associated with a rather poorly defined esker ridge, is also present at Carheens, close to the Agricultural College. At this location the sands and gravels have also been worked.

In all of the more southerly locations where glacial sands and gravels occur, the gravel content consists mainly of Carboniferous limestone, reflecting the extensive underlying presence of limestone over the southern half of the route.

Glacial Overspill Channel Deposits

During the initial retreat stage of the Midlandian Glaciation, when ice was still banked up against Slieve Fyagh, the Glencullin River valley probably acted as an overspill channel for glacial melt-water. Ice may have previously penetrated down this valley at the height of the Midlandian advance, helping to excavate the broad U-shaped form of the valley.

Deposits within this valley comprise a heterogenous mixture of sands, gravels, and boulders, many of which show signs of water sorting, but with rapid local variability. Fluvio-glacial soils of this type are typically deposited by torrential flows, such as those resulting from the periodic breaching of ice melt-water dams This situation can be visualised to have occurred when marginal moraine, banked up at the head of the valley by pulses of westerly ice movement, became overwhelmed by melt-water as the ice retreated.

Glacial Till (Boulder Clay)

The middle to southern portion of the route, around Tuam, is the region where, at the height of the Midlandian Glaciation, the ice is thought to have been thickest. An ice dome, probably many 100m thick in this area, provided the locus for snow/ice accumulation and the pressure centre for ice movement. Ice movement took place in all directions but was constrained to follow certain paths by the underlying topography.

Along the base of the moving ice sheet, pre-existing glacial deposits and loose rock material were eroded, and then subsequently deposited as a basal or lodgement till. This material was essentially smeared onto the underlying surface as a result of pressure melting of the ice.

In such an environment, local deposition often takes place in the lee of bedrock projections, which then become nuclei for further deposition. However, because of the flowing nature of the ice, the deposition naturally becomes streamlined and elongated in the direction of ice movement.

Slightly to exaggeratedly elongate streamlined mounds of basal till are called drumlins and the middle part of the route is replete with these features. They are particularly well developed along the section of the route between Turlough and Mayo Abbey. Reference to the 1:50,000 OS map for this area, clearly shows the size and form of these features, as well as their distinctive NNE-SSW orientation.

It has been postulated (McCabe 1985) that the origin of most drumlin debris is local, and that the associated erosional, transportational and depositional mechanisms were accomplished over a distance of as little as 2km. The composition (and probably origin) of the drumlins along this middle section of the route, therefore, owes much to the underlying presence of weak shaly bedrock, in the form of the Craggagh Shale Formation. Compared to the surrounding harder rocks, this shale formation would have been relatively easily eroded and ground-up by moving ice to form clay. It is also probable that some of these landforms may be more or less moulded in situ from the underlying shale.

Within typical trenching depth, the material over and between the individual drumlins generally comprises a stiff brown stony sandy clay. This is commonly known as Boulder Clay, and is an ideal material in which to trench and install pipelines.

Boulder Clay also extends over much of the southern portion of the route, underlain by Carboniferous limestone. However, in this area it tends to be quite thin and does not form the distinctive drumlin features, suggesting that ice movement was less active in this area. The boulder clay also contains a high percentage of angular limestone rock fragments of gravel to boulder size and the clay content tends to be quite low by comparison. It is possible that much of the clay may represent the insoluble residue resulting from dissolution of the limestone.

Glaciated Rock Surfaces

Between Gort and Ross West, the route crosses an area that was heavily glaciated by ice streaming northwards towards Lough Conn and Killala Bay. Westward movement of this ice was constrained by the high ground to the west.

The underlying bedrock in this area is granite, which is typically very resistant to ice erosion. However, such was the erosive power of the ice that it was able to not only scour off the weathered surface material but also abrade the un-weathered rock mass. Along this section, bare massive rock surfaces are common, with many showing score marks (striations) where boulders where dragged across their surface by the ice. Large boulders of granite (bigger than cars) are also common. Much of this area, not otherwise covered by peat, has a thin covering of glacial drift that would have been deposited when the ice eventually melted.

A drive along the R310 road between Pontoon and Ross West, reveals clearly the extent to which has ice has planed down the granite surface. This road, located approximately 1-2km to the east of the pipeline route, runs directly along the path of the ice.

The pipeline route, however, keeps to the edge of this ice fairway, and runs across mainly drift-covered areas that represent the marginal moraine deposited along the edge of the ice sheet. The route thus avoids the more difficult bare rock sections.

Local weakness in the granite bedrock, such as the fault zone that parallels the stream valley to the south of Gort, were also picked out by the streaming ice and over-deepened. The pipeline route also takes advantage of this stream valley, which has become in-filled by later superficial deposits.

Post-Glacial Deposits

Post-glacial deposits are essentially soil materials (in the geotechnical sense) that were deposited after the retreat and melting of the glaciers. They are, therefore, younger than 10,000 yrs and were deposited at a time when climatic conditions were approaching those of the present day and when sealevel was rising towards its present-day level. On balance, however, the climate was cooler and wetter than present, and there was significantly more water around as a result of the melting ice sheets.

The principal feature of post-glacial deposits, as they affect the pipeline, is the significantly greater content of organic matter, compared to the glacial deposits.

Peat

Peat is the most significant of all the superficial deposits in terms of its potential to affect the pipeline.

It covers a large part of the northern section of the route between the reception terminal and Castlebar. More isolated areas of peat, which become progressively fewer in number, also occur to the south of Castlebar (see Soils Maps, Figures 11.5 to 11.11).

The occurrence of peat, and its continuing present-day growth in the west of Ireland, owes much to the climatic regime, and particularly the rainfall. Annual precipitation in excess of 800mm is required to sustain the growth of peat on a regional scale, while in areas receiving less than this amount peat growth is generally restricted to low-lying wet hollows.

Peat growth probably started in areas, such as the Oweniny basin, where the glacial legacy had created an area of occluded drainage with small shallow lakes, and an intensely water-logged granular substrate. Peat growth was probably initiated in and around the shallow lakes, as swamp and fen peat, before it began to invade the adjacent land areas as bog peat. In such primary development areas, considerable thicknesses of peat are often present.

For instance, along the route, to the south of Lough Dahybaun, peat and soft mud thicknesses of up to 9m have been measured.

An important area of fen peat, characterised by the base rich composition of the groundwater, occurs close to the route at Eskeragh. In fact, the route was purposely moved onto the north side of the N59 road to avoid this area.

The subsequent spread of bog peat, first to the inter-lake areas, then to the higher ground, coincided both with the widespread felling of trees and subsistence-type agriculture practised by neolithic settlers, and with a deterioration in climate. These events are dated to about 3000 BC (Edwards 1985) and together, they contributed to a pronounced leaching (podsolization) of the soil and an inability to support other types of vegetation.

Sphagnum moss (the main constituent of bog peat), unlike higher plants, requires no mineral or nutrient contribution from the underlying substrate to support growth. It will grow simply from minerals extracted from rainwater. Spread of bog peat (to form blanket bog) occurred, progressively, upslope; and on hillsides crossed by the pipeline, such as along the Glencullin valley, the blanket bog shows an often remarkably uniform thickness of about 3m.

Sphagnum peat is characterised by the high acidity of the contained water (pH 4.5 to 3.3), which is due to the formation of organic acids released during the initial decay of the plant matter. This high acidity not only tends to inhibit the growth of other (deep-rooted) plant species but also reduces the rate of decomposition of the peat.

Arrested decomposition, which is also promoted by the high water level in the peat reducing access for oxygen, means that the peat along much of the northern section of the route tends to contain a high content of plant fibres. Plant fibres give the peat a measure of tensile strength, which more highly decomposed peat does not possess.

Notwithstanding this higher fibre content, peat is not a good material in which to construct pipelines and wherever possible the route has been selected to avoid areas of thick and/or intact peat and to route through areas where the thickness has been reduced e.g. by working. However, given the extent of blanket bog in NW Mayo, and other constraining factors, crossing areas of peat is unavoidable.

It is, therefore, extremely important that the behaviour of peat is understood both from an engineering construction standpoint and also from an environmental standpoint. The peat areas, of all the sections of the pipeline route, are the areas where engineering and environment considerations are likely to come most in conflict.

It is common engineering and environmental practise to divide peat into an upper acrotelm layer and an underlying catotelm layer. The acrotelm is the relatively thin (100 -600mm) surface layer in which aerobes are active, relatively un-decomposed plant remains are present and the permeability is correspondingly quite high. The upper surface of the acrotelm, the so-called mattress, is the surface that supports living plant growth.

The morphology of the mattress is frequently influenced by the type of plant growth: e.g. grasses growing in tussocks will produce a very hummocky surface. The morphology can also be influenced by water flowing over the surface. Water flow frequently occurs within small channels (water tracks) that may be partially or completely covered over by surface vegetation. Such features, often clearly visible on aerial photographs, may be difficult to detect on the ground.

The acrotelm is the layer of most concern to environmentalists, while the underlying catotelm is the layer of most concern to engineers. Peat, i.e. material that is composed primarily of decomposed plant matter, is strictly the catotelm and it is this layer that geotechnical engineers refer to when talking about peat.

It is somewhat ambiguous, however, to describe peat as a soil, because to a very large extent it is composed of water. In fact, a 5m thick section of bog peat may contain 4.7m of water and only 0.3m of solid material (Hobbs 1986). The water is contained partly as interstitial water (approx. 30%), which is water that can be relatively easy extracted, and partly as bound water (approx. 55%) within the plant structure. Bound water includes water contained in capillaries and in colloidal solution and is far more difficult to remove. Typically, peat also contains approximately 10% gas, which is usually a mixture of methane and carbon dioxide, produced by anaerobic digestion.

The solid constituents of blanket bog type peat typically comprise 90% or more organic material, with the remainder being extraneous mineral matter. Basin peats can contain more in the way of mineral matter, washed in from the surrounding area. For instance, the Oweniny basin peat worked to provide fuel for the Bellacorick power station, contains a relatively high proportion of quartz sand. This sand, being non-combustable, becomes concentrated in the waste ash.

The invariably water-logged condition of peat and its low density (by virtue of the low solids content) means that gas pipelines can be susceptible to flotation and, therefore, require some form of additional weighting to keep them below the surface.

Under load, peat will experience consolidation as a result of compression of the gas and squeezing out the interstitial water. Load induced consolidation is typically rapid at first but slows with time as the material become less permeable to water flow.

The strength of peat (shear strength) can be very variable due to the fibre content, but is typically low. Shear deformation under load is one of the main reasons for the poor trafficability of peat and the reason why heavy construction plant cannot be used in peat areas.

Shear strength is related to the fibre content and thus, ultimately, to the degree of decomposition of the peat. Shear strength, however, is difficult to measure by normal soil mechanical methods (Landva 1980), because these cannot cope with fibre-reinforced soils. A means for describing the relative fibre content of peats is embodied in the van Post classification method (see for instance, Hobbs 1986 - Appendix A and Landva and Pheeney 1980), which in turn is a measure of the degree of humification (decomposition) of the peat. The method involves squeezing a lump of peat in the hand and noting the extent to which the material exudes out between the fingers. Although seemingly crude, the method is very effective and has been used as an index to determine variations in character of the peat with depth, at intervals along the route.

Given that the upper mattress layer is the least decomposed portion of a peat profile, it follows that it is typically the strongest part of the profile in terms of shear strength (or more accurately, tensile strength). Making use of this fact and keeping the mattress layer in place is one of the key features of being able to get construction plant across peat bog areas. This runs counter to the normal pipeline construction practise of stripping topsoil/subsoil before allowing access for construction plant.

Maintaining the mattress layer in place, however, has to be balanced against the need to protect the uppermost living portion of the mattress and the need to preserve the surface morphology and hydrological characteristics of this layer. For instance, load consolidation of the upper layer of the peat can lead to a reduction in its permeability and water transmitting qualities, while the overall settlement of the surface due to consolidation of the peat profile can result in water-logging or possibly flooding of the peat surface.

Although there are a number of areas along the route where crossing of intact peat bog is unavoidable, by and large the peat crossed by the route is cutaway blanket bog. Cutaway blanket bog is bog that has been cut by hand to provide turf for use as domestic fuel.

Typically, the bog is cut in strips, usually on an incline to promote drainage, with up to 1.5m of peat being cut in one pass. By exposing a long cut face, drainage and drying of the peat is promoted, making it easier to cut subsequent lines. The cutting of peat by hand in this way on commonage land is an ancient right (turbary right) enjoyed by those who have access to the commonage. This form of peat-cutting is particularly evident along the section of route to the south and east of Lough Dahybaun and at Cunnagher North, to the north of Ross West.

The resulting irregular ridge and furrow surface of the peat makes for additional difficulties for construction of the pipeline. Careful consideration also has to be given to the depth of installation of the pipe, bearing in mind the potential depth of future peat-cutting on either side of the permanent wayleave.

Elsewhere along the route, peat cutting tends to be on a more local scale, e.g. on individual land-owner parcels. The designation of large tracts of intact peat bog as conservation and heritage areas has also helped to arrest the spread of peat cutting.

Within the Oweniny basin area, extensive tracts of peat-land have also been cut by mechanical methods, to supply fuel to Bellacorick Power Station. To the east of the Oweniny River, along the pipeline route, as far as the Muing River, the peat has been worked out and the land is being

reinstated. To the west of the power station, along the route as far as Tawnaghmore, the peat is still being actively worked, although some portions have already been stripped down to the underlying glacial surface.

The pipeline has purposely been routed through these actively working or worked-out peat areas in order to avoid crossing large thicknesses of intact peat.

To the south of Castlebar, many of the peat hollows shown (see Figure 11.5) as being crossed, or routed in close proximity to, by the pipeline, have been extensively drained and reclaimed for agriculture. Once drained, peat becomes a far more suitable material in which to install pipelines. However, consideration still has to be given to flotation, because of its low density and potential for water-logging.

Alluvium

Alluvium is a river-deposited material and along the pipeline route it is associated with some of the larger rivers, which have a distinct floodplain. The floodplain is the flat-lying area extending on either side of the river channel that is susceptible to inundation during times of flood.

Arterial drainage measures, instituted during the last 150 years, however, have served to reduce the extent and frequency of inundation of the river floodplains and also to reduce the water-logging that previously characterised floodplain areas. It is now often quite difficult to determine the extent of river floodplains and alluvial areas from their surface morphology.

The groundwater table still tends to be high in these areas, however, and the risk of inundation means that consideration has to be given to pipeline flotation, depending on the nature of the soil used as backfill.

Alluvium, which is the material that underlies the floodplain, does not constitute one soil type, but rather it varies depending on the size and type of river and geology within the upstream catchment area. Its thickness is also very variable.

As a general rule, however, the grain size of the material tends to diminish in passing upwards through an alluvial sequence. This is because the amelioration in climate that characterised the post-glacial period, resulted in a reduction in flow in the rivers and their capacity to transport coarse material. In a typical alluvial profile, therefore, sands and gravels are often succeeded by silts and clays.

The initial sand and gravel stage was characterised by braided river channels, which tended to migrate across the floodplain. The subsequent fine-grained deposition stage was associated with the spread of vegetation onto the floodplain areas, helping to further reduce the speed of overland flow. Peat development is, therefore, often a feature of the upper fine-grained portions of many alluvial sequences.

The Deel River is a good example of a river floodplain that conforms to the typical fining-upwards type of sequence. By contrast, the Addergoole River and the Manulla River show an upper peaty horizon underlain by soft clay. In both instances, the river has only recently come to develop a channel by silting up of what was once an extensive lake system or series of interconnected loughs.

Some of the smaller rivers that emerge from upland areas, such as the tributary streams of the Glencullin River, still show a very coarse alluvium, with braided channel tendencies.

Those rivers that flow across limestone bedrock on the southern part of the route tend to have diminutive amounts of alluvium, partly because a significant portion of their flow probably takes place through the underlying bedrock. The finer alluvial fractions may also have been washed down into the rock.

At least two of the rivers – the Clare River and the Eiscir River – also run in artificially excavated channels that are not related to the original floodplain. In both these rivers, where they are crossed by the pipeline, the bed of the river is in rock and there is no alluvium on either side.

11.2.2 Solid Geology

The solid geology is very much subordinate in importance to the pipeline, compared to the superficial deposits, to the extent that along sizeable sections of the route the nature of the underlying bedrock is largely immaterial.

The bedrock geology becomes important, however, in the following situations:

- Where rock is at or close to the surface and will (or may) be encountered during trench excavation
- To the east of Castlebar and along much of the southern half of the route where karstified limestone bedrock may affect ground stability.

Bedrock geology is also of indirect importance in relation to landscape development. This is because different bedrock lithologies vary in terms of their contribution to upland and lowland landscape features.

Information on bedrock geology for the northern half of the route has come from the 1:100,000 map 'Geology of North Mayo' and the accompanying memoir (Long et al 1992). As yet, no corresponding published geological maps are available for the southern half of the route. However, a useful summary of the bedrock geology along this portion of the route is given in the map: 'Bedrock Geology of Mid-Galway, South Mayo and North Clare', presented by Drew and Daly (1993).

For convenience of description along the pipeline route, the bedrock is divided into limestone and non-limestone lithologies. How these divisions relate to the northern portion of the route is shown in simplified form in Figure 11.3.

Non-Limestone Lithologies

To the north of the Clydagh River, save for a short section between the Deel River and Lahardaun, the route is underlain entirely by non-limestone strata.

Starting at the reception terminal and extending as far as the middle of the Glencullin valley, ancient metamorphic sedimentary rock types (of the Dalradian) underlie the route. Wherever these are seen at outcrop, which is only very infrequently along the route, they tend to be quartz-base in composition, either quartzitic sandstones or quartzites. They are intensely hard and this strength is responsible for their having formed prominent upland features such as the western

facing slopes of Slieve Fyagh, the isolated hill at Glencullin Lower, and Carrafull hill, further to the south.

Approaching Bangor Erris from the east, along the N59 road, there is a large quarry on the southern flank of Carrafull hill, which provides good exposures of these rock types.

Higher up the Glencullin valley, there is a significant change in age of the underlying bedrock, to Lower Carboniferous, although the lithology remains essentially the same. Quartzitic sandstones of the Glencullin and Minnaun Sandstone Formations underlie the upper Glencullin section of the route. Despite their having contributed significantly to the coarse granular drift deposits, these formations are not seen at outcrop along the route.

However, good exposures of these medium- to thickly-bedded sandstones are to be seen in road cuttings along the N59 road to the east of Bangor Erris.

Carboniferous sandstones complete the ring of hills that encircle the Oweniny basin on its western side. They form the main summit of Slieve Fyagh and the somewhat lower hill to the south of Glencullin Upper.

The uppermost part of the Glencullin valley, and the huge expanse of the Oweniny basin that lies to the east, is underlain by much weaker Carboniferous strata, namely mudstones and siltstones of the Downpatrick Formation. The flatness of this area, at an average elevation of between 60-100mOD, is in stark contrast to the hills to the north, west and south.

Needless to say, bedrock in this area is nowhere exposed, being deeply buried beneath glacial deposits and thick peat.

There is a further short section of Carboniferous sandstone (Mullaghmore Sandstone Formation) underlying the route, which extends from the point where the route heads southwards away from the N59 road to just before its crossing of the Deel River. But again, it is deeply buried beneath glacial deposits and thick peat.

South of the major fault (shown in Figure 11.3), which crosses the alignment at the White River, (to the west of Lahardaun), there is a return to ancient metamorphic rocks. In this case, mica schists predominate. Although these tend to occur at relatively shallow depth beneath the glacial deposits and were encountered during the site investigation, they tend to be deeply weathered to a readily excavatable soil material.

However, just to the west of crossing of the road that runs north-south through Lahardaun (Figure 4.3 G1356 0863), harder schists make an appearance and also outcrop on the hill at Knockfarnaght.

Immediately east of this road crossing, however, the route extends into the valley of the Addergoole River and thick drift and peat again overlies the bedrock. This drift cover masks a change back to Carboniferous sandstones, which occurs beneath the valley, although blocks of hard Capnagower Sandstone occur at shallow depth in the region of the first road crossing following the River Addergoole crossing.

Carboniferous sandstone continues to underlie the route, although deeply buried beneath drift and peat, as far as the stream crossing to the south east of the sharp bend in the R615 (Figure 4.3 G 1633 0502). There is then a short section underlain by quartzite (Leckee Quarztite), which

is probably similar in lithology to that at the start of the route (but is not exposed), before the route extends onto granite.

The granite (or more accurately, granodiorite) in this area forms the western-most extension of the Ox Mountains Granite. It contributes to the formidable peak of Farbreiga, to the south, and to the steep craggy slopes that extend down to Pontoon on Lough Conn/Lough Cullin, to the northeast. Upland continues also to the southwest of Farbreiga, so the route is obliged to cross this topographically difficult area at some point.

During the Midlandian Glaciation, the northern flank of Farbreiga lay in the 'wind-shadow' with respect to ice streaming northwards towards Lough Conn and Killala Bay, as described in 'Glacial Deposits' (Section 11.2.1.1). The granite on this side of the lower slopes of the mountain is thus largely covered by detritus, mainly coarsely granular hillwash and scree, that was shed from higher up.

Above the 100mOD level there is more or less continuous rock outcrop over much of the mountain. However, it would appear that glacier ice never extended above this level during the last (Midlandian) glaciation and so while the exposed rock was subjected to intense periglacial weathering, it was never overwhelmed by moving ice. Periglacial weathering has picked out weakness in the rock, such as faults and fractures, causing a general degradation (frost shattering) at the surface and a downslope washing of detached rock fragments.

By initially keeping at just below the 100mOD level and then following the alignment of a major north-south trending fault zone, the route avoids the main areas of craggy bare rock. The north-south trending fault zone is responsible for the formation of a narrow 'wind gap' through the granite uplands. Although small knolls of rock are present locally, the gap is essentially flat-floored and underlain by gritty sands (fault gouge and weathered granite), with a thin covering of peat. Craggy rock outcrops occur on either side of the gap.

Granite continues to underlie the route to the south of the gap, but this time on the flanks of Farbeiga that experienced the full effect of ice sheet erosion.

Along the route, however, marginal moraine provides a more or less continuous covering to the rock, allowing the route to avoid the more difficult bare rock areas to the southeast. Shallow rock is present, however, just to the east of the stream crossing south of Gort (Figure 4.4 G 1790 0037) but thereafter, south from this location, there is a relatively thick covering of peat, with drumlins making a local appearance at Ross West.

A change from granite to Leckee Quartzite occurs beneath the thick drift-covered area around Sranalee but the quartzite is not seen along the route until after the crossing of the R310 road. Across the rather flat, peat-covered area between the road and the northern edge of the Clydagh River floodplain, patchy rock outcrops are evident, with a more continuous outcrop occurring along the low escarpment that overlooks the river. These outcrops are probably a combination of quartzite, quartzose sandstone and schist, and various acidic and basic igneous rocks that are intruded into the Leckee and Slieve Gamph Group sequences, which form the southern limit of the ancient rocks along the route.

South of the Clydagh River only Carboniferous strata underlie the route.

Underlying the Clydagh River floodplain, the geological map indicates a narrow band of basal Carboniferous Moy Sandstone. This formation is the stratigraphic equivalent of the Capnagower

and Minnaun Sandstones described further north along the route. However, its low-lying position along the river valley in this area suggests that the locally higher content of siltstone has rendered the sandstone more susceptible to erosion.

Between the Clydagh River and Manulla Bridge limestones are present, which are described in the next section.

Southwards from Manulla Bridge, there is an unspecified length of crossing of Craggagh Shale Formation, which lies deeply buried beneath thick glacial drift, moulded into drumlins. This is an area for which there is no recent bedrock geological mapping. The shale is thought to extend possibly as far as the road crossing east of Lough Nambrackkeagh (Figure 4.5 M 2328 8445).

Limestone Strata

Two isolated sections underlain by limestone strata are present along the northern portion of the route (as shown in Figure 11.3).

From just west of the Deel River crossing to just west of Lahardaun, Ballina Limestone underlies the route. Outcrops of grey crystalline limestone are indicated on old drift maps in the bed of the Castlehill River, just upstream of where the pipeline crosses the river (Figure 4.3 G 1142 1097), but nowhere along the route does the limestone appear to approach the surface.

To the south of the Clydagh River, as far as Manulla Bridge (approximately), a southeasterly dipping sequence of limestones is crossed. These comprise, firstly, the Castlebar Limestone, which underlies the valley of the Castlebar River, then the Aille Limestone and finally the Barney Limestone. The Castlebar Limestone consists of a dark grey medium bedded rather muddy limestone, which is well exposed in man-made cuttings along the N5 road either side of the pipeline crossing and in a small overgrown shallow quarry just to the west of Clogher.

While exposures on the north side of the Castlebar River appear to be rare, with the rock largely buried beneath a relatively thick drift cover, the rock appears closer to the surface immediately to the south of the river and the N5 road.

The succeeding Aille and Barney Limestones are cleaner limestones and to this extent would be considered susceptible to karstic weathering (as discussed in Section 11.2.3). However, evidence of karstification is only seen around Drumcorrabaun, where the rock approaches the surface and where a number of large water-filled swallows are present just to the north of the route. Elsewhere, between Clogher and Drumcorrabawn, the rock is largely cover by drift (drumlins) with peat in the hollows. However, at Derrynacross there are again signs that the rock approaches the surface.

South of the aforementioned Craggagh Shale area, limestone underlies the remainder of the route as far as the Craughwell AGI.

As previously mentioned, there is no recently published bedrock geological mapping for the southern half of the route, but in their report on Groundwater and Karstification in Mid-Galway, South Mayo and North Clare, Drew and Daly (1993) record the broad bedrock sub-divisions and their mapped extent.

Along the route a relatively simple two-fold sub-division into Muddy Limestone and Pure Limestone is indicated. Note that these subdivisions are lithotypes (based purely on rock

lithology) and do not necessarily bear any relation to the mapped stratigraphic formation sub-divisions described further north along the route.

Based on Drew and Daly (1993), the two groups have the following characteristics:

Muddy Limestone - is a dark grey to black, clayey limestone with black calcareous shales, which becomes cherty towards its base. It is well-bedded with most beds being less than 80mm in thickness.

Pure Limestone - is a pale to medium grey, bedded, fossiliferous, coarse to medium grained limestone (calcarenite). It is generally not clayey but there are discernible variations in grain size, degree of crystallisation, occurrence of chert and shale bands. In stratigraphic terms, Pure Limestone appears to overlie Muddy Limestone.

Muddy Limestone underlies the route southwards to about the point where the pipeline crosses the road north-east of Knockrickard (Figure 4.5 M 2810 7698), although there is little sign of rock near the surface, with much of the route being underlain by relatively thick drift.

Pure Limestone then extends southwards as far as Davros (Figure 4.6 M 3056 6228). But while rock outcrops (generally described on old drift maps as near-horizontally bedded grey limestone), occur along the road between Lissatava and Bushfied, at Kilglassan and at Annefield House (all to the west of the route), along the route itself the rock generally lies buried beneath relatively thick drift. Evidence of karstification of the rock (that would accord with the high purity limestone lithology), is seen in Carrowkeel Turlough (Polleamagur Lake) and in the nearby smaller turloughs, and in Carras Lough, which is also a turlough.

The implication of the mapped extent of Pure Limestone in this area, is that it forms part of a shallow syncline orientated northeast-southwest. The southern (faulted) limb of this syncline is indicated as occurring along the route to the south of Davros, where Muddy Limestone is again mapped. However, continuing evidence of karstification, in the form of swallow holes on the eastern side of the route and nearby outcrop descriptions recorded on old drift maps, would both seem to suggest Pure Limestone continuing to underlie the route.

However, the rock generally appears to be quite thickly drift-covered along the route, with frequent low-lying hollows filled with peat.

South of Beagh More, much stronger evidence of karstification, in the form of turloughs (Turlough O'Gall) and widespread swallow holes as well as more frequent rock outcrops (recorded on old drift maps) and evidence of shallow rock on aerial photographs, all point to the continuing presence of Pure Limestone. From here to the end of the route, Pure Limestone is also shown on the Daly and Drew (1993) map.

Although small rock outcrops and larger areas of limestone pavement are common, the main areas of outcropping rock are: on the hills to the south of Castlehacket, on Knockdoe hill and on Knocknacreeva hill. The route generally avoids these hill areas, and outcropping rock areas in general, although it does extend across shallow rock at Knocknacreeva hill.

Natural outcrops commonly consist of ledges or flat pavement areas of near horizontally bedded light grey limestone, which typically have an irregular water-worn appearance. The latter is a result of solution etching of the surface. At outcrop the rock is typically compact and strong, with little sign of loose weathered material.

Elsewhere, where the rock is covered by drift, a weathered rock (regolith) layer is typically present. This consists of detached fragments of limestone, typically very angular in outline, varying in size from gravel to boulders. The size and frequency of the boulders generally increases with depth down to the bedrock surface. The process of detachment of the rock fragments from the bedrock and their reduction in size is by solution, as part of the surface karstification of the rock.

11.2.3 Karstification of Limestone Bedrock

Karstification is a complex process, giving rise to a potentially wide range of bedrock and soil profile weathering effects. However, because many of these processes take place underground, surface evidence may be relatively scant and an appreciation of karst and its implications for the pipeline may depend on the recognition of only subtle features at the surface.

At its most simplistic level, karstification is the dissolution of limestone (and other soluble rocks) by water flowing through the rock. The dissolution process is relatively slow in human time scale terms, but relatively fast in geological time.

In Ireland, it is mainly the Carboniferous limestones that undergo karstification. Because of the extent to which the country is underlain by these limestones compared to its overall size, there is a commonality of karst development, which means that similar features are often developed in different parts of the country. Before considering the local features along the pipeline route, it is appropriate to describe the general features of karst in Ireland.

Since by far the bulk of the dissolution takes place at or close to the surface, limestone areas (regardless of limestone type) experience a general lowering of the outcrop surface. Carboniferous limestone areas are, therefore, typically of low relief and flat-lying compared to other non-soluble bedrock types and this is particularly noticeable along the southern portion of the pipeline route, where the surface is generally at or below 50mOD.

Since surface karstification is accelerated both by mechanical weathering (causing fracturing) and by soil formation, a two-speed process of surface down-wasting occurs, with bare massive rock tending to stand proud of areas with a thick soil cover. This explains why limestone hills, such as those at Castlehackett, Knockdoe and Knocknacreeva can develop in an otherwise flat landscape. Pinnacles of massive rock, not visible at the surface, can also occur beneath an otherwise thick soil and regolith (fragmented weathered rock) cover.

Although virtually all types of limestone will experience some degree of internal karstification, it is the high purity limestones that are most susceptible. This is because the more muddy limestones produce an insoluble residue, which tends to inhibit water flow and further dissolution. Because most limestones tend to have low porosities, water-flow takes place primarily through fractures and joints (discontinuities). In high purity limestones these discontinuities become greatly enlarged, allowing increased water flow in a self-perpetuating process that leads to a progressive reduction in overall rockmass density and an increase in overall rockmass permeability. In the limit, solution enlargement may produce structural instability within the rock mass and ravelling or wholesale collapse into voids.

Certain factors can serve to accelerate the karstification process:

- Water flowing off sandstone or peat will tend to be acidic and more aggressive in terms of limestone solution.

- During the Pleistocene, periods of glaciation and de-glaciation were particularly conducive to karstification because of the increased amounts of cold water (limestone is more soluble at low temperatures).
- Periods of glaciation were also important because of the associated lowering of sealevel, which tended to promote groundwater flow through the rock and the establishment of subterranean river systems.
- Permeable soils (e.g. glacial sands and gravels) will allow more in the way of downward percolation of surface water so tending to increase the rate of karstification compared to less permeable soils (e.g. boulder clay).

Along the pipeline route, apart from the obvious landscape features noted above, the most common features indicative of karst are swallow holes (otherwise known as dolines, shake holes or sluggies) and turloughs (karst lakes). Caves and disappearing streams, which tend to be fewer in number, are also symptomatic of karstification.

Swallow holes are directly associated with ground instability and to this extent are of concern for the pipeline. They form by a process of progressive collapse of soil overburden into openings in the bedrock; typically, by migration of a cavity upwards through the soil profile until it breaks though at the surface. The initial surface breakthrough (crown hole) is generally circular in plan 0.5-1.0m in diameter with vertical or overhanging sides. With time, the sides tend to degrade to form the familiar shallow circular depression. Further collapse of soil into the bedrock may take place, resulting in progressive enlargement of the swallow hole, although enlargement is typically arrested by choking of the soil cavity or plugging of the bedrock opening.

The extent of previous swallow hole development along the pipeline route cannot easily be gauged from ground level. This is because:

- It is often difficult to visually discern shallow depressions.
- Many swallow holes have been in-filled as part of agricultural land improvement.
- Arterial and land drainage have reduced the likelihood of swallow hole formation, by reducing fluctuations in groundwater level.
- Recently formed swallow holes tend to be in-filled quickly (at the crown-hole stage) because they represent a hazard to livestock.

Old aerial photographs can provide a much clearer picture of their occurrence and extent, and so as part of the route selection process 1973-74 photography was used to record the locations of swallow holes. By way of example, Figure 11.4 shows an area along the pipeline route just to the south of Castlehackett. The extent of pock-marking, often by what appear to be recently formed swallow holes on the earlier photography, is in stark contrast to the present day smoother appearance of the ground.

Although isolated swallow holes occur in limestone areas to the north of Beagh More (Turlough O'Gall), the main area of development, along the pipeline corridor, is to the south, as far as the Craughwell AGI. There are three main reasons for this:

- High purity limestones predominate.
- The overlying drift is generally more granular.
- Bedrock occurs at shallower depth.

Within any one area, the latter two factors can also be seen to contribute to a variation in the concentration of swallow holes. This is because granular drift tends to facilitate the upward

migration of cavities through the soil profile and the cavities are less likely to choke before reaching the surface if the drift is thin.

In some areas adjacent to the pipeline route, average swallow hole concentrations as high as 5 per ha have been noted.

Swallow holes represent the end product and visual manifestation of ground instability. To this extent their occurrence and concentration in an area can be taken as an index of potential further instability in that area. The local environment within a swallow hole can also be seen as an area of potential further ground subsidence.

The risk to the pipeline, in terms of potential for localised ground subsidence, is not dissimilar to old (i.e. undocumented) pillar and stall mine workings. To reduce the risk, the pipeline has been purposely routed, as far as possible, to avoid individual swallow holes and areas of high swallow hole concentration. While to better evaluate the risk to the pipeline, a staged geophysical investigation approach has been adopted as part of the site investigation work along the route.

Swallow holes are also discussed under 'Groundwater' (in Section 13.2) in relation to aquifer issues.

Karst features along the route are indicated on Figures 11.9 and 11.10.

11.2.4 Economic Geology

Pipelines have the potential to sterilise areas of potential mineral resource and to adversely affect their economic working. Equally, the legacy of past mineral working (mining and backfilled quarry workings) can impact on pipeline stability.

A search of County Council and Geological Survey of Ireland records, has revealed that along the pipeline route there are no past underground mineral workings, while visual evidence indicates that surface workings are limited to the following:

- Extensive and localised working of peat.
- Localised working of sand and gravel for aggregate.
- Localised working of hard rock for building stone.

Although, as yet, undiscovered economic metaliferous mineral deposits may be present at depth anywhere along the route, the lack of past underground or surface ore workings indicates a low potential.

The pipeline will have a relatively minor impact on the extensive peat workings around Bellacorick Power Station, for two reasons:

- Peat-burning power generation is due to cease at Bellacorick in 2004, when much of the mechanised peat extraction by Bord na Mona will also cease.
- The pipeline crosses areas that have been largely worked out or where workings have ceased.

Although old (disused) sand and gravel pits, and quarries used for local building stone occur dotted along the route, none of these are actually crossed by the route or occur in close proximity to the pipeline. Save for the overgrown sand and gravel pit at Carheens, close to the Agricultural

Institute (see Figure 11.4). The Geological Survey of Ireland's most recently published directory of active quarries and pits (GSI, 1988) also records that there were no actively working rock quarries or sand and gravel pits within the 1km wide corridor in the late 1980's.

Recently a small sand and gravel pit has been opened up near Eskeragh in an esker deposit of sand and gravel. The pipeline route is located on the edge of the esker feature sufficiently distant and on the opposite side from the main road (N59) not to affect the economics of working.

A recently opened quarry in outcropping limestone is also present at Ardgaineen, (Figure 4.7 M 3764 4047). The pipeline route runs within about 150m of the western edge of the quarry, but the area of working is bounded by a minor road, and the route purposely skirts around the area of bedrock outcrop.

11.2.5 Landfills and Contaminated Land

Consultation with the Environmental Protection Agency, Galway County Council and Mayo County Council, has revealed that there are no landfills and no records of contaminated land along the route.

Likewise, the county councils have no plans to develop landfill sites within the 1km corridor along the route.

The only known area where waste disposal has occurred along the route is adjacent to Bellacorick Power Station, where the route runs close to the ash disposal facilities. The ash is not considered to be a source of contamination and its disposal is being monitored by the EPA.

11.3 Soils

In this section, soils are considered mainly in their pedological (soil science, rather than geological/geotechnical) sense. Pedological soil development has implications mainly in terms of agricultural potential.

Information for this section was obtained from the General Soils (1985) 1:575,000 scale National Map (see Figure 11.5). No regional guides for this area are available, therefore little information on the characteristics of the soils with regard to workability or properties is available.

Soil types shown on the National Map are divided into six categories:

- Mountain and Hill (Soil Numbers 1-5),
- Hill (Soil Numbers 6-11),
- Rolling Lowland (Soil Numbers 12-24),
- Drumlin (Soil Numbers 25-29),
- Flat to Undulating Lowland (mainly dry mineral soils) (Soil Numbers 30-38)
- Flat to Undulating Lowland (mainly wet mineral and organic soils) (Soil Numbers 39-44).

There are nine soil types that occur along the pipeline route.

Peaty podzols and blanket peat are part of the Mountain and Hill category and occur on higher ground between Bellacorick Bridge and Lough Dahybaun, a distance of approximately 4km.

Three soil types are part of the Rolling Lowland category. Podzols, gleys and blanket peat (lowland level). These soils underlie the proposed route in patches, between Broadhaven and Eskeragh (with the exception of the section between Bellacorick Bridge and Lough Dahybaun), a distance of approximately 20km (including the landfall to reception terminal length); and the section between Lahardaun and Castlebar (with the exception of the section between Levally Lough and Ross West), a distance of approximately 10km.

Grey brown podzols are part of the Drumlin category and occur between Castlebar and Mayo Abbey, a distance of 10km.

Two soil groups, degraded grey brown podzols and shallow brown earths and rendzinas are part of the Flat and Undulating Land category. The degraded grey brown pozolics occur between Eskeragh and Lahardaun. The shallow brown earths and rendzinas occupy approximately 35km or the pipeline route, underlying the section between Mayo Abbey and Galway. These soils are likely to be dry mineral soils.

Basin peat is the only soil type within the Flat and Undulating Land category, which is likely to constitute the wet mineral or organic soils. This soil type occurs in patches from Mayo Abbey to Galway, and underlies approximately 5km of the proposed route.

11.4 Evaluation of Impacts

11.4.1 Topography

The pipeline has been purposely routed to avoid steep slopes and irregular upland topography. While such avoidance is relatively easy along the southern half of the route, because of the general flatness of the terrain south of Mayo Abbey, the northern half of the route is more topographically challenging.

The following are local situations where steep slopes and topographical difficulties are present:

- Some of the stream crossings between the reception terminal and top of the Glencullin valley have quite steep banks due to active down-cutting and erosion.
- To the south and east of Lough Dahybaun, where strip working of the peat has resulted in a very irregular surface along the pipeline route.
- Just to the west of the road that runs north-south through Lahardaun (Figure 4.3 G 1356 0863) the route is crossed by a series of shallow rock ridges that produce a very irregular topography.
- Where the route passes through the gap in the mountains on the northwest flank of Farbreiga, the working width is locally constrained by rocky cliffs on either side.

The latter section (extending over a length of 1.5km) is expected to be topographically the most difficult portion of the whole route.

11.4.2 Superficial Deposits (Drift)

It is appropriate to consider potential impacts associated with superficial deposits (i.e. engineering soils) in terms of: trafficability, excavatability, trench stability, pipe floatation, corrosivity and reinstatement.

For simplicity, the superficial deposits occurring along the pipeline route can be grouped into three categories of increasing difficulty: glacial deposits, alluvium and peat.

Glacial Deposits

These include glacial sands and gravels, overspill channel deposits and glacial till (boulder clay). By virtue of their mode of deposition and lack of organic matter content, they tend to be relatively stable, easy to excavate, have good load-bearing characteristics, low corrosivity and allow easy reinstatement.

Boulder clay can be considered an ideal medium in which to construct pipelines, since vertically sided trenches can be dug that will remain stable without support for long periods. Clean (i.e. non-clayey) sands and gravels, however, tend to be rather more unstable, with trench sides collapsing to an angle of about 30-35^0, which represents the natural angle of repose of the material. It is also often difficult to shore trenches in clean sands and gravels.

Trenches in boulder clay tend to make little water, and what water does seep in can typically be dealt with by pumping from sumps. Sands and gravels excavated below the water table, however, can make a lot of water and large scale pumping may be required. Along the pipeline route in the majority of the situations where sands and gravels will be encountered in open trench, the water table will be below or towards the bottom of the trench.

Loose water-logged fine sands, in particular, can develop a running condition, whereby the sand flows with the water that is seeping out. Running sands are virtually impossible to trench (without prior dewatering) because the trench tends to fill up and enlarge as fast as it is excavated.

Since pockets and lenses of fine sand can occur in boulder clay as well as in sands and gravels, it is often very difficult to anticipate where running sand conditions might occur.

Some of these issues are considered again under Groundwater (in Section 13.2)

Virtually all glacial deposits are chemically inert, being formed from rock fragments, and so corrosivity is not generally a problem.

Glacial deposits also make suitable backfill material and generally facilitate trench reinstatement. The specific gravity of the soil particles also means that provided a reasonable level of backfill compaction can be achieved, glacial soil materials will resist pipe flotation.

However, deposits containing large boulder-size rock fragments can be less suitable in respect of backfill and reinstatement. Selective use, to exclude the large material, may be required.

Alluvium

Alluvium typically falls between glacial deposits and peat in terms of suitability as a medium in which to construct pipelines.

Being located in low-lying floodplain areas, groundwater will generally be encountered within trenching depth. However, construction during the summer at times of low flow in the river will help to reduce the effect of high groundwater.

The presence of near surface peat and/or soft clay/silt soils will reduce trafficability to the extent that normal construction plant may not be suitable. Some of the alluvial crossings, such as the Addergoole River and the Manulla River, may have to be treated as if they were peat areas.

The likely presence of sand and gravel at shallow depth, possibly in hydraulic continuity with the river, will mean that pumping out may not be possible and a flooded-trench form of construction may have to be adopted. Running sand conditions are a likely possibility in alluvial areas.

The generally soft/loose nature and frequently high organic content of alluvial soils means that they do not make good backfill materials and measures to combat pipe flotation will generally be required.

The fluvial environment also means that careful consideration has to be given to the potential for downstream suspension transport of fine-grained soils exposed during excavation. The potential for subsequent erosion of the banks, means that reinstatement needs to be carried out carefully and with due regard to the flood flows in the river.

Information on river flows is given in Surface Waters (in Section 13.1)

Peat

At the other end of the spectrum (from boulder clay), peat represents about the most difficult natural material in which to construct pipelines. It is important to appreciate that all of the factors, such as trafficability, excavatability, trench stability, etc., which in other soil materials can be considered singly, become inter-dependent critical constraints in the case of peat.

Many of the characteristics that influence the behaviour of peat in relation to pipelines are covered in the earlier section on superficial deposits. In this section, some of the critical inter-relationships are considered.

For instance:

- Normal methods of roadway construction in peat areas to provide access for construction (e.g. geotextile and crushed stone) can lead to permanent settlement and difficulties for reinstatement.
- Trenches dug in peat can be stable in isolation but can be rendered unstable when heavy equipment, such as side-booms, are located nearby.
- Concrete weight-coating, normally used to combat flotation, increases the weight of plant required to transport the pipe along the spread and lower it into the trench.

Some of the peat areas crossed by the pipeline have been designated as conservation and/or heritage areas. Many other areas of intact bog, not currently designated, are nevertheless considered worthy of preservation. Pipeline construction in all these areas needs to consider minimising change to the peat environment and maximising the quality of reinstatement.

11.4.3 Bedrock

Additional site investigation work, currently in progress, is intended to refine the understanding about areas along the route where bedrock may be present at shallow depth. This shallow rock investigation is concentrated in two areas:

- In the blanket bog areas at the northern end of the route, where the presence of rock at shallow depth beneath the peat could cause problems for the pipeline if it sinks through the peat. Shallow bedrock could also preclude the use of embedment anchors (as an alternative to concrete weight-coating) to combat flotation.
- In the limestone areas over the southern part of the route where massive rock may approach the surface without any obvious surface signs. Shallow rock could cause problems for trench excavation and increase the requirement for protection to the anti-corrosion coating.

Apart from these potential impacts on the pipeline, the pipeline construction has potential to impact on the bedrock in two possible areas:

- At the gap through the upland area to the NE of Farbreiga, where granite cliffs on either side of the route form part of this scenic and geologically interesting area.
- In highly karstified limestone areas where the underlying rock mass may be potentially unstable, pipeline construction may induce collapse at depth, affecting groundwater flow through the rock.

This latter situation is considered in more detail under Groundwater (in Section 13.2).

11.5 Mitigation Measures

There are two principal ways in which mitigation has been approached:

- By identifying and delineating the extent of impacts within the route corridor in order to avoid, or at least reduce the length of significant crossing, of those impacts.
- By fully understanding the residual impacts and their consequences either for the pipeline or for the impacted feature.

As part of the route selection process potential geological and soils impacts have been identified and delineated by a combination of desk study, field study and consultation with relevant authorities. The refined route has been selected primarily on this basis, but with interrogation by other disciplines having an influence on route selection.

By an iterative process, geology and soils impacts have been weighed against one another and against other competing impacts in order to arrive at the current route, which can thus be considered: the Best Practicable Environmental Option.

The outcome of this process is a residue of 'unavoidable' or 'residual' impacts, many of which are still in the process of being evaluated.

In order to alert the Contractor to the presence of these residual impacts, the route has been divided into lengths designated as Special Locations for construction purposes. Once fully evaluated, the aim is to develop method statements that will enable appropriate measures to be taken during construction to reduce to the absolute minimum the consequences of (or for) the impact.

In Appendix 6.1 a check-list is provided of the measures that the Contractor will be expected to take when preparing method statements for working in sensitive areas, including those affecting Geology and Soils.

11.6 Impact and Mitigation Summary

Residual Soils and Geology impacts occurring along the pipeline route can be summarised as follows:

- Crossings of peat areas, particularly towards the northern end of the route
- Crossings of river flood plain areas, particulary those rivers north of the Castlebar River
- Crossings of any low-lying sand and gravel areas, particularly towards the northern end of the route
- The gap through the mountain area at Farbreiga
- Areas underlain by karstified limestone over the southern half of the route
- Areas of shallow hard rock (which have yet to be fully defined).

Mitigation measures, either already instituted or set in train, include:

- Reducing the length of crossing of these area and their associated construction difficulties to a minimum (as part of route selection)
- Identifying the length of crossing and designating these areas as Special Locations for construction
- Establishing a protocol for preparing method statements, which will provide the basis for construction procedures on site.

11.7 References

Drew D. P. and Daly D. (1993)
Groundwater and Karstification in Mid-Galway, South Mayo and North Clare
Geological Survey of Ireland
Report Series
RS 93/3

Edwards K. J. (1985)
The Anthropogenic Factor in Vegetational History
In: Edwards K. J. and Warren W. P. (Eds)
The Quaternary History of Ireland
Academic Press

GSI (1988)
Quarry Directory
Active Quarries and Pits in Ireland
Geological Survey of Ireland
Report Series
RS 88/3 (Mineral Resources)

GSI (1992)
Geology of North Mayo
A Geological Description to Accompany
The Bedrock Geology 1:100,000 Map Series;
Sheet 6, North May
Geological Survey of Ireland

Hobbs N. B. (1986)
Mire Morphology and the Properties and Behaviour
of some British and Foreign Peats
Quarterly Journal of Engineering Geology
Vol 19, pp 7-80

Landva A. O. (1980)
Vane Testing in Peat
Canadian Geotechnical Journal
Vol 17, pp 1-19

Long C. B. et al (1992)
Geology of North Mayo
A Geological Description to Accompany
The Bedrock Geology 1:100,000 Map Series
Sheet 6, North Mayo
Geological Survey of Ireland

Landva A. O. and Pheeney P. E. (1980)
Peat Fabric and Structure
Canadian Geotechnical Journal
Vol 17, pp 416-435

McCabe A. M. (1985)
Glacial Geomorphology
In: Edwards K. J. and Warren W. P. (Eds)
The Quaternary History of Ireland
Academic Press

12 AGRICULTURE

12.1 Introduction

The proposed pipeline passes through predominantly agricultural land, and will cause some temporary disruption to farming activities. Farms affected may suffer temporary loss of agricultural land, field severance, interruption of services, and interference with natural and man-made drainage systems during the construction phase. However, effects will be minimised by careful planning, detailed consultation with the landowners/occupiers and close attention to detail during the construction and reinstatement phases.

This section outlines the main areas of concern and establishes the measures that BGÉ and their construction contractors will take to mitigate them.

12.2 Soil Care

12.2.1 Soil Handling

The moisture content is a very important factor to be considered when soils are being handled. If they are excessively wet there may be a loss of soil structure (including a loss of fertility) and it may be difficult to subsequently reinstate the soils properly. Whenever possible topsoil movements will only be carried out when conditions are considered suitable. This is usually between the months of April and October, when the soils are expected to be relatively dry.

12.2.2 Site Preparation

Topsoil will be stripped on a field by field basis and stored in a mound running alongside the working width on unstripped land. Weeds growing on the topsoil stacks will be treated with appropriate herbicides if necessary. Topsoil will be stored in accordance with good industry practice.

Subsoil removed from the trench will be stored on the opposite side of the working width, separate from the topsoil, and will be laid on top of undisturbed subsoil. Different subsoils will be stored separately to ensure successful restoration later. During reinstatement any bedrock removed will be replaced by sand or similar material immediately around the pipeline.

12.2.3 Backfill and Reinstatement

Excessive water will be removed from the trench prior to backfilling, whenever possible, to optimise restoration, and will be disposed of. This will be carried out in accordance with the recommendations made following consultation with Mayo and Galway County Councils.

The subsoil will then be replaced in the trench over the installed pipeline, in a sequential manner to ensure that layers are compatible. Where the ground is steeply sloping, and where considered necessary, impermeable barriers may be installed in order to prevent the trench acting as a drain and possibly causing flooding of lower land. The contractor will employ soil-loosening techniques such as deep-tine cultivation to break up any compaction that has occurred on the access road.

Topsoil will be reinstated when in a suitable dry condition in order to prevent compaction problems. Care will be taken to ensure that it is spread as evenly as possible.

The next stage will be to reinstate the vegetation. Subject to the landowners/occupier's requirements, pasture land will be sown with an appropriate seed mix and, if ruderal species such as nettles, docks and thistles appear, a selective herbicide will be applied as required. Arable land will be cultivated to the satisfaction of the farmer and left fallow.

12.2.4 Soil Temperature

There is no major impact anticipated from the small difference in soil temperature that may be associated with the construction and operation of the pipeline.

12.3 Land Drainage

Land drainage systems are a key element in the use of fields for arable crops and grassland, especially where soils are particularly heavy. The pipeline is likely to disturb a number of land drains and ditches and their successful reinstatement is essential. BGÉ and their contractors will consult affected landowners/occupiers on all land drainage matters. Land drains will be measured and logged during pipeline trench excavation. Where required, 'cut-off' drainage will be installed prior to pipeline construction, to ensure that existing drainage systems outside the pipeline area function properly during the construction phase. They also prevent water flowing on to the pipeline working area and into the pipe trench.

Drainage schemes will generally be designed to be parallel to the pipeline to reduce drain crossings of the pipe. After construction of the pipeline, further drainage will be installed, where required, parallel to the pipeline to complete the drainage reinstatement. The design of all drainage works will be agreed with the landowner/occupiers prior to the commencement of construction.

12.4 Notifiable Scheduled Diseases

Pipeline construction is a linear operation and it therefore has the potential for carrying diseases between fields and farms in a manner not normally possible. In order to prevent any such carriage of disease BGÉ and their contractor will take all appropriate precautions recommended by the Department of Agriculture. One of the most important recommendations is to avoid all contact with animals.

Stock-proof fencing will be erected where necessary, and workers will be instructed not to come into contact with animals or the buildings occupied by them, nor to leave machinery near to fencing. In order to prevent transfer by other means, soil from one field will not be transferred for storage to another, and gates will be shut when not in use. If there is an outbreak of a highly infectious disease the Department of Agriculture will be consulted and precautionary measures taken.

BGÉ and their construction contractors will also establish whether any plant or animal diseases are present along the route by consulting with the Department of Agriculture and the local farmers. If any are known to be present, precautions will be taken to prevent their spread.

12.5 Compulsory Acquisition

Under the Gas Act, Section 32, Bord Gáis may acquire compulsorily any land or right over land which is required by the Bord. As a consequence, although all reasonable requests for re-routes are assessed, land owners may be subject to an acquisition order to purchase the required portion of their land.

12.6 Predicted Impacts

12.6.1 Agriculture

The construction of a pipeline across agricultural land will have some impacts upon normal farming operations, for example, dividing fields and separating livestock from water supplies. However, it is anticipated that such interruptions will be relatively short term and with good planning and liaison between the landowners/occupiers and BGÉ and their construction contractor(s)' agricultural representative these disruptions can be kept to a minimum. Where necessary temporary water supplies will be provided during the construction and reinstatement

phases.

12.6.2 Drainage

During the construction period there is likely to be some disruption to field drainage systems. BGÉ's construction contractor(s) will endeavour to ensure that no discharge water be allowed to drain into the pipe trench. Temporary or permanent drains will be constructed to ensure that the pipe trench does not act as a conduit, and in some cases impermeable barriers may be constructed in the pipe trench to help prevent this happening.

12.7 Impact And Mitigation Summary

12.7.1 Agriculture

BGÉ will employ a team of Agricultural Liaison Officers (ALO) to maintain contact with landowners/occupiers before, during and following construction of the pipeline.

In order to mitigate the temporary impacts to farming, BGÉ will agree construction timing and access with landowners and occupiers. Compensation will be paid for loss of crops, and best endeavours will be made to ensure the successful restoration of the pipeline route to its previous condition. During the construction and reinstatement periods temporary supplies of services across the working width will be agreed. Stockproof fencing will also be erected in areas grazed by livestock. Hedges and fences will be maintained by BGÉ for some years after reinstatement.

It is anticipated that interruptions to normal agricultural use of the land will be limited to the construction period, and that during that time the ALOs will be responsible for ensuring that contractors adopt the correct construction practices with regard to agriculture.

12.7.2 Drainage

It is anticipated that there will be little impact to land drainage during the pipeline construction period, and that all drainage systems will be reinstated after construction to provide the same drainage regime. This may require new systems of drains to be installed in the pipeline area if lateral drainage was originally directed across the pipe trench.

12.7.3 Aftercare

BGÉ will inspect the pipeline for third party interference on a regular basis. The route will be inspected by helicopter periodically.

The route of the pipeline will be walked periodically. This will be done after consultation with the farmers and at a time when damage to crops will be minimised.

13. HYDROLOGY AND HYDROGEOLOGY

13.1 Introduction

This section of the document covers issues to do with surface water and groundwater.

Surface waters include rivers, streams and lakes, and any periodic overland flow or surface ponding associated with flooding of these drainage features.

Hydrogeology includes subsurface water either stored in, or flowing through, rocks and soils.

Both surface waters and groundwater represent important natural resources, which have to be protected, both in terms of quantity and quality. Surface waters also provide important aquatic habitats.

In some areas along the pipeline route, the distinction between surface and groundwater becomes blurred. For instance, basin peat areas can be viewed either as lakes infilled with organic matter, or as areas of organic soils with a high groundwater table. Over the southern half of the route considerable interchange takes place between the surface and groundwater environments, due to the very permeable nature of the karstified limestone bedrock. Disappearing and re-emerging streams are common in this area.

13.2 Surface Water

13.2.1 Watercourses

Ireland is divided into six hydrometric regions, with the pipeline being located entirely within the Western Region. Within the latter region, the EPA carries out water quality monitoring on most of the named rivers, while various bodies (including the EPA, OPW, County Councils and ESB) maintain gauging stations to record water levels and flows.

Surface water quality assessment, by the EPA, has been carried out for many of the rivers along the proposed pipeline route, and Table 13.1 summarises the current water quality status of these rivers. The rivers are listed from north to south. A fuller data set may be found in Appendix 13.1.

The following scale of classification has been used:

1. Seriously polluted
2. Moderately/Seriously polluted
3. Moderately polluted
4. Slightly polluted
5. Unpolluted

Table 13.1: Surface Water Quality

Ref. No. *	River name	Water quality (1994/5)
1.	Muingnabo River	4 (Unpolluted)
2.	Glenamoy River	3-4* (Slightly polluted
3.	River Muing	3-4 (Slightly polluted)
4.	Altnabrocky River	4-5 (Unpolluted)
5.	Shanvolahan River	3 (Moderately polluted)
6.	Shanvolahan River	4 (Unpolluted)
7.	Castlehill River	5 (Unpolluted)
8.	Addergoole River	4 (Unpolluted)
9.	Clydagh (Castlebar)	4 (Unpolluted)
10.	Clydagh River (Castlebar)	5 (Unpolluted)
11.	Castlebar River	3 (Moderately polluted)
12.	Castlebar River	3 (Moderately polluted)
13.	Manulla River	4 (Unpolluted)
14.	Robe River	3-4 (Slightly polluted)
15.	Black River (Shrule)	3-4 (Slightly polluted)
16.	River Clare (Galway)	4 (Unpolluted)
17.	River Clare (Galway)	3-4 (Slightly polluted)

(*see **Appendix 13.1** for location and chemical details)

The EPA maintains a register of all gauging stations in Ireland, and Table 13.2 lists those stations that are relevant to the rivers crossed by the pipeline. Again, the rivers are listed from north to south.

At some of these locations, stage-discharge relationships (rating curves) have been established that allow water level to be equated to volumetric flow in the river. In Appendix 13.2 water level data are presented (together with the corresponding flows where available) for a period of five years up to the last year for which information is readily available.

For those rivers having hydrometric data that has already been processed by the EPA, the catchment area upstream of the gauging station is given in Table 13.2. Further data for each of these locations is given in the Hydrological Data report (EPA 1995).

Gauging station locations given in Table 13.2 are also shown on the pipeline river crossing maps in **Volume 11** Figures 10.1 to 10.8. It should be noted, however, that not all of the gauging stations are located close to the pipeline crossing point on the respective rivers. It is, therefore, appropriate to consider the applicability of the data for each of the crossings, which has been done in the table.

Table 13.2: Hydrometric Stations on Rivers

EPA Stn No	Location	River Name	Body	Type	NGR	Catchment Area (km^2)	Distance to Gauge (km)	*Extent to which data is applicable to pipeline crossing*
33002	Bellacorick	Oweniny	ESB	SG	F973203		0.2D	Wholly applicable
34007	Ballycarroon	Deel	OPW	AR	G120160	156	6.9D	Generally applicable; minor intervening streams only
34039	Castlehill	Castlehill	Mayo	SG	G125116	7.0	1.5D	Wholly applicable
34037	Castle Bridge	Addergoole	Mayo	SG	G147092	38.5	1.0D	Wholly applicable
34014	Mill Bridge	Clydagh	OPW	AR	M222961	51	6.9D	Generally applicable; only intervening discharge is from Lough Fadda
34018	Turlough	Castlebar	OPW	AR	N206935	93	1.8D	Wholly applicable
34028	Drumask	Castlebar	Mayo	SG	M162916		2.5U	Wholly applicable
34011	Gneeve Bridge	Manulla	OPW	AR	M223911	144	3.4D	Wholly applicable
34033	Balla	Manulla	Mayo	SG	M255850		4.8U	Indicative only for the crossing of the Manulla River
30035	Kilrush	Robe	OPW	SG	M263675		8.8D	Generally applicable; minor intervening streams only
30037	Clooncormick	Robe	OPW	AR	M261675	210	9.0D	Generally applicable; minor intervening streams only
30030	Shrule	Black	Mayo	SG	M280526		>5.0D	Indicative of total discharge at the Black and Kilshanvy Rivers and a tributary stream
30012	Claregalway	Clare	Galway	AR	M373333	1075.4	6.7D	Generally applicable; minor intervening streams only
29006	Athenry	Clarinbridge	Galway	SG	M502273		2.8U	Indicative only
29014	Caherfinesker	Lavally	OPW	AR	M473241	87	ca1.5D	Indicative of total discharge at the crossing of the Lavally and Eiscir Rivers
29007	Craughwell	Dunkellin	OPW	AR	M510199	278	2.5D	Indicative only

Note: 'Body' refers to the agency that maintains the station (OPW = Office of Public Works; ESB = Electricity Supply Board; Mayo = Mayo County Council; Galway = Galway County Council). 'Type' refers to type of water level measurement (SG = Staff Gauge; AR = Automatic Recorder). NGR – National Grid Reference

An important distinction can be made between those rivers whose catchment areas are located mainly in limestone areas, and those located in non-limestone areas. Rivers north of the Castlebar River fall mainly in the latter category, while the Castelbar River and those to the south fall mainly or entirely in the former category.

Northern Rivers (north of Castlebar River)

The more northerly rivers also generally have their headwaters in upland areas, where rainfall is highest and as a result they tend to be rather flashy (prone to rapid rise in level). These rivers also show a high density of tributary stream drainage, and this is reflected in the fact that more than half of the total number of watercourse crossings along the pipeline route occur north of the Castlebar River (representing approximately 1/3rd the total length of route).

Excluding the Addergoole River, which flows in an in-filled embayment of Lough Conn, all the northern rivers are relatively shallow, gravel-bed rivers. In many of them the water has a brown dis-colouration, reflecting the extensive presence of peat within the catchment area.

Drainage of the more northerly rivers is either westwards into Blacksod Bay (directly, or via Carrowmore Lake), or eastwards towards Lough Conn (and thence into Killala Bay, via the Moy River).

Southern Rivers (south of Castlebar River)

Although the more southerly rivers are located in a lower rainfall area, the channel network density is still surprisingly low for the amount of effective rainfall. This reflects the extent to which groundwater flow has taken over from surface flow in this area.

Many of the smaller drainage elements of the southern rivers consist of short segments that sink underground and re-appear as springs. All these rivers drain westwards either towards Lough Mask and Lough Corrib (and thence into Galway Bay), or directly into Galway Bay.

The present day network of major channels is to a large extent artificial and was created by arterial drainage works undertaken in the latter part of the 19th century. Figure 13.1 shows the present and former pattern of surface drainage taken from Drew and Daly (1993).

The drainage works were essentially designed to alleviate extensive winter flooding that used to occur in NE Galway and one of the major elements of this scheme was the excavation of the lower reaches of the Clare River. Figure 13.1 shows that where the pipeline crosses this river the channel is entirely artificial; likewise with the Rivers Eiscir (tributary of the Lavally River) and Dooyertha (tributary of the Dunkellin River). These artificial drainage works may also explain some of the confusion with regard to river names towards the southern end of the pipeline route.

The importance of karst in determining influent drainage during low flow conditions is shown in Figure 13.2, also taken from Drew and Daly (1993). It shows river discharge, normalised with respect to catchment area and rainfall, plotted against flow exceednce duration for three of the southern rivers crossed by the pipeline.

All three rivers show similar behaviour at high and medium discharges, but progressive divergence at low flows. The Lavally exhibits what might be considered the most extreme influence of karst, with virtually no surface flow for 5% of the time.

Rivers that derive an appreciable quantity of their flow from highly karstified areas are subject to a very rapid throughput of water and this is reflected in their flashy regimes - extreme high and low flows (Drew and Daly, 1993).

13.2.2 Lakes and Turloughs

The pipeline passes a number of small lakes where it crosses the peat areas at the northern end of the route.

These lakes may well represent the vestiges of once larger bodies of standing water that have become infilled by peat. However, in the Oweniny basin area, the clustering of small lakes is very reminiscent of kame and kettle terrain. Kettle holes are closed depressions in the ground surface marking points where masses of ice, entrained in the underlying glacial deposits, slowly melted resulting in collapse of the overlying material. Kettle holes typically occur in clusters and often become the sites of small lakes.

Although the size of the original kettle hole lakes may have diminished, the general pattern has been perpetuated despite the upward growth and general increase in thickness of the peat.

These small lakes are not connected by any stream drainage, and peat growth generally extends up to the water's edge. Because of the possibility of an increase in peat thickness and soft deposits underlying deposits in the vicinity of these features, they have been given a wide berth during route selection.

The only larger lake feature that the route runs close to within the northern peat area, is Lough Dahybaun, between Bellacorick and Eskeragh. As with the smaller lakes, the water in this lake is strongly peat stained. Glacial gravels form the shoreline around the northern side of the lake and around the island in the middle, but the southern shore is formed mainly in peat. Lough Dahybaun also appears to be a glacial lake feature, which has become partially infilled on the southern side by peat. In this area, peat thicknesses up to 9m have been recorded in site investigation probeholes.

A number of small lakes occur around Manulla. These have formed in hollows between the drumlins and the contained water is essentially 'perched' on the underlying clayey drift. The lakes are connected by small streams, many of which link to the Manulla River. Many former smaller bodies of water in this area, not shown on the 1:50,000 maps, have become completely infilled by peat.

Southwards from Manulla an increasing number of small lake features are seen, which are karstic in origin. The name turlough applies to these features.

Turloughs are essentially enlarged sinkholes that have captured sufficient of the surrounding runoff to become self-sustaining growth features. Many turlough do not have any associated stream drainage, and their water level is controlled entirely by variations in groundwater level. In-filling by peat and sediment washed in from the surrounding area, means that the water depth in turloughs is generally very shallow. Many turloughs are dry during the summer and only contain water during the winter. Flooding may only occur after exceptionally prolonged rainfall leading to very high groundwater levels.

The natural tendency for turloughs to form in hollows means that they can also become included within drainage networks. With the establishment of a more permanent surface supply of water,

further dissolution of the underlying limestone takes place and turloughs becomes sites for sinking streams.

Figure 13.1 shows the former extent of turloughs and their importance as sinks for river and stream discharge. With surface water penetrating to ground being concentrated in these areas, they became enlarged by the accelerated dissolution of the underlying limestone. Turloughs connected by streams are also characterised by seasonal flooding as a result surface water being unable to penetrate quickly enough to ground.

Many turloughs, particularly those occurring along river systems, have been artificially drained and flows that formerly disappeared into the ground have been canalised and diverted out of the turloughs. This is particularly evident along the Eiscir and Dooyertha Rivers.

Apart from their unique geological origin, extant turloughs also represent oases of water and lush vegetation in an otherwise rather dry landscape. They, therefore, constitute important wetland habitats and potential over-wintering sites for birds.

For a variety of reasons, therefore, turloughs have been given a wide berth during pipeline routing.

13.2.3 Areas Liable to Flooding

Areas liable to flood, particularly during the winter, include river flooplains and turloughs, as well as general low-lying areas with occluded drainage.

River floodplains and turloughs, which are historically prone to flooding, are generally indicated as such on OS 6inch maps by the notation 'Liable to Floods'. To further define the extent of flooding on the main rivers, the Office of Public Works has produced maps (available for consultation) showing the extent of river floodplains.

The OPW-defined floodplain areas generally accord closely with the extent of alluvium shown on old drift maps and what can be seen morphologically on stereo aerial photographs. In combination, the aerial photographs and OS/geological drift maps have been used to delimit areas liable to flooding for the purposes of route selection.

River crossing locations have then been selected purposely to reduce the width of floodplain crossing, recognising also that floodplains are likely to be underlain by less suitable soil materials. Turloughs have been avoided for reasons noted earlier.

General low-lying areas liable to develop standing water during the winter, typically have vegetation and soil characteristics, which allows them to be easily recognised on aerial photographs. These areas have been classified as general 'wet ground' as part of the route selection studies. Such areas would tend to be avoided during route selection, although with construction being during the summer such areas need not represent particularly difficult ground conditions.

With all areas historically liable to flooding, consideration has to be given to the possibility that arterial and land drainage may have permanently removed the flooding risk. In most cases, however, it is generally advisable to err on the side of caution and include measures to combat pipe flotation, depending on the length of route likely to be affected and the local soil conditions.

The extent to which land has been improved (i.e. drained) along the route has been assessed by comparing the areas of wet ground recorded on the 1973-74 aerial photography, with that evident on the recent (2000) project photography.

13.3 Groundwater

Operational natural pipelines do not constitute a pollution risk for groundwater, nor do they pose a threat to groundwater from the point of view of quantity or availability of supply. Pipelines can also be easily routed around individual supply features (wells, boreholes, springs, etc.), so there is no question of these features being lost or damaged.

Excavation of the pipeline trench will, however, involve interaction with the groundwater environment wherever water tables are high, and this will necessitate pumping out to remove water from the trench and possibly advance de-watering to ensure trench excavatability and stability. Such construction measures, being temporary, do not generally have a lasting impact, although the form of the trench and the types of backfill used can have long-term adverse consequences particularly for wetland habitats. Construction plant can also pose a risk for groundwater quality.

Although groundwater issues often tend to be interactive and difficult to treat in isolation, it is convenient to discuss them under three broad headings: Geotechnical, Aquifer, Karst and Habitat.

Geotechnical Issues

Wherever groundwater is encountered in any quantity during trenching operations it will generally need to be removed to allow the pipeline to be installed 'in-the-dry'. The level of the groundwater table relative to the base of the trench and the permeability of the soil will, therefore, largely determine the amount of water that will have to be contended with.

As a general observation, it can be stated that groundwater levels tend to be higher along the northern half of the pipeline route for the following reasons:

- Rainfall is higher towards the northern end
- Peaty soils, which predominate towards the northern end, tend to hold water close to the surface
- Permeabilities of the non-limestone strata at the northern end of the route tend to be quite low, thus reducing the rate at which water can drain away into the bedrock
- Karstification of the limestone bedrock over the southern half of the route promotes rapid downward percolation, rapid lateral flow and a lower phreatic surface (water table)

Groundwater is, therefore, more likely to be encountered during trenching operations along the northern half of the route, than along the southern half.

Along the northern half of the route soils comprise predominantly peat and glacial drift, with the latter tending to be highly granular. Despite its high natural water content, open trenches in peat do not produce significant amounts of water, due to the natural tendency for the peat to hold on to the water, as discussed in Section 11.2.1.2. The exception is if the peat is very fibrous and/or if 'water tracks' are intersected (see also, Section 11.2.1.2).

The granular drift will tend to produce significant quantities of water and 'running' conditions may be expected wherever fine sands and silts occur. Stream and river crossings, where groundwater

levels will be naturally high; and wherever the pipe has to be installed with a greater than minimum depth of cover (e.g. ditches and non-open cut road crossings), are all situations where consideration will have to be given to pumping and/or de-watering to control the inflow of water.

A redeeming feature about the northern section of the route, with regard to geotechnical groundwater issues, is that there are frequent rivers and streams along this section in to which water from trenching operations can be potentially discharged.

Along the southern half of the route, near surface soils tend to be more clayey, although, granular soils occur locally as noted in Section 11.2.1.1. The generally lower water table, however, will tend to be the overriding factor in terms of reducing the amount of water entering the trench. Notwithstanding this, lenses of sand in boulder clay may contain 'perched' water even during the summer, and peaty hollows will tend to have shallow groundwater throughout the year.

A potentially very difficult geotechnical situation can arise in peat areas, where the peat overlies granular soils (silts and fine sands, in particular). Peat tends to have very low permeability and where it covers large areas (e.g. blanket bog) it can trap groundwater in the underlying soil layer. If this groundwater develops a higher than hydrostatic pressure, for instance due to recharge from higher up the hillside, the peat (due to its low density) may become unstable. This is the mechanism whereby bog bursts and bog flows take place.

The route has purposely been selected to avoid the combination of topography, peat coverage and sub-soil types that would lead to such slope instability. Nevertheless trench excavation through peat will need to be mindful of the underlying soils and the potential for confined water pressures that might lead to 'blowing' of the peat or 'boiling' of underlying fine sands and silts.

Aquifer Issues

In keeping with other European countries, Ireland has embarked on a programme of ranking and mapping of aquifer areas in terms of importance and vulnerability.

The detailed mapping of superficial soils that will influence the vulnerability of underlying aquifers, is being carried out by the Geological Survey of Ireland. It will form part of a Groundwater Protection Scheme programme that will be operated by the county councils, who will use it to vet proposals for development in order to protect groundwater and individual supply sources.

The detailed vulnerability mapping stage is still ongoing, but the basic aquifer areas have already been identified and the methodology for mapping and application of the programme is embodied in guidelines 'Groundwater Protection Schemes', published jointly by the Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey of Ireland (DELG, EPA and GSI 1999).

In the absence of these detailed maps, interim measures for groundwater protection are suggested in the guidelines, which combine: 'the principles of a groundwater protection scheme with the best available hydrogeological information, to form a defensible basis for decision-making regarding groundwater protection'.

Application of these interim measures essentially involves:

- Delineating source protection zones around wells and springs
- Delineating aquifer categories
- Mapping the extremely vulnerable areas, particularly on regionally important aquifers

An inventory of individual groundwater supply sources is currently in the process of being established. This will identify locations along the pipeline route, which fall within a distance of 500m from the pipeline. 500m is the suggested (DELG, EPA and GSI 1999) radius of a circle defining the Inner Protection Zone around a source, to be used in the absence of detailed hydrological information.

The main aquifer areas in Ireland, with their importance rating, is shown in Figure 13.3. The pipeline route has been added to this map to indicate the main aquifer areas that will be crossed by the pipeline.

As part of the route selection studies, draft maps have been prepared showing the different soils types within a 1km wide corridor centred on the pipeline. A simplified version of these maps, showing generalised soil types along the route, is given in Figure 11.5 to 11.8. Together with site investigation information from along the route, confirming soil types and thicknesses, the corridor soils maps can be used to delineate vulnerability categories in regionally important aquifer areas.

In terms of potential aquifer risk, the route can be provisionally sub-divided into the following segments:

- Reception Terminal to Massbrook South (just south of Lough Conn) - The route is underlain almost entirely by Minor/Complex Sand and Gravel Aquifer. Initially (as far as about the Shanvolahan River), this is in turn is underlain by Bedrock Aquifer.

  As noted in Section 11, the sands and gravels tend to be rather clayey, diminishing their aquifer potential, and much of the area is covered by peat, whose low permeability will serve to protect the underlying aquifer.

- Massbrook South to Clydagh River - The route is underlain by Poor/Minor Aquifer in the form of thin drift overlying low permeability bedrock.

- Clydagh River to Craughwell AGI - Save for a short section just south of the Castlebar River (corresponding to the Aille Limestone Formation) and an unspecified length south of Manulla Bridge (see Section 11.2.2), which is though to be underlain by Downpatrick (shale) Formation, the route is underlain by Bedrock Aquifer.

- As noted ealier, (Section 11.2.2) Muddy Limestone overlain by rather thick clayey drift extends southwards as far as the road crossing north-east of Knockrickard (figure 4.5 M 2810 7698). Drew and Daly (1993) classify the Muddy Limestone as a Poor Aquifer with locally productive zones (see Table 13.3).

- South of this crossing (Figure 4.5 M 2810 7698), Pure Limestone predominates and as noted in Table 13.3, this is classified as a Regionally Important Aquifer. Initially, however, the bedrock is moderately thickly covered with clayey drift, which will serve to reduce the vulnerability of the aquifer. Between Beagh More and Craughwell AGI the drift tends to be very thin and in places also very granular; swallow holes are an important feature also. Along the Beagh More to Craughwell AGI section of the route, therefore, the underlying aquifer is considered to be highly vulnerable.

This sub-division will be further refined once the additional site investigation work is complete.

Specific measures, in the form of method statements governing working procedures in vulnerable regionally important aquifer and source protection areas, will then be incorporated into the construction programme.

Table 13.3 Bedrock Aquifer Definition (after Drew and Daly 1993)

Rock Type	Aquifer Category
Pure Limestone)	Regionally Important (karstified)
Muddy Limestone) Carboniferous	Poor with locally productive zones
Basal Sandstone)	Locally important
Sandstones and Shales) Older	Poor
Granites and Gneiss) Rocks	Poor

Karst Issues

While Aquifer Issues, above, cover the groundwater protection aspects of karst, karst has a unique hydrogeological significance, which warrants special consideration. This has to do with the potential for change in the subterranean flow regimes that develop in karst areas.

In their report on Groundwater and Karstification in Mid-Galway, South Mayo and North Clare, Drew and Daly (1993) draw attention to the importance of specific groundwater flow directions and flow pathways. South of the River Robe as far as the Craughwell AGI, groundwater flow is predominantly westwards across the line of the pipeline.

By means of tracer studies, proven underground connections have been established between turloughs or influent streams (where water enters the ground), located upstream of the pipeline and springs, located downstream of the pipeline. Figure 13.4 shows an example for the Dunkellin - Lavally catchment area.

Many of the springs lying downstream have been utilised for public and group water supply schemes, although these often show significant winter to summer variations in discharge and also considerable variations in water quality; with bacteria, iron and suspended solids being the main types of contaminant.

Given the rather tenuous and uncontrolled nature of the underground pathways to these springs there is scope for blockage or diversion by surface development, with concomitant water quality implications. The ways in which these might occur include:

- Blasting causing collapse roof collapse in caverns
- Induced collapse of swallow holes causing blockage by soil materials
- Local influx of soil due to wash-out along the trench during heavy rain

Although these are considered unlikely to occur along the pipeline for the following reasons:

- Because the route has been kept away from areas where localised water inflow occurs
- Areas of shallow rock requiring blasting have generally been avoided
- The route has been kept at a high level relative to the groundwater table

Nevertheless special precautions will need to be taken in order to avoid further derogation of the springs

In order to identify areas along the pipeline that might be considered at risk, geophysical investigation will be carried out. Staged geophysical investigation work is being implemented in any case to identify areas which may be potentially susceptible to karst ground instability.

A construction methodology will then be developed for those sections of the pipeline route where geophysical data and previous tracer studies indicate a potential for blockage of underground flow paths.

Habitat Issues

The specific habitat issue that concerns groundwater is the peat wetland habitat. Since peat wetland covers a significant proportion of the north part of the route and local areas along the southern portion, it is appropriate that special consideration be given to it.

However, a clear distinction has to be made between the extensive basin and blanket bog peat areas that occurs at the northern end of the route and the more isolated occurrences of peat in low-lying hollows that occur along the southern section. While the former are sustained mainly by direct rainfall, the latter are reliant on a combination of rainfall, surface run-off and high groundwater.

Of principal concern is the possibility that construction of the pipeline may affect the hydrology of the peat, either causing permanent de-watering or surface flooding and consequent loss of habitat sustainability.

While these concerns apply to peat areas in general, it is particularly to those designated intact bog areas (NHA and SAC areas) and areas considered worthy of preservation, that the concerns are addressed.

It is evident from the perpetuation of small shallow lakes (as noted in Section 11.2.1.2) that bog peat cannot grow when fully covered by water. A reduction in surface level, either by load consolidation of the underlying material or erosion/removal of the surface, has therefore to be avoided, as this may lead to permanent inundation. Disruption of surface drainage e.g. water track also has to be avoided.

In the northern bog areas, simply trenching through the peat and/or temporary de-watering along the line of the trench will have no permanent impact on the growth of the mattress. This is clearly indicated by:

- The way in which the mattress at the top of cut faces in peat continues to flourish even though the cut face may dry and crack during the summer.
- The way in which the mattress will quickly re-establish itself even over extensive ridge and furrow cut-away bog

This is because the northern bog areas are sustained chiefly by rainfall. The underlying peat simply provides a buffer reservoir of groundwater, which will not readily drain out, but is available for use by plants. Abstraction of this contained groundwater (e.g. by evapo-transpiration) causes shrinkage of the peat, but does not lead to a significant change in moisture content.

However, in the more southern bog areas the balance is tipped more towards reliance on the underlying groundwater and surface run-off, as is indicated by the speed with which the wetland habitat is lost when these areas are artificially drained.

Although this would suggest that more attention should be paid to maintaining groundwater conditions in the southern bog areas, in effect, all bog areas will be treated equally and the following measures will be applied during construction:

- The trench will be left open for as short a time as possible
- A minimum of de-watering will be carried out in peat areas
- On sloping ground only short sections of trench will be opened or way-boards will be used to prevent drainage along the trench
- Were de-watering of more permeable soil materials has to take place adjacent to peat areas, care will be taken to ensure a minimal effect on the peat.

On sloping ground, where there is a possibility of the trench providing a long-term drainage path for surface or groundwater, backfill of comparable or lower permeability will be used. If more permeable bedding material has to be used around the pipe, clay way-boards will be placed at intervals along the trench to prevent a continuous flow through the bedding material.

Any near surface drainage features (water tracks) will be identified in advance and reinstated on completion.

13.4 Impact and Mitigation Summary

Residual Hydrology and Hydrogeology impacts occurring along the pipeline route can be summarised as follows:

- Crossings of main rivers
- Crossings of areas liable to flood (including river floodplains)
- Crossing of areas with water-logged soil (peat) and high groundwater
- Areas of highly vulnerable Regionally Important Aquifer
- Crossings of karst areas with underground flowpaths to springs used for water supply
- Crossing of wetland habitat areas (mainly peat areas)

Mitigation measures, either already instituted or set in train, include:

- Reducing the length of crossing of these areas to a minimum (as part of route selection
- Identifying the length of crossing and designating these areas as Special Locations for construction
- Establishing a protocol for preparing method statements, which will provide the basis for construction procedures on site.

13.5 References

Daly D. P. (1998)
The Importance of Rocks and Groundwater in
Preparing an Environmental Impact Study
In: Environmental Impact Studies
14th Annual Environmental Conference
5-6th November 1998
Imperial Hotel, Cork

Drew D. P. and Daly D. (1993)
Groundwater and Karstification in Mid-Galway, South Mayo and North Clare
Geological Survey of Ireland
Report Series
RS 93/3

(DELG, EPA and GSI 1999)
Groundwater Protection Schemes
Department of the Environment and Local Government,
Environmental Protection Agency and
Geological Survey of Ireland

EPA (1995)
Hydrological Data
A Listing of Water Level Recorders and
Summary Statistics at Selected Gauging Stations
Environmental Protection Agency

14 ARCHAEOLOGY AND CULTURAL HERITAGE

14.1 Introduction

This section assesses the archaeological and historical importance of the proposed route. The purpose is to evaluate the impact of the project on the receiving archaeological environment and to propose measures to safeguard any monuments, features or finds of antiquity.

The study is based on the Sites and Monuments Record (SMR) of Dúchas, the Heritage Service of the Department of Arts, Culture, Gaeltacht and the Islands, and a number of other published and unpublished sources detailed in the references. **Appendix 14.1** lists known SMR sites within 500m of the pipeline, whilst **Appendix 14.2** lists known stray finds.

The sites are numbered according to the OS six-inch sheet on which they are located, so that Site No. 1 on OS six-inch sheet 45 is listed as 045:001. A county code—MA for Mayo and GA for Galway—is utilised.

The section is divided as follows:

- **Historical and archaeological background:** discussion of the archaeological and historical features common to the wider area, the records of the National Museum of Ireland and known monuments recorded by the Sites and Monuments Record (SMR) of Dúchas.
- **Evaluation criteria:** an outline of the methodology adopted for the archaeological section of the Environmental Impact Statement.
- **Archaeological and heritage evaluation:** description of the topography of the land under consideration for development, together with the townland names and types of archaeological sites encountered by the pipeline. Discussion of construction and site preparation effects, including a description of the procedures that will be undertaken prior to and during the construction of the pipeline route and the possible effect on the surrounding archaeology.
- **Mitigation measures:** discussion of the archaeological implications of and the proposed mitigation for the development.
- **Residual effects:** long-term or outstanding effects on the archaeology of the area.

14.2 Historical and Archaeological Background

14.2.1 Mesolithic (c. 10000-4000 BC)

This period saw the first people come to Ireland after the end of the last ice age. Mesolithic people did not build permanent stone monuments, and the sites dated to the Mesolithic are usually connected with habitation or food production activity. The hunting and fishing economy of this period means that many sites are coastal and estuarine, and there is a significant possibility that work in estuarine and riverine areas might reveal Mesolithic habitation sites.

14.2.2 Neolithic (c. 4000 to c. 2300 BC)

The Neolithic period saw the arrival of the first farmers and the adoption of the farming economy in Ireland. This period also saw new developments in ritual activity, and the first permanent monuments were built in the Irish landscape. The most famous and spectacular of Neolithic monuments are the megalithic tombs, which are divided into four classes. The court tombs are the earliest form and are largely limited to the northern and western parts of Ireland. A court tomb is identified by the SMR as part of a complex of monuments in the townland of Eskeragh. Portal tombs, known popularly as dolmens, are dramatic constructions, often situated near streams or rivers. Passage tombs are unique among megalithic tombs in occasionally having decoration on some stones. They are often situated at vantage points or on the summits of hills. Wedge tombs are dated to the end of the Neolithic and the very beginning of the Bronze Age.

14.2.2.1 *The Céide Fields*

The Céide Fields site in north Mayo encloses an area of $12km^2$ and consists of two large conjoined coaxial field systems preserved intact under a mantle of blanket bog in excess of 4m deep in places. Within these field systems, there is evidence for settlement in the form of enclosures and megalithic tombs.

The modern landscape of the Céide Fields is seen by many as an isolated, barren and harsh environment; but the picture for the thriving Neolithic community of the fourth and early third millennia was quite different. Prior to this period, the area was covered in extensive woodland, with blanket bog forming in some areas. The land was then cleared to produce a planned open landscape for agricultural use.

Numerous pre-bog field systems have been recorded along the west coast. It is highly probable that sites of a similar nature to the Céide Fields remain buried throughout Mayo, with their archaeological potential as yet unrealised.

14.2.3 Bronze Age (c. 2300 to c. 500 BC)

The Bronze Age saw new developments in agriculture, including the introduction of tillage, and Ireland also saw an improvement in the climate. Metal was also extracted for the first time, and areas such as southwest Ireland and Wicklow produced large amount of copper and bronze. Bronze Age monuments tend to be smaller than those of the Neolithic period, and often incorporate elements of the natural landscape.

The Bronze Age is represented by a range of different monument types, including a variety of burial monuments, including cairns, tumuli and barrows, as well as a number of actual burial sites. Standing stones too are generally dated to the Neolithic and the Bronze Age, and while they occasionally mark burials, they often appear to mark routeways through the landscape, the presence of sacred areas, or territorial boundaries, and are a common archaeological site. Stone circles, ceremonial rings of stones, are generally dated to the Bronze Age, and are sometimes associated with contemporary burial monuments.

Among the more unprepossessing Bronze Age monuments are the *fulachta fiadh* or cooking sites. A possible *fulacht fiadh* was identified in Clooneen townland, Co. Mayo. This feature lies adjacent to the pipeline and will need to be further investigated prior to construction. A dense concentration of *fulachta fiadh* (152) has been recorded around the town of Turlough.

14.2.4 Iron Age (c. 500 BC to c. AD 500)

Iron Age monuments are less common, as the period was marked by a change in the climate (and a consequent growth in bogland) and upheaval in society. Apart from the aforementioned barrows, the best known Iron Age monuments are probably hillforts. Much of the information on the Iron Age in Ireland is based on metalwork of this period, which was sometimes deposited as votive offerings in wet or boggy areas.

14.2.5 Early Christian/Early Historical (c. AD 500 to c. AD 1100)

Christianity was introduced into Ireland in the fifth century AD, and brought with it not only writing and recorded history, but also a range of new monuments. The best-known native monument of this period is the ringfort, a classic Early Christian settlement type. Numerous examples flank the route—in the townlands of Doonbreedia and Lahardaun, in Co. Mayo (MA 038:109, 047:066 and 024).

Among ecclesiastical, or at least Christian, sites, there are several monument types that are not, strictly speaking, 'official' church sites. These include holy wells and children's burial grounds. Another commemorative monument, which may be part of a pre-Christian tradition, is the *leacht cuimnhe*, or wayside death cairn. These are heaps of stones, which are continuously added to by passers-by, built in remembrance of people who have died at that particular point on the road.

14.2.6 The Medieval and Anglo-Norman Periods

The Normans came to Ireland in the middle of the twelfth century, bringing with them new military traditions and fortifications, new language, and new social structures. Anglo Norman fortifications include mottes and baileys and moated sites.

There are a number of stone castles along the route but all are located over 250m from the pipeline and therefore are not included in the archaeological inventory (**Appendix 14.1**).

14.2.6.1 *Battlefields*

Due to the difficulty of fitting battlefields into the context of the definitions of the National Monuments Act, it has in the past been a category largely omitted from state archaeological policy. However, an important battlefield site (the Battle of Knockdoe) is marked in the SMR (GA 070:080) for County Galway.

14.2.7 General

Major river crossings always offer the potential for uncovering archaeological remains. In addition, many lodges were erected in the vicinity of such crossings by wealthy landowners for the purpose of gaming (fishing and hunting) pursuits before and after the Famine (which halved the indigenous community).

The Mayo and Galway county development plans were consulted to identify if any protected structures were close to the path of the proposed pipeline. No structures will be affected.

14.3 Evaluation Criteria

14.3.1 Introduction

The desk study conducted for the archaeological assessment identified all known and standing monuments. Given the landscape through which the pipeline passes, the context of these monuments and their relationships to adjacent sites must also be considered, and the surrounding zones of archaeological potential will have to be a focus for avoidance.

14.3.2 Sites and Monuments Record (SMR)

The primary source of information for the desk study was the SMR, a database of known upstanding archaeological monuments, their original location (in cases of destroyed monuments) and the position of possible sites identified as cropmarks on vertical aerial photographs, which is maintained by Dúchas.

Individual archaeological site information was obtained in a digital format through a computer-based version of the SMR database. This database provided the name of the townland in which the sites and monuments were located, the type of monuments encountered, and the national grid reference for each monument. This information was then superimposed onto electronic files of 1:50,000 OS mapping, and a corridor was generated highlighting all known archaeological sites occurring 1.5km either side of the proposed pipeline route. The study finally concentrated on all known, and potential, remains within 250m of the route.

14.3.3 Documentary Sources

Various documentary sources were used and are listed in the references. Cultural heritage issues were addressed by examining the lists of protected structures recorded in county development plans for Mayo and Galway.

14.3.4 National Museum of Ireland Topographical Files

The topographical files of the National Museum of Ireland (NMI) were used to identify recorded

stray finds held in the museum's archive. The finds have been donated to the state in accordance with national monuments legislation. They sometimes include reports on excavations undertaken by National Museum of Ireland Archaeologists earlier in the twentieth century.

14.3.5 Geofilm

An aerial film (Geofilm) of the pipeline was examined to identify known monuments, areas of archaeological potential, topography and current land use.

14.3.6 Field Walking

A field inspection at certain critical places along the route was undertaken to assess the distances of known archaeological sites and possible associated archaeological material from the route, current and previous land use, local topography and any additional information relevant to the report. The field inspectors also sought to identify any low-visibility archaeological features with little surface expression.

However, this does not necessarily ensure that everything is identified in advance and that sites will not be revealed during the early stages of construction-phase earthmoving. It does inform the route selection about identified potential.

14.3.7 Archaeological Consultation

Consultation on the appropriate methodology to be used took place with Dúchas at the early stages of the archaeological assessment. Reviews of as yet unpublished works and discussion sessions were held with individual archaeologists familiar with the study area.

14.3.8 Archaeological Site Classification

The proposed pipeline corridor was initially reviewed at a 1:50,000-scale mapping. This provided an overall view of the land through which the pipeline travels. The primary function of the current study was to ensure that all known and potential archaeological sites identified by the field inspection or on the Geofilm are avoided. Therefore, the process has involved constant route refinement to ensure, where at all possible, that no conflict has occurred between the emerging route and the archaeology.

Archaeological sites are generally classified for the purpose of impact assessment in such a way that their status in the archaeological record is suggested (**Appendix 14.4**).

A detailed description of each individual site that lay within 500m of the pipeline corridor was gathered (**Appendix 14.1**). An area of interest was suggested for each site. This is a zone of archaeological potential around the known extant remains in which related archaeological features are likely to occur.

Where the site location on the SMR mapping was called into question due to ongoing research, features were checked with the archaeologist who had originally surveyed the site. The re-routing procedure facilitated the avoidance of all known archaeological sites. If a distinct area was deemed to have a high archaeological potential in which the parameters could be defined, the pipeline was re-routed and the area avoided.

14.3.9 Archaeological Monitoring of Geotechnical Trial Pits

An archaeologist monitored all geotechnical trial pits excavated as part of the site investigation along the route. Some of the results, where relevant, are included in this report. **Appendix 14.5** provides a sample of the site investigation sheet used during the monitoring process. Every trial pit was recorded archaeologically, and the data will be submitted to Dúchas on completion of the work.

14.4 Archaeological and Heritage Evaluation

14.4.1 General

The avoidance of all known sites must be the focus of the study. However, it must be stressed that in any area subject to development, there is always a possibility that archaeological features will be revealed during construction, even in areas in which no impact is predicted. This potential is high in areas where archaeological material is masked by the re-growth of bog. This is particularly evident in County Mayo, where archaeological research to date has revealed large pre-bog field systems (earthen and stone) up to 3m beneath the surface of the bog.

Some areas in County Galway have been extensively modified due to intensive agricultural development, and many of the field boundaries marked on OS maps have disappeared and fields have been amalgamated and surrounded by deep drainage ditches. This pattern is also evident in the inventory of archaeological sites along the route (**Appendix 14.1**), as many of the recorded sites have been levelled and have no discernible visible trace.

Even though there has been a significant level of disturbance to the original field layout, there remain many intact dry stone wall boundaries that will need to be crossed and appropriately reinstated after the placement of the pipeline.

All contractor's compounds, machinery and storage compounds, lay-down or string-out areas for pipeline and any area that will be occupied or stripped of topsoil as part of the pipeline activity will have to be assessed archaeologically if the area is additional to the present study.

14.4.2 Detailed Route Description

14.4.2.1 *Introduction*

The following detailed description follows the pipeline from the reception terminal at Bellanaboy Bridge to Craughwell; however, where possible, the route is discussed under the type of terrain and landscape through which the pipeline passes. This approach gives a sense of the setting and context of the archaeological monuments and assesses the potential of additional archaeological sites occurring within these specified landscapes. **Figure 14.1 (Volume II)** illustrates all sites identified.

14.4.2.2 *County Mayo*

Bogland

The land is mostly boggy with areas of cut bog, forestry and rough pasture. There are several areas of possible archaeological interest. The first of these, which includes a possible megalithic structure, is located approximately at Grid Reference E89615 N326578, *c.* 50m south of the proposed pipeline in an area of pasture. The structure consisted of several large stones c. 0.5m in diameter. The Geofilm was viewed, but no remains of any structure could be seen.

A second area of possible archaeological interest, a circular stone structure, occurs on the slope *c.* 80m south of the pipeline and *c.* 70m north of two derelict stone houses (approximate E89770 N326499). The structure (diameter 2m; height 0.5m) was made of dry-stone masonry and small boulders.

Approximately 50m north of this circular structure (approximate E89499 N327114) there is an area of stone debris with two cut stones. A stream flows south into the Glencullin River immediately to the west of this area, and a stone wall, aligned east–west, is located immediately to the south. There are no defining walls of a structure extant, but the area of debris measures 4m east–west and c. 10m north–south. There are two cut stones among this debris. The first of these measures 0.37 m by 0.45 m and has a circular depression carved into it; the second stone is similar and measures 0.3m by 0.35m.

The next area of potential archaeology identified during the field inspection is a stone spread that occurs in an area of reclaimed pasture along the pipeline route itself (approximate E91193 N325937). There is also a possible clearance cairn c. 100m southwest of this spread of stones.

A final area of archaeological potential was identified through Geofilm between PA3-08 and PA3-09 (approximate E94240 N322412) in the townland of Tawnaghmore, where there appears to be an irregular layout of ridges in the bog, most likely associated with drainage.

Industrial milled peat

The townlands of Kilsallagh and Bellacorick are mostly milled peat and uncut bogland with no discernible archaeological features. However, the harvesting of peat by Bord na Mona has led to two wooden artefacts being found in Bellacorick and four artefacts being found in Tawnaghmore. In Moneynierin and Dooleeg More, the bogland continues in a relatively undisturbed form.

A cist, MA 027:003, was uncovered on a south-south west-facing mountainside in an area of rough mountainous terrain. There is no visible trace above ground. The burial comprises a circular flat-bottomed pit (diameter c. 1m) within which was found a rectangular cist walled by four large slabs set on edge and closed by a single large capstone. The cist was c. 1.35m under the peat and had been covered by several large boulders. It yielded a quantity of poorly cremated human bone, which is now in the National Museum (NMI Reg. No. 1971:1042), but no associated funerary deposits (unpublished SMR information, Dúchas). The burial, which is likely to be Early Bronze Age in date, is *c.* 150m north of the proposed route, though its exact location is difficult to determine.

Marginal bogland

There is a standing stone MA 028:004, located on a prominent height in an extensive area of peatland in Dooleeg More, *c.* 150m north of the pipeline. It is a massive irregularly shaped boulder set into a hollow filled with rushes. The pipeline will not affect it.

Also in Dooleeg More is MA 028:006, there is a stone row situated on a low rise in the peatland. It comprises three large boulders aligned north-northeast–south-southwest. The row is 5.1m in length, and the stone at the south-southwest end is roughly dome shaped; the others are irregularly shaped. It is *c.* 150m away from the pipeline and will not be affected.

In Eskeragh, there is a small complex of monuments, MA 028:003, containing two standing stones, a stone row, a court tomb, an enclosure and a pre-bog field wall. The standing stone, MA 028:00302, is situated on a prominent height in otherwise low-lying peatland. It is a large irregularly shaped block tapering to a point. There are a number of packing stones at the base of this stone.

The possible entrance to the court tomb MA 028:00303 is defined by two large boulders to the south of a group of several much smaller boulders. The stone row MA 028:00304 comprises five stones aligned north-northeast–south-southwest (total length 4.9 m). The enclosure MA 028:00305 is a small circular feature (diameter c. 5m) to the north, and it contains a cut stone. This complex is situated north west of Eskeragh School and 200m north of the proposed pipeline route located on the other side of the road. It will not be affected, but it demonstrates the archaeological potential of the area. The majority of archaeological sites in this area, dating to the Late Neolithic and Early Bronze Ages, are found on natural gravel ridges that afford good views of the surrounding district.

Eskeragh is an area of high archaeological potential, particularly in and along the margins of the cut bog. The pipeline has been re-routed to the disturbed reclaimed pasture to the south of the houses, away from the uncut bogland, which has a higher archaeological potential.

After the Shanvolahan River, the pipeline turns south through commercial forest plantation and areas of bogland in the townland of Carrowgarve South. The pipeline has been re-routed in this area to avoid an enclosure and possible associated field walls that were identified during the viewing of the Geofilm and later verified in the field by the monitoring archaeologist.

Improved land—drumlin landscape

The typical types of archaeological monuments encountered change to the ringfort and the enclosure, located on the summit of the low drumlin hills that characterise the area.

The pipeline will run to the south west of MA 037:003, an enclosure in Knockbrack, at a distance of 70m. The monument is situated on a northwest-facing slope overlooking the River Deel. It is a raised circular area (diameter *c.* 25m) enclosed by a much denuded earthen bank (unpublished SMR information, Dúchas). This feature is located in a private garden associated with a house immediately to the northeast. The pipeline will not affect it.

Several known archaeological monuments are located in the vicinity of the larger rivers in this area. The pipeline crosses a rivulet in Killacorraun, *c.* 100 m southeast of the ringfort MA 038:065. The second crossing occurs where the river forms the townland boundary between Srahyconigaun and Doonbreedia. Another minor river is crossed in the townland of Doonbreedia, about half a kilometre west of Rathkell. The same rivulet is crossed again approximately 300 m further along.

The pipeline will cross the Castlehill River at the boundary between Ballymoyock and Carrowkeel (approximate E111422 N310982). There are several known monuments in this area: three ringforts (MA 047:004, MA 047:005 and MA 047:007) and a court tomb (MA 047:008), but these will not be affected by the pipeline.

Another major river, the Lecarrow, is crossed *c.* 1.7km further along the pipeline at E112537, N309968. This river forms the north western townland boundary of Lahardaun. There are four monuments within 500m of the river crossing: three enclosures (MA 047:011; MA 047:012; MA 047:060) and a ringfort (MA 047:013).

There are seventeen known archaeological sites along the route between Killacorraun and Knockfarnaght. The first, a ringfort with a possible associated souterrain (MA 038:065), is located in the townland of Killacorraun, within 50 m of a rivulet and 50 m west of the route. It is marked on the map as 'Coolcran Fort'. Located on a hillock in good pasture, along the eastern boundary of a field grazed by sheep, the site was found as a well-preserved subcircular raised platform, *c.* 25 m in diameter, surrounded by an earthen bank. The souterrain could not be located, as the area was heavily overgrown. Immediately east of the monument, many medium-sized loose stones were scattered. In the fields to the east of the monument, there were large boulders and piles of small to medium tightly packed stones, these were remnants of stone cairns. The majority of the cairns had been removed, leaving a spread on the ground. These features may have been of archaeological origin, though it is impossible to say for certain in their present denuded state. The pipeline will not affect the ringfort itself, and has been re-routed to avoid this complex of sites.

The second site is MA 038:151, a mound located on the crest of a hill, 130m west of the proposed pipeline route. The pipeline will pass through the same field as this feature, but at a lower level. No interference is anticipated.

The third and final monument visited in the townland of Killacorraun was MA 038:152, a cashel situated 30m east of the pipeline on a north-facing ridge in rough peatland, with cut bog located to the south. The cashel comprises a circular enclosure, approximately 19m in diameter, defined by a low bank of loose stones and moss-covered rocks. A significant dip in the feature at the

north may represent a possible entrance or a collapsed souterrain. There are substantial field walls to the east of the cashel, and a large semi-circular enclosing wall to the southeast. Five hundred meters further south of this site, in Srahyconigaun, there is a ringfort, MA 038:100. This ringfort is situated 170m west of the pipeline and will not be affected.

The next monument, enclosure MA 038:108, is in the townland of Doonbreedia *c.* 100m east of the pipeline. The monument is a circular enclosure defined by a bank of earth and stone with a raised interior. Former field boundaries around the enclosure have been removed, and the material has been piled up, artificially raising the banks to a height of 2.5m or more. The pipeline will run through an adjacent field and will have no impact on the site.

Also in Doonbreedia there is a ringfort, MA 038:109, situated 30m south of the proposed route, at the southern end of an ungrazed field. It was a roughly circular enclosure (diameter c. 31m) bisected by a north east–south west field boundary and cut short by an east–west field boundary at the south. An earthen bank with stone inclusions defines the western half of the monument, 1m high at the southwest. The rest of the bank on this side is denuded to a low rise leading into the interior of the monument. The eastern portion is better preserved. The outer circular boundary indicated on the OS map is not visible in the field or on the Geofilm. It may have been an outer enclosing feature associated with the ringfort and may still have surface presence. The pipeline has been re-routed from this possible outer enclosure.

There are three known sites in the townland of Ballymoyock. The first is a children's burial ground within a ringfort, MA 047:002, located in good pasture in a hollow on a south-south west-facing ridge. The ringfort is a well-defined oval enclosure measuring *c.* 22 m by 14 m. Within the interior are a number of low cairns and two uninscribed upright slabs. The pipeline was proposed to run in the same field but has been relocated to an adjacent field to the west to avoid the monument.

Two hundred meters north west of the burial ground is MA 047:003, another ringfort. The monument comprises a raised circular area (diameter 28.6 m) enclosed by a low bank of earth and stone. Along a section of the perimeter, dry-stone masonry has been applied to the outer face of the bank, which has been incorporated into the field boundary. The pipeline runs through lower ground 150 m south of the ringfort, and no impact is anticipated.

The final monument in Ballymoyock is the enclosure MA 047:006. This site is completely overgrown with scrub, making inspection impossible. It is located on raised ground approximately 50 m north of the proposed pipeline route. The pipeline runs in an adjacent field, through lower ground, and no impact is anticipated.

Two ringforts, MA 047:005 and MA 047:007, occur within the corridor in Carrowkeel. The former had been levelled and no remains are visible at ground level. The pipeline will travel 120 m north west of the site, in the same field, but will not affect it.

From MA 047:005, a large circular feature can be seen to the northeast. This is a prominent hillock and the location of MA 047:007. The site has been destroyed, and there are no remains now visible at ground level (unpublished SMR information, Dúchas). The pipeline will travel 160m south west of this area, and no impact is expected.

There are six monuments within the 500m corridor in the townland of Lahardaun. Due to agricultural activity, the majority of monuments have been levelled in this area. The first is MA 047:012, an enclosure situated a short distance south west of the highest point of a prominent drumlin hill. The site has been levelled, and no remains are visible at ground level. The route is 150 m south of the location,

and no impact is anticipated.

The feature previously recorded as MA 047:060 was declared a non-antiquity by Dúchas archaeologists in 1996 and de-listed from the SMR (unpublished SMR information, Dúchas). There are, therefore, no recommendations to be made regarding this site. It was identified through aerial photography as a result of a curving field boundary, stone-lined to the west with a ditch to the east. The next known archaeological site along the route is MA 047:061, *c.* 230m east of the pipeline, near the village of Lahardaun. This is an enclosure with an associated field wall. No remains are now visible at ground level, but its location is a steep north-north west-facing slope in an area of good pasture. The outline of a circular enclosure with at least three field boundaries running off from it are visible on an aerial photograph (unpublished SMR information, Dúchas). This area is several small fields away from the pipeline and will not be impacted upon.

MA 047:025 is a group of monuments centred around an enclosure in the townland of Lahardaun, *c.* 230m from the proposed pipeline route. This miniature complex is situated atop a prominent steep-sided hillock in an area of poor pasture. The enclosure comprises a raised circular area (diameter 27.5m) enclosed by a low bank of earth and stone with an external fosse. Close to the centre of the site is a subrectangular area, 4m by 4m, defined by a series of boulders. Within this is a small, irregularly shaped depression that probably represents the blocked-up entrance of a souterrain. These features are all located at a safe distance from the proposed pipeline and will not be affected.

The ringfort MA 047:066, is situated on a low but prominent drumlin hillock. It is a raised circular area (diameter 20.4m) enclosed by a low bank of earth and stone that closely resembles disused field boundaries in the vicinity of the site. The bank barely rises above the internal ground level for much of the circuit. A break in the bank at the northeast, with an accompanying ramp, probably represents the original entrance, and there are several large boulders piled up at this point. MA 047:024 is visible to the west on a raised hillock. The proposed route will take the pipeline 30m southwest of the monument in an adjacent field.

MA 047:024 is an enclosure lying on a prominent hill. It is a raised circular area (diameter 23.2 m) enclosed by a low bank of earth and stone. Dry-stone masonry has been applied to the outer face of the bank where it was formerly incorporated within a north–south field boundary. Field clearance stones have been piled up against the outer face of the bank at the northwest. There appears to be no fosse, and the original entrance is not recognisable (unpublished SMR information, Dúchas). The pipeline travels in a northwest–southeast alignment, 150m north east of the enclosure, and no impact is expected to the monument.

Boggy and marginal land

The only known archaeological monument within the 500m corridor between Knockfarnaght and Gort is MA 060:051, in the townland of Largan. This is classified as a hut site and is located over 200 m west of the proposed pipeline route, along the rivulet crossed by it at E118078 N302070. Another hut site, MA 060:050, located *c.* 200m further west, has been declared a non-antiquity by Dúchas archaeologists. This site is situated on a steep east-southeast-facing heather-clad hillside (unpublished SMR information, Dúchas).

The nearest monuments are an ogham stone, MA 069:001, in the townland of Sallagher, situated 750m from the proposed route, and a holy well, MA 069:002, in Crumlin, 600m from the route. Although there are no known sites or monuments along this section of the route, the area has high archaeological potential because of the boggy landscape and the large number of watercourses.

Improved pasture

In Clogher, the pipeline passes to the west of two ringforts (MA 70:180 and 181) in rolling countryside in an area of largely reclaimed pasture. A field boundary curves around the enclosure MA 079:011.

Between Rockfield and Knockmore Eighter, all the archaeological sites located within the 500m corridor are enclosures, two of which are classified as ringforts. The first ringfort, MA 070:172, occurs in Rockfield itself and is located 200 m west of the proposed pipeline route. On the OS maps, it is indicated as a circular area with field boundaries emanating from it on the east, south, west and north. A bank appears to be shown from the southwest to the north. The pipeline will not have any affect on this site.

The next three enclosures are in the townland of Ballinvoash. The first of these is MA 079:011, *c.* 70–100m east side of the proposed route, one field away. This monument is situated at the highest point of a prominent drumlin hill in an area of good pasture. The monument comprises a raised circular area (diameter 30.8m) enclosed by a low earthen bank that barely rises above the internal ground level for much of its circuit. At the outer foot of the bank are the remains of a wide shallow fosse with a modern low field boundary on its upper edge. There is also a wide berm at the outer foot of the bank that is similar in width to the fosse (unpublished SMR information, Dúchas). The proposed pipeline route will not affect this enclosure.

The second enclosure in Ballinvoash is MA 079:030 located 200–250m west of the route at the highest point of a prominent drumlin ridge. The monument consists of a raised circular area (diameter 36.4m) enclosed by a substantial bank of earth and stone with a wide deep external fosse. At the outer lip of the fosse is a low bank of earth and stone that formed part of the field boundary at one time. The bank is much degraded, and the fosse is infilled as a consequence of the construction of modern field boundaries. A short distance inside the bank are two low cairns of stones of unknown significance, both encircled by trees. The internal area is overgrown with vegetation (unpublished SMR information, Dúchas). The monument will not be affected.

The final enclosure in Ballinvoash is MA 079:031 and is situated at the highest point of a low drumlin ridge 50–70m west of the pipeline. A modern riding arena now occupies the site. The pipeline will travel through lower ground between the drumlins and will have no further impact on the site.

In Drumdoogh, there are two enclosures, MA 079:038 and MA 079:039, at 170m and 250m from the route, respectively. MA 079:038 is situated on the south side of the proposed pipeline route (which travels west-northwest–east-southeast in this area) at the highest point of a steep-sided drumlin ridge. The monument is a raised circular area (diameter *c.* 22m) enclosed by a low bank of earth and stone. The internal area has been planted with coniferous trees and contains a large quarry hole. The proposed pipeline will not affect the site. The pipeline passes to the south of Manulla, within 100m of an enclosure (MA 079:058) in the townland of Skiddernagh.

In Creaghanboy, there are ecclesiastical remains, MA 079:082, *c.* 130m west of the proposed pipeline route. These comprise a possible church site and a children's burial ground and are situated in rolling countryside in an area of good pasture. No remains of the church are now visible, and the children's burial ground has been destroyed.

There are two enclosures in the townland of Lisnolan, MA 079:083 and MA 079:084. MA 079:083 is defined as a raised circular area (diameter c. 32m) enclosed by a low earthen bank and an external fosse. The bank and fosse have been partially levelled. The site is divided by a northeast–southwest field boundary, and the southeast portion is being used as a farm garden (unpublished SMR information, Dúchas). The pipeline will pass through an area of cleared forestry *c.* 200m east of MA 079:083, two fields away, and will not interfere with the site.

The second enclosure in Lisnolan is MA 079:084, situated on a prominent ridge in good pasture with excellent views in all directions. There are no remains

visible at ground level or from the air, but the enclosure is marked on the OS map and the field is known locally as the 'fort field'. The site is 150m east of the pipeline and separated from it by a large open field (unpublished SMR information, Dúchas). There will be no direct impact from the scheme, though the area between it and MA 079:083 may be of high archaeological potential. A bronze spearhead was discovered in this townland, and a bronze dish was found in nearby Smuttanagh. (NMI Topographical Files).

Wetland

MA 090:046 is one of three crannógs on the shores of Cuilmore Lough, situated on the southern shore of the lake along Tullymore's western townland boundary, *c.* 220m from the proposed pipeline route. It will not be affected, but the land through which the pipeline passes in this area is reclaimed marshy bogland and the archaeological potential will be high as a result. The forestry plantations in the area may have lessened the potential, however.

Rough pasture

The next monument is an enclosure, MA 090:048, in the townland of Brownhall Demesne. It is clearly marked on the map as a circular enclosure, *c.* 150m west of the proposed pipeline route and three fields away. It will not be impacted upon by the scheme.

MA 090:070 is an enclosure with a souterrain. The pipeline runs to the north of the site at a distance of 100m and will not affect the archaeology there.

There are only three known monuments within 250m of the proposed pipeline route between Shinganagh and Carrowkeel, and they are all enclosures. The first two are in the townland of Polldrian. MA 101:031 is located in its own field, *c.* 220m east of the proposed route, several fields away and will not be affected. It is marked on the map as a roughly circular enclosure measuring *c.* 50m east–west and 60 m north–south.

The second enclosure in Polldrian, MA 101:046, is marked on the map as Polldrian's Fort and measures roughly 45m east–west by 40m north–south. It is situated 120m west of the proposed route and is separated from the pipeline by two small fields that have been amalgamated (Geofilm). It will not be affected.

The third and final enclosure along this section of the route is MA 101:048, in the southeast corner of Carrowmore, *c.* 70m west of the route. This site was once a circular enclosure *c.* 50 m in diameter, but it has been bisected east–west by a road that forms the townland boundary with Carrowkeel, and only the northern half of the monument is depicted on the OS maps. The site is located in its own field and will not be affected by the pipeline.

Larger open field systems (pasture and tillage)

All the monuments along the section of the route between Carrowkeel and Annefield are enclosures, except MA 111:00701, Tagheen Church, and its associated graveyard, MA 111:00702. This site is located in the north west corner of a crossroads, 100m west of the pipeline. There are several small irregularly shaped fields between the pipeline and the ecclesiastical site and there will be no impact.

There is a concentration of enclosures where the townlands of Knockalegan and Garreens meet. The first within the 500m corridor is MA 111:025, but this is at a distance of 250m to the east and outside the field through which the pipeline passes. It will not be affected.

The second enclosure is MA 111:023, which is 90m from the proposed pipeline. Dwellings now separate it from the rest of the field through which the pipeline will travel, and, therefore there will be no impact. The pipeline will pass to the rear of Gardenfield House, an example of the vernacular architecture of the area. The next enclosure encountered along this stretch of route is MA 111:039, in the

townland of Clooneen. It is 250 m east of the pipeline, several fields away, and no impact to the site will occur.

Approximately 1.2 km beyond the point where the pipeline crosses the Great Southern Railway, it passes between two more enclosures, MA 111:050 and MA 111:051, at a distance of 180m and 240m, respectively. The fields have been opened up between these enclosures, but they remain several fields away from the route. There will be no impact on the monuments. In the townland of Clooneen, a possible fulacht fiadh was reported to the east of the pipeline. It presents as a low (0.5 m high), sub-circular mound measuring 9 m by 10m in diameter on a north–south by east–west orientation. It displays the classic kidney shape. A further fulacht fiadh site was subsequently located in this area.

The next enclosure, MA 111:152, is located in Shantallow, 200m west of the proposed pipeline route. From the air, it appears as ridge in an area of rough ground, but there is no visible trace of a monument.

There are two more enclosures along the south side of this road, beyond the lodge, at a distance of 300m+. 350m south of the road the pipeline will enter the small area of demesne land associated with Bushfield House.

Two known archaeological sites are located in the townland of Annefield. They are an enclosure, which is not considered an antiquity, and a linear earthwork. The enclosure, MA 119:026 is indicated on the third edition OS six-inch map as a large oval wooded enclosure (*c.* 35m east–west by *c.* 60m north–south). The site appears to comprise a natural elongated oval hillock that may have been adapted as an estate feature in the grounds of Annefield House (unpublished SMR information, Dúchas). It is approximately 50m west of the proposed pipeline and will not be affected.

The linear earthwork, MA 119:025, is described as a 'moat' on a map of 1771, but no visible surface trace remains, no trace of a monument is visible from the air and no local tradition of a 'moat' survives. An earthen field bank topped by thick overgrowth occurs at this location and serves as the townland boundary between Annefield and Davros. In parts, the earthen bank has been replaced by a stone wall (unpublished SMR information, Dúchas). The proposed pipeline was to pass through this bank and the pipeline was therefore re-routed to avoid this feature and now travels to the northeast.

In addition to the linear feature that borders the townland, there are three monuments within Davros. The first of these is MA 119:027, an enclosure set in level, low-lying pasture. The site is *c.* 120m east of the proposed pipeline, two fields away, with a road 50m to the east also. The monument will not be affected.

The next monuments encountered in Davros are MA 119:044, an enclosure, possibly a ringfort, and another possible enclosure that was recently discovered by the Archaeological Survey of Ireland and that has no site number at present. MA 119:044 is situated in level pasture. It is depicted on the OS six-inch map (third edition) as a large hachured enclosure open to the east and straddling two fields. The division is marked by a farm trackway, flanked by field fences, that bisects the site along a northeast–southwest axis. The site was destroyed on both properties within the last five years, and only the outline of the site is now apparent as a cropmark (diameter 42m), though portions of the bank survive in places (unpublished SMR information, Dúchas). This site is 50–60m east of the proposed route.

The newly discovered possible enclosure is located *c.* 12m to the north-northwest of MA 119:044, at the highest point in the surrounding landscape. The location is marked on the six-inch OS map (1915) as 190'. Its co-ordinates are E130472 N262169. The rise is distinctly circular in form (diameter c. 20m) with a level top defined by a low broadly sloping scarp. It is possibly another levelled

enclosure (Dúchas, unpublished information). The pipeline will travel *c.* 40m southwest of this area.

The next archaeological monument along the route is an enclosure in Oultauns that contains a children's burial ground. This site, MA 119:059, is situated 150m west of the route in average pasture with good, but not extensive, views and has been marked on the OS map as 'Lisheenacorane Children's Burial Ground (Disused)'. The proposed route of the pipeline is at a safe distance from this site and therefore will not affect it.

14.4.2.3 *County Galway*

In an area measuring *c.* 80m east–west by 100m north–south, there are five ringforts, an ecclesiastical site, a moated site containing a children's burial ground (GA 028:032), a mill, and an earthwork. Two-thirds of the monuments in this cluster are located less than 250m from the proposed route.

The first of these is the bivallate ringfort GA 028:001, which is located in level grassland on the boundary between Kilshanvy and Ardour. This is a well-preserved quadrangular rath measuring *c.* 40m by 34m, defined by two banks and an intervening fosse (Alcock et al. 1999). The pipeline runs 40m to the east of this monument on a northwest–southeast alignment. Approximately 350m to the south of this ringfort is Kilshanvy Mill, GA 028:039. There are no details concerning this structure in the *Archaeological Inventory of County Galway*, which suggests that it is post-1700 in date. It is situated 230m from the proposed pipeline route to the west and 100m north of Kilshanvy Church, GA 028:033.

The church is on the roadside at the south end of a small house cluster, 125m southeast of a crossing point on the Kilshanvy River. The remains comprise a rectangular medieval church in fair condition, but there is no trace of a graveyard (Alcock et al. 1999). The proposed pipeline route passes 200m east of the church in a north–south alignment.

Beyond the church, the pipeline crosses a road and passes through a line of three ringforts: GA 028:034, 50 m to the west, and GA 028:035 and GA 028:036, 80 m and 120m to the east, respectively. The pipeline first passes GA 028:036, a well-preserved univallate ringfort with a possible souterrain attached just over 120m to the east of the route. It measures 46m by 37.5m and is defined by a bank. The probable souterrain is located in the interior and was marked as a 'cave' on the first edition OS six-inch map. It is now visible as a stony nettle-filled L-shaped hollow, 24.5m long and up to 1m deep (Alcock et al. 1999). Immediately southwest is GA 028:035, a well-preserved circular rath (diameter 27m) defined by a bank of earth and stone. A gap at the east could be the original entrance, and field boundaries cut the monument at the north and south. The pipeline will run 80m west of this monument (Alcock et al. 1999). On the other (west) side of the pipeline is GA 028:034, a poorly preserved subcircular bivallate ringfort located on a slight rise in grassland 50m away from the proposed route. It measures 51m by 43m and is defined by two banks and an intervening fosse (Alcock et al. 1999).

The land in Cloonsheen includes undulating grassland and forestry to the east of the pipeline in the vicinity of GA 028:009, a poorly preserved circular univallate ringfort located on a rise in undulating grassland approximately 50m southwest of the proposed pipeline route. It has a diameter of *c.* 34m and is defined by a degraded scarp. A field bank cuts the monument at the east and west (Alcock et al. 1999). No impact to this monument is anticipated.

The National Museum of Ireland Topographical Files record three archaeological finds from the latter townland: a flat copper axe, a bronze pin, a leather shoe, and a container with bog butter. These finds suggest activity dating as far back as the early Bronze Age (*c.* 2300–1800 BC).

The highest concentration of known monuments is in the townland of Caherakeeny, where there is a cashel and associated field system, a set of earthworks and two enclosures to the east of the pipeline. These monuments probably date to the Early Christian period (*c.* AD 500–1000).

The pipeline has been re-routed to avoid the cashel, GA 042:051, and its associated field system, and these are now located over 200m to the east of the proposed route in undulating grassland. It now also avoids the national heritage area (NHA) Turlough O'Gall. The field system, GA 042:074, is also located to the east of the pipeline.

There is a cist burial, GA 042:070, in Caltragh, close to the western foot of Knockmaa. This is a polygonal cist in a small field, and the pipeline was re-routed to run in an adjacent field to the west of the site, in an area of gently sloping grassland. There is no visible trace above ground. The cist was discovered during ploughing in 1959 and excavated by Rynne in 1961. Rynne revealed that it was constructed of eight upright stones placed in a circular pit and roofed with a capstone. It was approximately 1m wide and 1m deep and contained an inverted urn with the cremated remains of at least one adult and one child. A flint knife and a bone pin were also found (Alcock et al. 1999).

There are seven known archaeological monuments within 250m of the pipeline along this section of the proposed route: three enclosures, two ringforts and two sets of earthworks.

In Caltragh, a little over 200m south of the cist burial site GA 042:070 is a circular enclosure, GA 042:065, located in undulating grassland on the lower southeastern slopes of a hill. It was marked on the first edition OS map as a circular enclosure with a diameter of *c.* 30m. Only faint traces of the enclosure remain, however, and a denuded bank defines these. A field fence cuts the monument at the north-north east and southwest (Alcock et al. 1999), and it is 100m east of the pipeline in the southeast corner of the field. No impact is anticipated as a result of the pipeline.

The next monument to be considered is GA 042:066, another circular enclosure on a south-facing slope in undulating grassland. It was marked on the first edition OS map as a circular enclosure *c.* 40m in diameter and cut by a field wall at the northwest and southeast. All that survives of this enclosure is a portion of a curving degraded stony bank, with some displaced stones visible along its line (Alcock et al. 1999). It is *c.* 170m east of the proposed pipeline and will not be affected.

GA 042:067, 100m east of the pipeline, is an unclassified earthwork, marked on the first edition OS map as a circular enclosure with a diameter of *c.* 20m. The final monument in Caltragh within 250m of the proposed route is GA 042:068, another unclassified earthwork immediately south of GA 042:067. It was also marked on the first edition OS map as a circular enclosure. No visible surface trace of either monument now survives (Alcock et al. 1999). It is located 50m from the pipeline route, and no further impact will be caused.

A little over 2km further south, the pipeline passes a univallate ringfort, GA 042:029, in Biggera Beg. Situated in level grassland, this is a circular rath *c.* 36m in diameter and is defined by a well-preserved bank and external fosse from the south to the southwest and at the northeast. Quarrying has occurred just outside the monument to the south (Alcock et al. 1999). The pipeline will not affect it, as it is located 50m from it.

The next monument encountered is GA 056:088, a circular enclosure in Laurclavagh, on level ground 60m east of the proposed pipeline route. It was marked on the third edition OS map (1920) as a circular enclosure with an external diameter of *c.* 50m and was cut by the townland boundary at the west-north west and north-north east. No visible surface trace of this monument

survives (Alcock et al. 1999). No further impact from the pipeline is anticipated.

There is a ringfort, GA 057:064, in the townland of Bunoghanaun. It is situated in low-lying grassland on the eastern side of the pipeline at a distance of *c.* 60m. It is a very poorly preserved oval ringfort defined by two banks of earth and stone and an intervening fosse. A field wall cuts the monument at the north and south. The fosse and outer bank only survive from the southwest to the western sides (Alcock et al. 1999). The monument appears from the air (Geofilm) as a circular cropmark. No impact is anticipated.

Farmed land

The proposed pipeline passes within 250m of two enclosure sites in Slievefin (GA 057:142) and Racoona (GA 070:096). In addition to known archaeological remains within 250m of the proposed route, there are several others in the general area. The highest concentration of these is in the townland of Tomnahulla and includes ringforts, circular enclosures, a field system and three houses. To the east of the proposed route, at a distance of approximately 1.5 km, is a large field system, GA 057:067, *c.* 750m by 500m surrounding a plantation bawn.

The route also passes through a complex of sites located in Knockdoebeg West. Two ringforts (GA 070:105, 104) are located to the west but will remain unaffected by the proposed route. It will then pass around the lower reaches of Knockdoe Hill. It is at the summit of this hill that the site of an important battlefield (GA 070:080) is located. A number of other archaeological sites are also located in its immediate environs, such as a ringfort and souterrain (GA 070:079). The pipeline will avoid all these features by a considerable distance to the west and travel through large, flat agricultural field used for pasture.

GA 070:057 is a very poorly preserved circular cashel in Cregmore townland, situated on a gentle north-facing slope in pasture. It is 36m in diameter and defined by a dry-stone wall, best preserved from the west through the north to east. A field wall cuts the monument at the west and east (Alcock et al. 1999). The proposed pipeline will travel in a northwest–southeast direction approximately 230m to the west of this monument and will not affect it.

In Knocknacreeva, the pipeline travels to the north east of an earthwork, GA 083:045. This is a circular enclosure, designated 'caher' on the Fair Plans. No upstanding remains of the site survive, as the land in the vicinity has been levelled and is now used for tillage (unpublished SMR information, Dúchas). No interference to this monument is anticipated, as the site is located 150m away from the proposed pipeline route.

Also in Knocknacreeva, between 150 and 200m to the northeast of GA 083:045, is a poorly preserved circular enclosure, GA 083:044. It lies *c.* 250m away from the pipeline and will not be affected.

Vernacular farmhouses line the road to Athenry (R348). Less than 250m after the pipeline crosses the R348, it travels 60–80m west of GA 084:067, a cashel and souterrain in the townland of Cloran. The cashel is a univallate structure in poor condition and heavily overgrown by trees, briars and scrub. It has a diameter of 30m. The enclosing wall is best preserved at the west and consists of an inner and outer facing of large blocks of stone either side of a rubble core. Only a single course of the wall survives. It measures 0.5m high and 1.9m wide. The interior of the site is divided through the centre by a field wall. The souterrain, GA 084:06702, is in the northern sector of the site, just east of the dividing field boundary. It is collapsed but traceable for 5m and aligned north–south. At the northern end, in a clump of briars, a roofing slab protrudes at an angle from the ground. One meter to the south of this are two roof slabs in situ, 0.2m apart. Viewed through the gap between these roof slabs, the sides of the souterrain are seen to be of dry-stone walling. The site is *c.* 150m to the east of the pipeline, and no impact is expected (unpublished SMR information, Dúchas).

The next site within the corridor of interest is GA 096:061, a ringfort in Cloran. The pipeline will pass the monument to the east at a distance of *c.* 200m. It will not be affected.

The pipeline continues through the townlands of Lecarrow and Cahercrin, where there are three archaeological sites (a ringfort and associated souterrain, a ringfort and associated children's burial ground and a house site) all of which are located over 150m and will not be affected by the construction of the pipeline. It then passes through Knockatoor and Parkroe.

In the townland of Templemartin, the site of a church and graveyard was visited. The vernacular cottage, located to the south of the feature was once said to have grave markers in its rear garden, which lies adjacent to the enclosing wall of the feature. However, none could be found upon inspection. The land has been extensively cleared in the field surrounding this feature, and it is possible that the surrounding enclosing wall has been built up and added to in the passing years. The proposed pipeline is to run in the adjacent field to the north of the site at a much lower elevation than the monument. Because the extent of the monument is so well defined, there should be no impact on archaeological remains in this area.

There are several other monuments in Ballywinna. GA 096:012 is an enclosure situated 200–250m from the pipeline, and no interference will occur. On the opposite side of the pipeline, to the northeast, is GA 096:010, a ringfort that contains a children's burial ground. This site is also located approximately 150m away from the pipeline route and will not be affected by it. In the townland of Garracloon South, much closer to the pipeline (*c.* 50–100m), are GA 096:099, an enclosure, and GA 096:098, a ringfort. There is a souterrain, GA 096:092, in Ganty, 200m south of the route. The final monument encountered by the pipeline is GA 096:006, an earthwork in Ballynageeragh. This is 200m south of the pipeline, and it will not be affected.

14.5 Mitigation Measures

14.5.1 General

Bord Gáis Éireann is committed to the preservation of all known archaeological sites, and the pipeline corridor has been routed to avoid all known archaeological sites by a minimum of 30m. No known site shall be impacted physically or visually by the proposed pipeline.

To achieve this objective, the pipeline was re-routed to take account of the possible archaeological potential, landscape setting or density of known archaeological sites in a defined area. Where possible, these changes were agreed and the pipeline re-routed, the archaeological re-routes to date are outlined below (**Tables 14.1, 14.2**). It must also be noted that during the course of the EIA, other re-routes were sought for a number of environmental and engineering reasons; these were assessed and agreed to archaeologically. Thus, constant route refinement has taken place to ensure the best placed line in terms of known archaeology potential.

However, not all archaeological sites will be identifiable at the EIS stage due to the nature of the terrain (for example, the blanket bogland of Glenturk, Glencullin and Eskeragh or the lower reaches of drumlin hills where ringforts are located). There is also the possibility of archaeological sites occurring with no surface indication or any archaeological or historical context that may suggest such a presence.

14.5.2 Mitigation Strategy

The lack of known sites along the route in some areas may be attributed to the area's remoteness and should not be taken as an indication of a very low archaeological potential, as it is in terrain like this that new sites with no surface ground visibility are often revealed.

To date, the archaeological potential along the suggested route has been addressed through

documentary and cartographic sources, consultation with experts in the area, aerial photography, Geofilm, and field inspection where access could be gained.

All sites that are located within 60 m of the proposed pipeline were visited in the field, (**Table 14.1 and 14.2**) as well as areas that were considered to be of a high archaeological potential as identified via documentary sources or the Geofilm.

An archaeologist has been appointed under the instruction of Dúchas to monitor all engineering test pits. This level of monitoring at a pre-construction stage will help inform the regulatory authorities and design team as to the level of archaeological potential in different areas, as well as providing valuable stratigraphic details. Each trial pit is individually numbered, and a note, together with photographs and sketches, is taken of the townland name, trial pit dimensions, details of stratigraphy, proximity to archaeological monuments, access, general topography and any additional information deemed appropriate (**Appendix 14.5**).

This information will be forwarded to Dúchas and the National Museum of Ireland as soon as site investigations are completed in the form of a series of site investigation sheets. The results will be analysed and fed into the research design and sampling strategy, which will be dependent on the construction techniques to be employed—for example, the depth of the pipeline to be inserted and the level of envisaged disturbance to areas considered of a high archaeological potential.

14.5.3 Archaeological Testing

14.5.3.1 *General*

The pipeline passes through many varied landscape types. The known archaeological record reflects these variations, with certain site types occurring only in specific environments. However, the vast majority of archaeological monuments that flank the route of the pipeline are enclosures and ringforts (some of which have been reused as children's burial grounds). These are located in prominent positions, usually at high elevations that ensure good views to and from the site, and are ideally suited to the drumlin-type terrain through which the pipeline passes.

Tables 14.1 and **14.2** list all known archaeological sites that occur within 60 m of the proposed pipeline for Mayo and Galway, respectively. They list the SMR number, townland and distance from the pipeline and describe the site type, preservation, associated archaeologica+l sites and proposed mitigation measures.

Table 14.1: Known archaeological sites in County Mayo

SMR Reference	Distance	Townland	Site type and status	Associated archaeological sites	Mitigation
MA 038:109	50m	Doonbreedia	Ringfort (Straddling a field boundary well preserved on the eastern side, while the western half is slightly denuded.	Enclosure MA 038:108: well-defined circular enclosure; a stone field wall had once bisected the site. The site is located approx. 100m north from the pipeline, immediately north of MA 038:109.	Outer enclosing feature identified by aerial photographs and first edition mapping. The pipeline has been moved to the west to avoid this. However, testing may be necessary to define the extent and nature of this feature.
MA 042:002	50m	Ballymoyock	Ringfort and children's burial ground (well preserved)	Enclosure sites MA 042:006 and 003 are located on the upper slopes of a hillock and will not be affected the pipeline.	The pipeline has been re-routed to occur in adjacent field to the north
MA 047:066	20–30m	Lahardaun	Ringfort (upstanding)	Ringfort MA047: 024 lies to the southwest of the proposed pipeline and is visible from MA 046:066.	Testing in the form of trenching will determine the potential of the area
MA 119:025	The pipeline is travelling outside the area of interest as marked on the SMR map	Annfield/ Davros	Earthwork (no visible trace)	No associated features	The pipeline has been rerouted. Testing may be required to establish if there is a subsurface archaeological presence; if so, the nature and extent will have to be determined so the pipeline can avoid the feature.
MA 119:044	50–60m	Davros	Enclosure/ringfort (identified as a cropmark through aerial photography)	A new possible enclosure site was located this year 12m to the south-southeast of MA 119:044	This site has been extensively disturbed, as a laneway bisects the feature and the rest of the site has been removed. The pipeline crosses the field and avoids this feature. However, a detailed field inspection is necessary to identify the possibility of further archaeological sites in the area.

Table 14.2: Known archaeological sites in County Galway

SMR Reference	Distance	Townland	Site Type and Status	Associated archaeological sites	Mitigation
GA 042:029	50m	Biggera Beg	Univallate ringfort (well-defined bank and external fosse located in level grassland)	No associated archaeological sites	The pipeline travels to the east of the site, and it must be ensured that the feature is avoided.
GA 042:068	50m	Caltragh	Unclassified earthwork (no visible trace)	A circular enclosure and unclassified earthwork (GA 042:066 and 67) located to the north east of the site and to the east of the pipeline; no visible trace exists.	The pipeline is passing to the west of a known cluster of archaeological monuments. GA 042:068 was located in the field, so the pipeline can avoid this feature. Testing may be necessary.
GA 057:064	60–80m	Bunoghanaun	Univallate ringfort (very poorly preserved and disturbed site)	No associated sites	Located in low-lying grass land, the pipeline is presently avoiding the site by 60–80m, which should be enough to ensure no disturbance to the site
GA 056:088	60–80m	Laurclavagh	Circular enclosure (no visible trace)	No associated features	The site is located on level ground and is cut by the townland boundary. The pipeline is presently passing to the west of the site. It should be ensured that when the wayleave area is fenced off the site is outside the area of disturbance.
GA 070:105	40–50m	Knockdoebeg West	Ringfort (poorly preserved)	Ringfort GA 070:104 is located 230m north-north east.	Should be fenced off prior to construction to ensure that the site is not disturbed.
GA 083:044	50m	Knocknacreeva	Earthwork (no visible trace)	Enclosure site GA 083:044, located to the east of GA 083:044, 200m from the pipeline.	The site should be identified prior to construction. It should be ensured that no disturbance takes place to this area. Testing may be necessary if the pipeline encroaches on the area of interest for the site.
GA 096:098	30–50m	Garracloon South	Children's burial ground	Enclosure GA 096:099 is located 70m from the pipeline.	Should be fenced off prior to construction to ensure that the site is not disturbed.
GA 096:165	50m	Templemartin	Church and graveyard (well defined site, enclosed by a dry stone wall that encircles the summit of the hillock occupied by the site	No associated archaeological sites.	The pipeline crosses on sloping ground in an adjacent field to the north of the site. It would be preferable if the pipeline could be moved further north to lessen the potential of associated remains being revealed during the construction process.

14.5.3.2 *Areas of archaeological potential in County Mayo*

Bogland
Glenturk, Glencullin, Eskeragh, Dooleeg More and Carrowgarve South

To assess the archaeological potential of the terrain in bogland areas, it may be necessary to take environmental archaeology samples (such as pine stumps for radiocarbon dating), depending on the nature and extent of the bogland through which the pipeline passes. This strategy is currently under investigation, with the geotechnical analysis and the monitoring archaeologist recording all bog and soil types encountered.

The extent of the pre-construction assessment must be agreed in advance with Dúchas and very much depends on the type of construction method employed for various sections of the pipeline.

Milled peat
Tawnaghmore, Bellacorick and Dooleeg More

Even though the peat has been extensively milled in some places, exposing the glacial till, and there are very few known archaeological monuments along this stretch of the route, the potential for subsurface remains is quite high. This potential is indicated by the relatively large number of artefacts recovered from the bog in this area, specifically in the townlands of Tawnaghmore (3), Bellacorick (2) and Dooleeg More (3) (**Appendix 14.4**).

Improved land
Killacorraun, Doonbreedia, Ballymoyock, Carrowkeel, and Lahardaun

The above townlands are quite rich in enclosures and ringforts. In addition, there are a large number of watercourses in the area, further increasing the potential for subsurface remains. The pipeline has been re-routed to avoid known sites and areas of archaeological potential in this drumlin landscape.

14.5.3.3 *Areas of archaeological potential in County Galway*

Pasture (large, open field systems)
Knockdoemore

The pipeline is avoiding all known monuments in this area, however the potential to reveal subsurface archaeological sites is high.

Templemartin

In the townland of Templemartin, there is a church and graveyard. However, because the extent of the monument is so well defined, there should be no impact on archaeological remains in this area.

Garracloon South

Two archaeological sites are located close to the pipeline (c. 50–60m) in Garracloon South: GA 096:099, an enclosure, and GA 096:098, a ringfort.

14.5.3.4 *Areas of archaeological potential identified on the Geofilm*

Many features could be identified as possibly archaeological when viewed from the air (Geofilm). The majority of curving field boundaries followed the contours of the land and reflected the topography rather then an archaeological enclosing feature. However, in the townland of Ardgaineen, two archaeological features were identified from the Geofilm aerial survey of the pipeline route. The first of these is a semi-circular cropmark located *c.* 30m west of the proposed route at E137363 N240979 in a large ploughed field. It is cut on the south by a removed field boundary. Also in Ardgaineen, and immediately east of the route, at E137757 N239847, is a circular wooded area, *c.* 40m in diameter. There is also a possible rocky enclosure just beyond this to the northeast. These features are located in an area of reclaimed pasture, and will not impact on the pipeline work.

14.5.3.5 *Previously unidentified archaeological features in County Mayo*

During the monitoring of geotechnical test pits in the townland of Clooneen, two fulacht fiadh (Bronze Age cooking sites) were identified. The investigations did not disturb these features in any way, but there is the potential for finding more of these sites, as they tend to occur in groups.

14.5.3.6 *Watercourses*

The pipeline traverses many major rivers in both counties, such as the Manulla, Castlebar, Deel and Clydagh Rivers in Mayo and the Robe, Black, Eiscir and Clare Rivers in Galway. The construction technique to be employed at these points will have to be discussed in advance with Dúchas and the appropriate level of mitigation decided upon.

14.5.3.7 *Protected structures*

The development plans for Counties Mayo and Galway were examined for buildings of architectural merit that are protected under the 1999 Local Government and Development Act and the Architectural Heritage (National Inventory and Historic Monuments) (Miscellaneous Provisions) Act 1999. The proposed pipeline will not affect any protected structures. All dwellings are to be avoided and, therefore, there will be no impact on any upstanding structures, including the vernacular farmhouses and cottages that flank the roadways of the west of Ireland.

The pipeline is passing through the land of a number of denuded and old demesnes in South Mayo—Bushfield, Mount Jenings and Annefield—indicating that this was once a very prosperous area. No structures or landscape features will be disturbed, except those walls that are directly on the pipeline route. Care will be taken in this case to reinstate any original boundary walls that may be breached during the construction of the pipeline.

14.5.3.8 *Reinstatement of stone-walled field boundaries*

The Galway landscape is characterised by large, open, flat fields of pasture bounded by dry stone walls. Even though there has been a significant level of disturbance to the original field layout, there remain many intact dry stone wall boundaries that will need to be crossed and appropriately reinstated after the placement of the pipeline.

14.5.4 Archaeological Practice

A team of competent, licensed archaeologists will monitor all soil-stripping works undertaken in relation to this scheme, and their findings will form part of any subsequent mitigation deemed necessary in the protection of archaeological features.

BGE's attention is drawn to the appropriate sections of national monuments legislation (1930–94; **Appendix 14.3**), which state that, in the event of the discovery of archaeological features or finds, Dúchas and the National Museum of Ireland must be informed. Where the pipeline disturbs subsurface archaeological deposits, all construction work should cease until the area has been fully archaeologically resolved, whether this is by excavation or, if the remains are archaeologically significant and should be preserved *in situ*, by rerouting. In each case, an estimate of the costs involved, and the time required for excavations, should be agreed in advance to ensure the smooth running of the construction programme.

All archaeological finds should be recorded and removed from site. Each find is required to be appropriately conserved, numbered and accompanied by a finds report before being accepted by the National Museum of Ireland.

All archaeological findings should be made available to the public, and the developer should fund all archaeological research to a publication standard.

14.6 Residual Impacts

There will be no residual impacts to archaeology or cultural heritage provided that all known sites and monuments are avoided and that all soil-stripping procedures are monitored by a licensed archaeologist.

15. LANDSCAPE AND VISUAL IMPACT

This section describes the impact of the pipeline and associated AGIs on the landscape in which they are located.

15.1 Introduction

The overall landscape character of a site and its surroundings is determined as a result of the relationship between landform, landcover, landscape elements and climate.

Landscape is never static and is in a constant state of change. Change results from both natural processes and human activities. All landscapes have a relative sensitivity to change, which is known as 'landscape capacity'. The introduction of a new feature into an existing landscape whether it be a commercial, industrial or residential development, public open space or recreational uses, inevitably brings about change.

The capacity of the landscape to accommodate change, without deterioration or loss of its essential landscape character and quality is as varied as the range of different landscape types themselves. Assessing the impacts of such change requires a clear understanding of the landscape character of the study area.

15.2 Background and Methodology

The Landscape and Visual Impact Assessment assesses the following:

a) Landscape Impacts, including:

- direct impacts upon specific landscape elements within and adjacent to the site;
- effects on the overall pattern of the landscape elements which give rise to the landscape character of the site and it's surroundings;
- impacts upon any special interests in and around the site.

b) Visual Impacts:

- direct impacts of the development upon views in the landscape;
- overall impact on visual amenity.

As a matter of best practice the assessment has been undertaken in accordance with the advisory guidelines set out in the document - "*Guidelines for Landscape & Visual Impact Assessment*", published by The Landscape Institute and Institute of Environmental Assessment (1995).

Both the landscape and visual assessments include baseline studies that describe, classify and evaluate the existing landscape and visual resources, focusing on their sensitivity and ability to accommodate change.

The assessment was undertaken between July and October 2000 and information was gathered from the following:

- consultations with the design team regarding the development proposals;
- a site visit and fieldwork to confirm data derived from available mapping and to identify and assess potential impacts.

In conjunction with the landscape survey and assessment of the study area, a visual survey was undertaken in order to assess the potential visual impact of the proposed development. If the landscape is to absorb the development successfully, the development must be integrated in a

way that protects, and where possible enhances the visual appearance of the landscape.

The visibility along the pipeline route is dependent upon a range of factors, including location of viewpoint, angle of the sun, time of year and weather conditions. Of importance also is whether the route is seen completely, or in part, above or below the skyline, where land provides a backdrop and where there is a complex foreground or an expansive landscape surrounding the view.

The aspect of dwellings and whether the development is seen as a main view or as an oblique view from a secondary window is also a consideration, as is direction or speed of travel.

In order to determine the critical viewpoints of the development, whether in the immediate locality or further afield, the principal and minor roads within the surrounding the area were travelled. Particular attention was paid to the existing residential properties and public open spaces.

It should be noted that the visual survey was undertaken during the summer, therefore the results do not show the worst case scenario which occurs during the winter months when there is a marked reduction in deciduous vegetation.

15.3 Baseline Conditions - Landscape Setting

From the proposed reception terminal site at Bellanaboy Bridge to the end point at Craughwell, the proposed pipeline route passes through a number of landscape types, each with various features and elements combining to form areas with a distinct landscape character. The proposed pipeline route can be assessed as having an impact on five main landscape character types as follows:

- upland moorland;
- wet pasture;
- rocky moorland;
- minor ridge and valley;
- lowland pasture.

15.3.1 Upland Moorland

The proposed pipeline route passes through upland moorland for a distance of approximately 30kms (21%) of the route. This landscape character area extends from the Terminal to a point approximately 7kms southwest of Crossmolina. In general this is an expansive landscape with distant views available in all directions (**Plate 15.1**).

The landscape comprises of predominantly flat to undulating peat bog and damp acidic grasslands. Numerous small streams cross the land. The open landscape is interrupted by occasional large coniferous plantations, which act as strong focal points. There is frequent evidence of small-scale peat cutting for fuel, together with vast areas given to commercial peat extraction. The predominant land use is peat extraction. Occasionally areas of unimproved and semi-improved pasture may be found, particularly near to settlements (**Plate 15.2**).

The large cooling tower of the peat-fired electricity generating station at Bellacorick provides a focus towards the southern end of this section; but there are few other features of interest, and the extensive peat extraction has scarred the land.

Species such as pine, rhododendron, birch, goat willow, and gorse are evident as areas of developing scrub. These areas, which are infrequent and distributed throughout this section, are most often associated with locations where the peat cutting has ceased for a relatively long period of time.

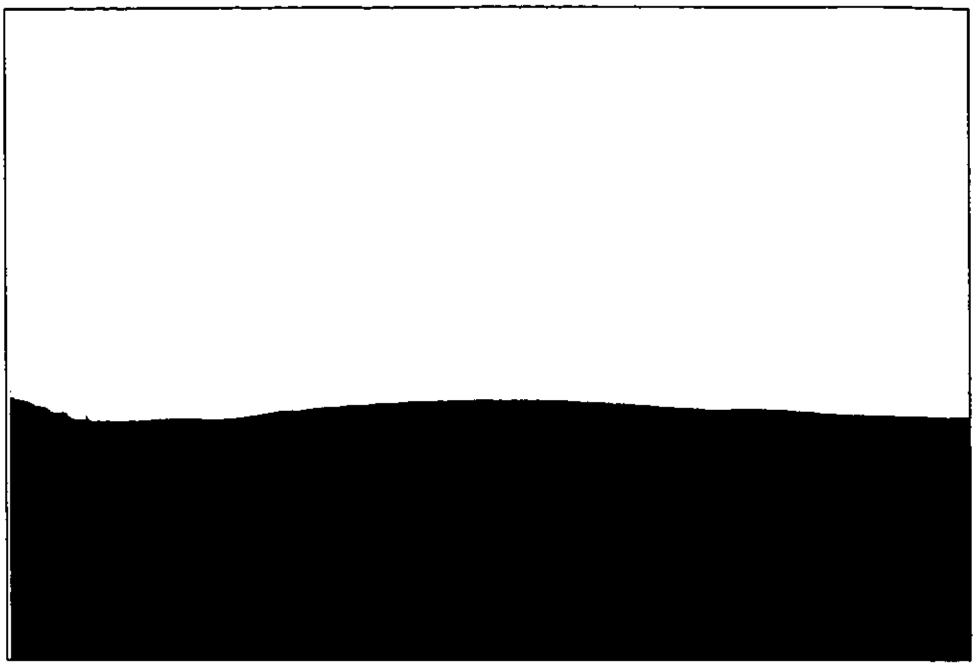


Plate 15.1: Upland Moorland - open and expansive landscape with long distance views available across flat to gently undulating peat bog.

Plate 15.2: Upland Moorland - long distance views across occasional fields of semi-improved pasture and a new small linear settlement.

Large fields exist, with a regular field pattern that is defined by boundaries of predominantly post and wire fencing, with occasional dry stone walls enclosing small fields of unimproved pasture.

To the south of the terminal is the small settlement of Bellanaboy Bridge. Bellanaboy Bridge is typical of the settlement pattern of the area, that being scattered dwellings found in linear formation alongside the network of roads. Many dwellings are isolated and the area is generally sparsely populated.

15.3.2 Wet Pasture

The next section of the proposed pipeline extends for a distance of approximately 15kms (10%), to a point approximately 1km south of Lough Conn and has been assessed as wet pasture. The main features that dominate the area are the extensive Lough Conn, and Nephin Mountain.

The landscape comprises of undulating pastoral fields, dominated by unimproved pasture, with occasional fields of semi-improved pasture. Crossed by many tributaries of Lough Conn, the land is wet and poorly drained, with some areas of peat bog, and many fields featuring large tracts of rushes, see **Plate 15.3**.

The field pattern is irregular with small fields defined by mature, gappy hedgerows. These hedgerows combine with numerous trees and areas of gorse and willow scrub to give a well-vegetated and enclosed feel to the area. Within the lower lying areas views are restricted by the landform and vegetation, however extensive views may be afforded from minor roads located on the lower slopes of Nephin.

Nephin is one of the most prominent features of this section, and of the entire pipeline route. Distant views to Nephin may be gained from many points along the proposed pipeline route.

The small fields are occasionally interrupted by large areas of peat bog moorland, which are in strong contrast to the surrounding area. Numerous coniferous plantations also feature and form important focal points within the landscape.

There is an extensive network of minor roads and lanes often with well-vegetated margins; adjacent to which may be found numerous scattered dwellings, however the area is generally sparsely populated. The settlements are small, generally linear, and comprise rendered houses that are predominantly whitewashed and occasionally painted.

15.3.3 Rocky Moorland

From the south of Lough Conn, the next section of the proposed pipeline route extends for a distance of approximately 16kms (11%), to a point approximately 1.5kms southwest of the small settlement of Turlough. This area has been assessed as rocky moorland.

Within this area the proposed route crosses a difficult terrain of undulating peat bog moorland, which features many outcrops of exposed rock. The terrain changes from hummocky land on the lower slopes of Farbreiga, where many rock outcrops can be found (**Plate 15.4**), to an undulating moorland landscape with occasional rock outcrops, to the south-west of Lough Cullin (**Plate 15.5**).

The extensive areas of exposed rock at the surface are the most distinctive features of this area, with boggy peat developing over rock to create a hummocky landform, with species such as heather and sphagnum commonplace. Occasional fields of unimproved pasture defined by dry stone walls and post and wire fencing may be found. Tracts of rushes are common features of these fields. Other areas are vegetated by gorse and willow scrub, with some colonisation of birch, and some areas are given to commercial forestry. The vegetation and the varying topography give a sense of enclosure to this predominantly open landscape.

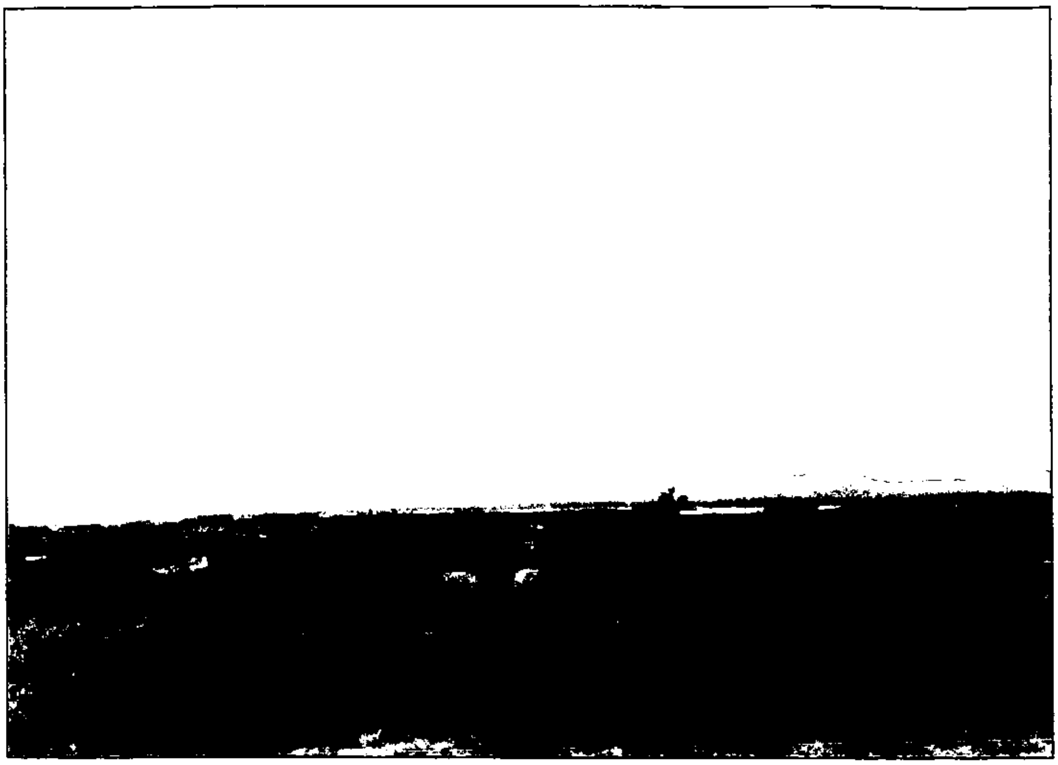


Plate 15.3: Wet Pasture - view across undulating unimproved, poorly drained pastoral fields featuring large tracts of rushes. Hedgerows, trees and gorse and willow scrub combine to give a well-vegetated enclosed feel to the landscape.

Plates 15.4: Rocky Moorland - view of hummocky land with large areas of exposed rock at the surface.

Plates 15.5: Rocky Moorland - open views across undulating moorland landscape with occasional rock outcrops, towards Lough Cullin.

Plate 15.6: Minor Ridge and Valley - views across rolling landscape of low hills and ridges. A well vegetated, enclosed landscape of pastoral fields defined by hedgerows with trees.

The hummocky land descends into undulating moorland areas, which fall gently to the banks of Lough Cullin. This is an open and expansive landscape, with few field boundaries. Attractive panoramic distant views may be afforded across the moorland and Lough to the surrounding landforms. Again rocky outcrops feature, though they occur less frequently than on the higher land.

15.3.4 Minor Ridge and Valley

The next section of the proposed pipeline route extends for a distance of approximately 37km (25%), to a point approximately 7km east of the small settlement of Kilmaine. This section of the route crosses land which is assessed as minor ridge and valley and it is in sharp contrast to the area to the north. This landscape comprises generally a rolling topography of low hills and ridges with flat broad valleys (**Plate 15.6 and 15.7**).

The land use is dominated by unimproved and semi-improved pasture, with lower lying fields being wet and featuring tracts of rushes. A patchwork of irregular large and small sized fields are bounded by well-maintained hedgerows with hedgerow trees, with occasional dry stone walls.

These hedgerows and trees combine with small areas of semi-natural deciduous woodland, to give a well-vegetated and enclosed feel to the landscape. The numerous low hills and ridges further enclose by restricting distant views. The lower lying valleys feature rivers and streams feeding numerous small loughs and lakes. The banks of the rivers and streams are often well vegetated with trees and areas of willow scrub.

Numerous minor roads and lanes cross the area, with many small linear settlements evident. Although dwellings are well spaced, area is more populated than other sections of the pipeline route.

15.3.5 Lowland Pasture

The most southerly section of the proposed pipeline route extends for a distance of approximately 48km (33%) from the east of Kilmaine to the end point at Craughwell, and has been assessed as lowland pasture.

This is a gently undulating landscape dominated by pastoral agriculture, featuring fields of improved, semi-improved and unimproved pasture.

Distinctive dry stone walls enclose fields, and the field pattern is of irregular predominantly large fields. Occasionally lines of trees and mature hedgerows follow the lines of the field boundaries. Tree cover is relatively low, with trees and woodlands being isolated incidents in an otherwise open landscape. They therefore form important and sensitive focal points.

Some areas feature rather hummocky, undulating landforms, and occasionally exposed rock may be found.

15.3.6 Construction Compounds and Pipe Storage Areas

The large volume of linepipe will be temporarily stored in three compounds along the route. Although the locations for these have not been finalised at the time of writing, the probable locations are:

- near the village of Bellacorick
- close to Castlebar
- Knockdoebeg - close to the N17 road

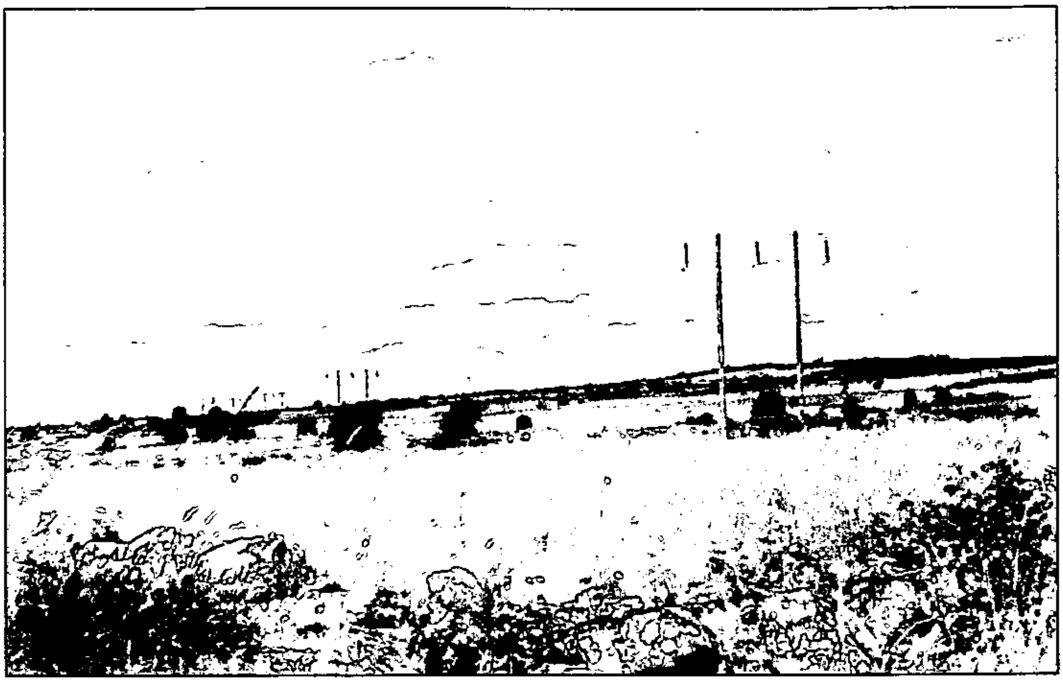


Plate 15.7: Minor Ridge and Valley - views across broad flat valleys featuring pastoral fields defined by dry stone walls.

These will need to be approximately 10 acres, securely fenced, with a level hardcore surface. They will be constructed in the autumn of 2001, and will be operational for the duration of the contract (until the end of 2003). When they are no longer required by the construction contractor(s), they will be dismantled and the affected area reinstated.

15.4 Landscape and Visual Impacts

For the majority of its route, the proposed pipeline will only impact the landscape in the short-term, during construction and for a short period afterwards. The working width of the pipeline will be visible through the landscape during construction, when sections of field boundaries and topsoil are removed.

The most significant landscape features that will be affected by the proposed pipeline are the mature hedgerows and associated hedgerow trees, and stone wall field boundaries. Such linear features can not be avoided, and breaches will visually emphasise the route of the pipeline within the landscape.

In addition to hedgerows, the route will cross other areas of semi-natural vegetation. These features include watercourses and lanes or tracks that are lined by trees, woodlands, and coniferous plantations. Such features form important visual focal points along the route and are sensitive to pipeline construction.

A reduced working width will be utilised in sections of the route that traverse coniferous forestry, minimising the visual impact of the tree felling required. The 14m strip centred over the pipeline will remain clear of trees, and will have a long-term visual impact on the landscape.

15.4.1.1 Bellacorick Compound

The proposed alternative sites are both on areas that have been stripped of peat for the nearby power station. The surrounding area is generally very flat, resulting in an extensive zone of visual impact. However, this zone is also very thinly populated, and there are no publicly used viewpoints within 1km of the sites. The proximity to the large cooling tower at the power station will help reduce any perceived contrasts of scale and association.

15.4.1.2 Castlebar Compound

At the time of writing, a number of sites are under consideration in the Castlebar area. The setting is 'minor ridge and valley'; generally pasture, with overgrown stone field boundaries and some mature trees. Some of the sites have a natural sense of enclosure, derived from local topography and small areas of mature trees. Careful consideration must be given to the configuration of the compound on the selected site to take full advantage of the screening available.

15.4.1.3 Knockdoebeg Compound

The Knockdoebeg area is subject to ribbon development along all the local roads, and is the most visually sensitive of the three compound locations. The site is improved grassland, with dry stone walls defining the field boundaries. The compound will be situated on a sloped area close to the site of the Battle of Knockdoe. Knockdoebeg hill will act as a natural screen from the N63 to the south, but the compound will be visible from the local roads and houses to the north and east, for the duration of the construction work.

15.4.2 Above-Ground-Installations

The greatest long-term impact on visual amenity as a result of the project will be from the above-ground-installations (AGIs). These installations are a permanent feature and generally contain small items of equipment, which are essential to the running and maintenance of a pipeline. The site will be levelled, and surfaced with hardcore. There will be a small single-storey control and monitoring building, and the site will be fenced all around its boundary. They will generally require a site area of approximately 60m x 60m, except for BV4 which incorporates a pigging station and may require an area of up to 120m x 120m. The locations are as follows:

- BV1 at Bellacorick, on the bank of the Oweniny River
- BV2 at Srahyconigaun, west of Lahardaun village
- BV3 at Rockfield, west of Turlough village
- BV4 at Knockroe, south of Mayo village
- BV5 at Shancloon, south of Togher River
- BV6 at Ballymoneen, south of River Clare

Each of these will require planning permission prior to construction.

15.4.2.1 BV1 at Bellacorick

This AGI site is located in on a small area of grassland close to the bank of the Oweniny River. The surrounding area is generally flat peat, which is being intensively stripped by Bord na Móna. The AGI itself will be effectively screened by the local topography, being significantly lower than the surrounding area. To the north there is a small coniferous plantation, which forms a visual barrier between the site and the nearest house. The site is bounded to the west by a local access road, and beyond this there are large silt ponds. To the south and west, the power station and some extensive coniferous plantation screen most possible viewpoints.

15.4.2.2 BV2 at Srahyconigaun

This is a sloping site, in an area of boggy pasture, located close to the R316, a quiet regional road. Nephin, an 806m mountain 4km to the south of the site, dominates the landscape of this whole area. The two dwellings near the site will not have their view of the mountain affected. The installation will, however, have a local negative impact on the attractive views to the south from the road. The site is bounded and screened to the east by a mature hedgerow and ditch, and to the west by a natural rise in topography. Beyond the road, to the north, extensive coniferous plantation forms a visual boundary.

15.4.2.3 BV3 at Rockfield

The installation will be sited in a boggy field beside a laneway off the Castlebar-Turlough road. One dwelling overlooks the site, across the lane. The site is quite enclosed, set in a natural depression in the landscape. To the north, a small coniferous plantation provides a visual block, and small hills rise up to the east and west, effectively screening the site. To the south there is a slight rise in topography, and occasional trees and shrubs, all of which will serve to minimise any negative visual impact from the main road.

15.4.2.4 BV4 at Knockroe

Situated in gently undulating and slightly boggy pasture, this site is overlooked by a farm complex and a house. The local topography effectively screens the site to the west, north and east, but there will be an impact on the landscape as perceived from the road to the south. Careful selection of fencing colour and type, and optimising the site layout should be considered to minimise this impact. The site is accessed via a lane that has mounded ditches with timber post and wire fencing over. These posts provide a rhythmic contrast with the horizontal lines of the stone field boundaries, and will soften the effect of the installation fencing from some vantage points.

15.4.2.5 BV5 at Shancloon

This site feels quite enclosed, with mature hedgerows and drainage ditches surrounding it to the north, west, and south. It is well-drained pasture, gently and evenly sloping down towards the Togher River. There are no dwellings overlooking the site, and the road boundary (an overgrown stone wall) will screen the visual impact of the installation for road users.

15.4.2.6 BV6 at Ballymoneen

The landscape in this area is open and flat, with dry stone walls being the dominant feature. There are occasional mature trees along the stone walls to the east, south and west, but the installation will be clearly visible from these aspects. There are individual houses to the east, west, and across the road to the north that are overlooking the site, but the visual impact for road users will be softened by the stone wall with occasional trees which marks the boundary with the field.

15.5 Mitigation Measures

Over the past twenty years pipeline reinstatement techniques have developed and improved so that high standards can now be achieved.

The greatest opportunity to minimise the visual impact of the pipeline is presented during the route-planning phase. Approximately 69% of the proposed pipeline crosses agricultural land, which is typically the easiest to reinstate, provided that land drainage is replaced, topsoil carefully handled and fields are re-seeded (**Section 9**). Therefore the visual impact within the fields will only be significant during the construction period.

Where the proposed route crosses the rocky moorland and the extensive areas of exposed rock at the surface, boulders will be removed and carefully replaced after the pipeline has been laid.

Wherever possible hedgerows and in particular hedgerow trees will be avoided, and gaps or weak points within the hedgerow will be selected as the crossing point.

Wherever possible, within woodlands and plantations, the proposed pipeline route will avoid mature trees and select natural gaps in the vegetation. Every effort will be made to reduce the working width for the pipeline construction to avoid individual mature trees and their roots. Every measure will be taken to keep tree and vegetation removal to a minimum.

Where the proposed pipeline is to cross dry stone wall field-boundaries, the walls will be carefully dismantled and replaced after the pipeline has been laid. Care will be taken to rebuild walls using the techniques, style and stone type to match the existing walls in the area.

AGIs are often visually intrusive and careful techniques will be adopted to mitigate the effects and integrate the installations successfully into the landscape. The AGIs have been positioned

carefully in relation to existing site features such as topography, hedgerow field boundaries, and trees to provide screening.

Techniques such as those following will be utilised in order to successfully integrate AGIs into the landscape, mitigating the visual impacts:

- positioning AGIs toward the corners of fields and adjacent to existing established planting to utilise the screening effects of hedgerows and trees;
- careful siting below skylines to make use of existing local topography for screening effect;
- screen planting.

Screen planting to the boundaries of any AGI will be introduced to help mitigate any visual effects. The introduction of native species planting, in a mix reflecting those species found in hedgerows and woodlands within the local area, will help to successfully integrate the installation into the wider landscape and provide valuable wildlife habitats.

By selecting such species and specifying, where possible, plant material of local provenance, new planting would respond to local landscape character and would follow best practice in terms of sustainable development.

15.6 Residual Effects

After construction, the degree and duration of any visual impact will be determined by the nature of the landscape crossed. For example, arable land, permanent or temporary grasslands and woodlands respectively take an increasing length of time to reinstate. Reforestation will not be allowed directly over the pipeline route, so those portions of the route that traverse forestry must remain clear of trees after construction.

One of the objectives of reinstatement of the pipeline route is to return the visual integrity of the landscape, as closely as possible, to its previous condition.

The pipeline route through the coniferous forests will be visible as a residual impact until the forests are clear-felled. Further planting in the zone directly over the pipeline will not be allowed, so the route will be a long-term linear feature – similar to firebreaks and areas under overhead electricity lines.

The AGIs will have a minor residual impact, which will gradually reduce as screen-planting matures.

16 ROAD AND TRAFFIC STUDY

16.1 Introduction

The impact of pipeline construction and operations on the road network and on traffic along the route of the pipeline is assessed in this section.

This assessment has been carried out following a site visit along the pipeline route corridor, meetings with Senior Engineers in the roads divisions of Mayo and Galway County Councils and inspection of various internal reports prepared for Enterprise Energy Ireland Ltd by its contractors and consultants.

It addresses the general traffic issues relating to the logistics of constructing the pipeline; actual details relating to each particular road affected by the project will require assessment as part of the Traffic Management Plan prepared by the contractor and approved by the relevant road authority.

16.2 Existing Road Network

The road network within the study area for the route of the pipeline comes under the jurisdiction of three authorities: Mayo County Council and Galway County Council, and the National Roads Authority.

The National Roads Authority was formally established as an independent statutory body under the Roads Act, 1993, with effect from 1 January 1994. The Authority's primary function, under the Roads Act 1993, is 'to secure the provision of a safe and efficient network of national roads.' For this purpose, it has overall responsibility for planning and supervision of construction and maintenance works on these roads. The local authorities have responsibility for all non-national roads.

The route of the pipeline crosses 143 public and private roads between the reception terminal at Bellanaboy Bridge and its termination at Craughwell, Galway. These are summarised in **Table 16.1**.

Table 16.1: Number and classification of roads crossed by pipeline

Classification/ Location	National Primary	National Secondary	Regional	Local or laneway	Total
County Mayo	1	2	5	94	**102**
County Galway	1	1	4	35	**41**
Total	**2**	**3**	**9**	**129**	**143**

The hierarchy of roads within both counties is the same as it is throughout Ireland, as listed in **Table 16.2** below:

Table 16.2: Road Classifications

Road Category	Description
National Primary Road	These account for 3% of the total road network but carry 27% of the total road traffic. They are predominantly single-carriageway with some dual carriageway (no motorways in Galway and Mayo at present). Generally high speed (60mph) roads and the subject of major infrastructure development to reduce journey times for strategic traffic.
National Secondary Road	These are medium distance through-routes connecting important towns, serving medium to large geographical areas and link to the primary routes to form a homogeneous arterial network.
Regional Road	Predominantly single carriageway roads of regional and local importance. Receive higher priority in maintenance criteria than Local Roads; hence tend to be structurally sound.
Local Primary Road Local Secondary Road Local Tertiary Road	The local road system is operated in 3 tiers defining local importance, usage and maintenance priorities. A network of single carriageway roads with numerous sections which are sub-standard for heavy goods vehicles (HGV) traffic (limited visibility, poor alignment and/or road surface and poor construction)

The national roads have been and are being upgraded as part of the National Development Plan and Road Needs Study. As part of the strategic route network throughout the country they are capable of carrying all conventional traffic associated with the project.

There are, however, restrictions on some regional roads within the vicinity of the route of the pipeline. Height restrictions obtain on bridges under the railway west of Athenry on the R348 (4.12m headroom) and the level crossing west of Claremorris on the R331, and any abnormal loads (in height, width, length or weight) may be restricted in the routes available to reach the pipeline route.

16.3 Local Roads and Current Traffic Loads

The local road network consists of numerous roads of varying standard of width, horizontal and vertical alignment, running surface and carriageway construction. The majority of these roads are poor quality, historically having been tracks and roadways which have been gradually improved in a piecemeal manner by overlaying with surfacing layers and surface dressing to provide a reasonable running surface. This is particularly the situation in bog areas.

The poor quality of these roads means that they suffer frequent damage to the structural layers from heavy goods vehicles and maintenance is an ongoing operation by the road authorities. The prioritising of maintenance budgets within the county councils, however, means that early treatment of minor damage is not always possible and roads deteriorate in standard quite rapidly if damage is left unrepaired.

Notwithstanding the above, a number of the local primary roads are of greater importance, in a local and community context, than some of the regional roads and have received frequent maintenance and strengthening to reflect the level of usage. These roads may be assessed and treated in the same category as regional roads.

The existing county road network, in general, carries all permitted vehicles with the exception of some very poor standard local tertiary roads where there are width and weight restrictions. In the

present economic climate, development (residential, commercial and agricultural) is widespread and the road authorities accept that they cannot prejudice such developments by restricting heavy goods vehicle movements along the county road network. The local authority does, however, make a charge on developers whose construction traffic causes significant damage to these roads; thus reducing the residual life of the carriageway. This process is outlined in **Section 16.7**.

The condition of the roads is also affected by excessive axle loads caused by the overloading and poor load distribution of loads on wagons; both are occasional practices in the construction industry and ones that the road authorities are attempting to eliminate. As an example Mayo County Council, for deliveries to County Council sites, will refuse to sign for the actual tonnage of an overloaded delivery wagon – only signing for (and hence only paying for) the permitted tonnage. The hauliers are responding by keeping loads and hence axle loads within the permitted limits of each wagon when delivering to the County Council.

16.4 Traffic Generated by Proposed Development

The development will generate a considerable number of heavy goods vehicle trips. Based on the following criteria, total numbers and frequency of traffic movements have been projected for the construction period.

- Pipeline length (approx.) 150km
- Pipeline diameter 660mm (nominal)
- Standard pipeline wall thickness 9.52mm
- Heavywall pipeline thickness 19.1mm
- Concrete coating thickness 50mm (nominal)
- Individual pipe length 12m
- Concrete pipeline protection slab 960kg

This study identifies the numbers of trips of the various types of vehicle used throughout the construction process based on the proposed construction sequence and focuses on the various heavy goods vehicle movements. It assesses the traffic generated by movement of materials in Ireland, from ports to storage yards and to the construction points along the route of the pipeline. Ideally all construction traffic would be confined to the temporary access roads, which will be constructed in the working width. However, obstacles along the route of the pipeline such as rivers and railways can prevent the movement of construction plant and materials along the route of the pipeline. This study identifies these obstacles and the need for routes for moving plant around the obstacles.

16.4.1 Major Traffic Generators

The major traffic generators related to the project will be:

- line pipe transport,
- aggregate/sand transport,
- concrete protection slab transport,
- transport of the pipeline construction machinery,
- site workers' transport.

16.4.2 Linepipe and Fittings

The linepipe suppliers are likely to ship to Galway and Foynes or Cork ports. It will be delivered from there by road to the pipe storage depots in the winter season 2001-2002. It will be transported subsequently to the pipeline spread as required over the period April 2002 – April 2003.

There will be 12500 individual pipes, with 3500 of them concrete coated. For the purposes of this assessment it has been calculated that uncoated pipes can be transported 6-per-trailer, and the coated ones 3-per-trailer. A conservative estimate of the total number of HGV trips required to deliver these and all associated bends, pig traps, ball valves, bulk fittings, skids, small valves, tees, isolation joints and transition pieces, is 2800 loaded trips. With delivery to the pipe dumps to take place over a ten-week period, there will be up to 35 HGV trips per day each direction between each delivery port and the pipe dumps.

There are three construction compounds proposed for storage of linepipe, fittings, and site accommodation. These are at Bellacorick, near Castlebar and close to the N17. Refer to Figure 5.1, Volume II for construction compound locations. Linepipe will be hauled from the ports to each of these locations over the time period October 2001 to February 2002. Approximately equal amounts of linepipe will be required at each pipe dump. Because the northern section of the route is generally the wettest part, it has been assumed that half of the concrete-coated linepipe will be routed to the Bellacorick pipe dump, with one quarter to each of the other sites.

The transfer of the linepipe and fittings from the pipe dumps to site for stringing-out will happen over the 12 months from April 2002 to April 2003. All the national and regional roads in the vicinity of the pipeline will be used for this work. The impact of this will be dispersed across the national and regional roads near the route.

16.4.3 Aggregate and Sand

It is possible that the running strip beside the trench will require imported aggregate stone in some of the wetter sections of the route. There is also likely to be a requirement for imported sand for pipe bedding. The BGÉ construction contractors will decide on this during detailed construction planning, and will need to consider in detail the logistics of transporting the material between quarry and site.

There are quarries located in Bunnahowen and Westport that could supply the stone requirements for the northern section of the route. Towards the south, the Roadstone and Cannon quarries near Galway City may be used for the aggregate and sand needs.

Approximately 51.25km of the pipeline route is either coniferous plantation woodland, marsh, heathland, bog, fen, flush or bare peat (**Figure 9.1, Volume 2**). Any or all of this terrain may require aggregate reinforcement for the running strip. The running strip will be removed on completion of construction unless required by the landowner. If one assumes an average road depth of 500mm and an average width of 5m, a total of 256250tonnes of aggregate would be required. Transporting this from the quarries to site, and then back to the quarries on completion, would require a total of 32000 loaded trips.

The delivery to site would take place over a three-to-six month period, and so could result in up to 205 HGV movements each direction per day, six days a week.

Because this traffic load will potentially have a much greater impact than any other aspect of the project, consideration will be given to alternative means of creating a running strip. Bog mats are a potential option, and may prove useful in reducing the volume of aggregate and sand required for the construction work.

16.4.4 Reinforced Concrete Pipeline Protection Slab

At any ditch crossing that might be deepened in the future, I.S. 328 requires that protection be provided above the gas pipeline. Bord Gáis Éireann has developed standard reinforced concrete pipeline protection slabs for this purpose, which are approximately 960kg. Approximately 350 of these slabs will be needed; requiring 16 fully loaded HGV journeys to site.

16.4.5 Pipeline Construction Machinery

Pipeline construction is quite a specialised process, and for a project of this scale there will be a considerable number of machines on the spread such as traxcavators, excavators, tipper trucks, bulldozers, cranes, tug units, sidebooms, pay welders, bending machines, welding generators, etc, which will require transport to site. The *Onshore Gas Pipeline Constructability Study* prepared by Project Management Limited for Enterprise Energy Ireland Limited estimates that transporting this machinery will require 48 loaded HGV journeys.

Where the pipeline route crosses Iarnród Éireann railway tracks that are in active use, it is unlikely that the construction machinery will be allowed to cross the tracks. The contractor(s) will need to consider the trucking of the equipment around these crossings in their Traffic Management Plan.

16.4.6 Site Workers' Transport

With the potential for up to 500 workers on the spread at peak, transport and parking on the project will require careful management. Temporary accommodation is likely to be provided at one or more of the construction compounds, and in that case the contractor may provide transport from the compound to the pipeline spread. Sufficient parking space will be required in the compounds, and close to designated road crossings.

The traffic volumes associated with these items are summarised in **Table 16.3.**

Table 16.3: Roads Affected by Construction Traffic

	From	To	Total	Daily	Duration (Weeks)															
			(each way) HGV trips	(each way) HGV trips	N5	N17	N18	N59	N60	N63	R310	R311	R312	R313	R314	R315	R316	R332	R339	R347
Pipe	Cork	Galway	1400	28			10													
delivery to	Galway	Knockdoe	2800	56		10														
storage	Knockdoe	Turlough	1866	38	10	10			10											
depots	Castlebar	Bellacorick	933	19				10				10	10							
Machinery	Galway	Knockdoe	48	5		2														
delivery to	Knockdoe	Turlough	32	3	2	2			2											
compound	Castlebar	Bellacorick	16	2				2				2	2							
Sand and	Bunnahowen	Bellanaboy Bridge	5000	65-32											13-26					
gravel	Bunnahowen	Bellacorick	15000	193-96										13-26						
	Bellacorick	Castlehill	10000	130-65				13-26					13-26							
	Westport	Derrynamuck	7500	96-48	13-26						13-26									
	Westport	Massbrook	7500	96-48	13-26							13-26	13-26			13-26	13-26			
	Claregalway	Lecarrowmore	2000	26-13		13-26														
	Lecarrowmore	Castlehackett	1000	13-7		13-26												13-26		
	Lecarrowmore	Ballymoneen	1000	13-7						13-26									13-26	13-26
Concrete	Castlebar	North	10	10				1			1				1					
slabs	Castlebar	South	6	6		1			1											
Movement around Railways & Rivers	Intermittently along route		1000	3	64															

16.4.7 Restrictions on Vehicle Types

Neither Mayo nor Galway County Councils will allow 'Volvo' type articulated dump trucks travel on the roads.

16.4.8 Access Proposals and Haulage Routes

Both Mayo and Galway County Councils are compiling a list of suitably constructed roads for the project traffic. These are generally the national and regional routes, and written approval will be required from the local authority for any construction traffic on unlisted roads.

16.5 Evaluation of Impacts

16.5.1 National and Regional Road Network

16.5.1.1 The Pipeline and Access Points

The route of the pipeline crosses 5 national and 9 regional roads between the Terminal at Bellanaboy Bridge and its termination near Craughwell. These 14 roads will provide the focus for access by all traffic associated with the construction.

The locations of site accesses on the national and regional roads will require agreement with the relevant local authorities. At the majority of locations, local road widening works to provide left and right-turning facilities into the site and parking space will be required. On the national routes, the width of road and the high speeds at these access points mean that a more detailed plan will be required on safety grounds; possible options being the provision of physical barriers to define lanes and/or a roundabout. An assessment by BGÉ's construction contractor(s) in liaison with the local authorities will determine the agreed layout for inclusion in the Traffic Management Plan.

16.5.1.2 Construction of crossing points on National and Regional Roads

The pipeline crosses a total of 14 national and regional roads. The general approach of Mayo and Galway County Councils is that none of the national routes can be closed for the construction of the pipeline. For the regional roads, closures for one or two days will be considered on an individual basis. The choice of construction method for the road crossing is not, however, determined solely by the category of the road being crossed. The construction method being used on the approaches to the crossing and the geology of the ground at the crossing point have equal, and sometimes greater, importance in the decision making process.

The contractors will have a range of options to consider at each road crossing. It may be possible to provide a temporary diversion onto adjoining local roads, which would be acceptable to the County Council, to avoid the crossing point. It may be possible to provide a temporary road or lanes on land adjoining the crossing point. The Council may accept one lane being closed and traffic lights provided to allow traffic through in each direction in turn. The Council may accept road closure for a short duration at a weekend. A trenchless method may be required, if ground conditions allow. As with the details for the assess points, each crossing point will need to be assessed on its own merits and details agreed with the county councils, and included in the Traffic Management Plan.

16.5.1.3 Proposed New Road Projects or Improvements

There are a number of schemes for new roads, or the widening or realignment of existing roads, for which route corridors have been identified in the vicinity of the pipeline. At the time of preparation of this EIS, two proposals have been developed in sufficient detail to be considered; these are for the N17 and the N6. The pipeline crosses both these route corridors close to Athenry in County Galway, and provision will be made for them in the construction process. It is likely that pipeline construction will be complete prior to commencement of the road construction.

16.5.2 Local Road Network

16.5.2.1 Pipeline and Access Points

The route of the pipeline crosses a network of local roads running parallel and perpendicular to the pipeline. These roads are generally not suitable for use by construction traffic to access the site, with two exceptions at Derrydonnell and at Massbrook Lower where there are no suitable National or Regional roads. The routes from the National/Regional roads to the access points on these Local roads will need to be assessed with regard to their suitability to take the volume of heavy goods traffic associated with the project. Liaison with the County Council will identify any advanced works (pavement strengthening and junction and alignment improvements) required on the grounds of road safety.

16.5.2.2 Construction of crossing points on local roads

The general approach of the county councils is that local roads can be the subject of a temporary closure up to 5 days; but a suitable, viable diversion route has to be available. There are, however, a number of local primary roads that are considered to be of local importance, the temporary closure of which may not be acceptable. The treatment of the crossing points on local roads requires assessment of all the factors in consultation with the relevant county council.

16.5.3 Other Issues

16.5.3.1 Construction Camps

The total workforce on the project is likely to be approximately 500, including subcontract operations. Because of the specialised nature of much of the work, the majority of the workers (circa 300) will not be from the local area, and will require accommodation. The contractors may choose to establish temporary camps to accommodate the non-local workforce. Consideration may be given to providing transport for the workers by bus or coach between the site and the camps. These camps would require planning permission. The planning authority will consider the traffic issues at that stage. The Traffic Management Plan should include a section on these issues.

16.6 Mitigation Measures

16.6.1 County Council Charges

The County Councils levy a charge on developers for use of the Local road network where the traffic associated with the development is substantial and the residual life of the road pavement will be substantially reduced by this traffic. The charges levied will contribute towards the strengthening or reconstruction of the road pavement. Mayo County Council assesses the residual life of the road pavement before the start of a major construction project, using conventional equipment such as a falling weight deflectometer.

The process is repeated upon completion of the project and a charge calculated based on the reduction in residual life of the pavement.

16.6.2 Legal Loads

It is suggested that the contractors follow the lead set by the County Councils and only accept the payload limit of any vehicle as the quantity that will be signed and paid for.

16.6.3 Restricted Use of Roads

The County Councils prefer that all construction traffic uses the national and regional Road network to access the pipeline and propose to prohibit the use of some local roads for all construction traffic, including cars and light vans associated with the works. These roads tend to run parallel to the route of the pipeline and would offer a more direct route between access points than following the national and regional roads.

16.6.4 Road Closures and Temporary Diversions

The county councils accept that road closures are necessary on the local roads to permit open trench construction methods to be used for road crossings. Temporary closures for up to 5 days can be applied for and will not be refused as long as alternative arrangements are in place for traffic, either local temporary roads or the signing of temporary diversions. The local authorities will not adopt a standard approach for the closures and each road has to be assessed on its own circumstances. The contract documents should include an appropriate schedule of the requirements for each of the crossings.

16.6.5 Traffic Management

Traffic management during the construction works will have to comply with the requirements of each County Council and any signage and road marking measures required will be approved by the County Councils before implemented.

16.6.6 Traffic Management Plan

This will be prepared by the contractor in close liaison with the local authorities, which will ensure that the transportation needs for the pipeline have minimal impact on the road network and the local communities. The Traffic Management Plan will be a comprehensive document identifying all issues relating to the following **(Table 16.3)**:

Table 16.3: Traffic Management Plan

Issue	Notes
Road usage by construction traffic	A clear and concise list of roads that can and cannot be used by all construction traffic.
	Specific requirements of the County Councils on signage for the construction works
Site access layouts	The various site access points will need to be designed for visibility, turning traffic and road safety.
	Approval of layouts by the County Councils
Open cut road crossings	The procedure and timetable necessary for the road opening up and temporary closure Orders; including notice periods prior to closures, diversions, etc for County Council inspections and approvals
	Duration of road closures or Temporary road diversion layouts and construction
	Diversion routes and signage.
Trenchless road crossings	Safety measures for road users adjacent to deep excavations either side of the road – such as temporary concrete barriers.
Carriageway reinstatement	Agreed pavement construction for reinstatements – both temporary and permanent.
	Identification of road crossings with 1 or 2 year maintenance periods.
Construction camps	Parking facilities – for cars and coaches at both the camp and the pipeline route.
	Approved routes between the camp and construction sites.
	Service requirements for the camp.

16.7 Residual Effects

16.7.1 Impact on the Residual Life of the Road Pavement

The County Councils' pro-active approach to dealing with road pavement damage by development traffic should ensure that there is minimal loss of residual life in any of the roads used by the construction traffic.

16.7.2 Temporary and Permanent Reinstatements of Carriageway Excavations and Maintenance Periods

The standard procedure for reinstating road carriageways is to complete a temporary reinstatement immediately upon completion of the pipeline crossing. A permanent reinstatement is then carried out after 1 or 2 years. The normal period for completion of the permanent reinstatement is 1 year; a period which allows for any settlement of backfill to take place, however in areas of deep bog the settlement period is longer. Mayo County Council requires a 2-year period of settlement to take place before the completion of the permanent reinstatement. The contract documentation will, therefore, identify the maintenance periods for all road reinstatements.

16.7.3 Road Traffic

Following the construction contractor's Traffic Management Plan will ensure that the residual impact of the construction work will be minimised. Nevertheless, the volume of works-related vehicles on the roads will inconvenience local traffic. As part of the traffic management of the project, the contractor(s) will maintain contact with the road authorities as the work progresses, and comply with any restrictions those authorities impose.

17 NOISE

17.1 Introduction

This section considers the potential impact of noise and vibration generated during the various stages of the pipeline's life.

The implications of construction, commissioning and operation of the pipeline are considered in the context of appropriate standards and guidelines, in addition to the requirements for monitoring and controlling the levels of resultant noise and vibration.

Pipeline decommissioning is not anticipated to generate a significant level of noise and as such is not addressed in this Section.

General procedures for constructing, commissioning and operating pipelines are well known. Typical techniques have been assumed in order to predict the impacts in this section, enabling previously measured and published standard noise and vibration source data to be considered.

The precise details of methods to be used in the construction and commissioning will be the responsibility of the selected construction contractors. The contractors will be required to produce a series of construction method statement detailing the methods to adopted for construction of the different elements of the pipeline.

17.2 Legislation And Planning Guidance

The Irish Environmental Protection Agency administers Ireland's primary noise control mechanism via the integrated pollution control (IPC) licensing regulations. This applies to ongoing noise emissions from fixed installations, rather than temporary noise generated by construction / installation operations.

The EPA document *Guidance Note for Noise in Relation to Scheduled Activities* does, however, give guidance on noise and vibration thresholds for quarrying and mining activities. It is understood that these limits will be considered applicable to rock blasting which will be required in certain areas.

17.2.1 British Standard BS 5228; 'Noise Control on Construction and Open Sites'

For temporary works (e.g., construction work) BS 5228: Part 1: 1997 provides guidance on criteria for setting noise control standards. BS 5228 does not give detailed guidance for determining whether or not noise from a site will constitute a problem in a particular location. The code of practice does refer to a number of factors that are likely to affect considerations of construction site noise. These are:

- existing ambient levels;
- noise characteristics;
- duration of site work;
- hours of work;
- attitude to site operator.

The standard states that complaints due to industrial noise increase as the difference between generated noise level and the background increases. It considers that a similar effect could occur for construction activities but suggests the tolerance may differ when it is known that the

timing of the activity is of a short duration.

With this in mind the code of practice recognises that good public relations are important and that the local residents should be kept fully informed of likely noisy activities and the anticipated duration of such activities.

The sensitivity of local residents to noise from the construction sites will, to a certain extent, depend on the hours of work of the operations. Although the code of practice falls short of setting an absolute noise level limit it does state that the periods when people are getting to sleep and just before they awake appear to be particularly sensitive. It is suggested in the code of practice that site noise expressed as an $L_{Aeq,\ 1h}$ at the facade of noise sensitive premises may need to be as low as 40 dB to avoid sleep disturbance.

BS 5228: Part1 also quotes noise source data values for typical construction related activities such that noise impacts can be assessed in advance if proposed activities are relatively well defined. These data forms the basis of the noise levels quoted previously in this document.

17.3 Environmental Noise Climate

The majority of the area through which the pipeline route passes is rural and relatively sparsely populated. Although this means that any environmental impact will affect a relatively small population, it also means that the background noise levels are low and construction activity noise will be more noticeable.

Prevailing noise levels will vary along the pipeline route with local circumstances and proximity to roads and other noise sources. The following ranges have been derived from recent baseline survey data as generally typical for the areas involved:

- daytime (0700 - 1900) ambient $L_{Aeq,1hour}$ between 50 and 65 dB(A);
- daytime (0700 - 1900) background $L_{A90,1hour}$ between 40 and 45 dB(A).

Night-time noise levels drop to significantly lower levels, with the minimum $L_{A90,\ 1hour}$ dropping below 30 dB(A) in many areas. Specific attention will be required for any operations proposed outside the hours quoted.

17.3.1 Distances to Properties

For an indication of the likely impact on residential neighbours along the pipeline route, the number of properties within a range of distances from the proposed pipe alignment has been estimated.

Properties have only been considered within 500m of the pipeline route. As noise attenuates with distance, it has been assumed that noise levels at greater distances will have fallen to levels that do not give rise to significant excesses of ambient noise levels.

Table 17.1 below gives details of the estimated number of properties within four categories defined in one hundred metre wide bands on either side of the proposed pipeline route.

Table 17.1: Estimated Numbers of Residential Properties within a range of distances from the Proposed Pipeline Route

Distance from the proposed pipeline route	0-100 m	100-200 m	200-400 m	400-500 m
TOTALS	90	110	215	90

17.4 Noise And Vibration Predictions

17.4.1 Construction

The assessment presented has been prepared using the most recent, typical noise data available for construction operations likely to be employed in the pipeline construction and the timings of such operations. As such, it must be considered as a preliminary indication of the likely noise and vibration impact until additional information is available on finalisation of the actual activities involved. This may result in a requirement for an updated assessment once the detailed design phase is complete, should significant differences arise.

The pipeline contractor's responsibilities will include reference to this document prior to commencement of site operations and the submission of comparative data for noise and vibration levels associated with the operations and plant items proposed. In consideration of these factors, the contractor will also be responsible for any mitigation requirements to ensure that any agreed target noise levels can be achieved in practice throughout the scheme.

17.4.1.1 Standard Pipeline Construction

Activities associated with standard pipeline construction methods have been cross-referenced with standard noise source data to give the most accurate estimate of site noise possible at this stage. These values have been calculated using the procedures described in BS 5228: 1997. The noise levels will not be constant, fluctuating with operating periods for each item of plant and the combination of machinery being used at any one time.

Table 17.2 below shows typical noise levels that may be expected at the centre of each of the previously defined distance 'bands' along the working width of the pipeline construction. The appointed contractor will be required to minimise excess noise levels and liase with local residents over any particularly noisy activities.

Table 17.2: Typical Noise Levels Associated With Various Construction Activities.

L_{Aeq} dB calculated from BS 5228 at varying distances from working width					
Construction activities	**50 m**	**150 m**	**250 m**	**350 m**	**450 m**
Initial access & fencing	76	67	62	59	57
Site preparation & right of way	74	65	60	57	55
Topsoil stripping & site grading	82	72	68	65	63
Pipe haul & stringing	83	73	69	66	64
Cold pipe bending	73	63	59	56	54
Mainline welding	79	70	65	62	60
Trench excavation	79	70	65	63	60
Pipe lower and lay & tie-in	75	66	61	58	56
Backfilling	72	62	58	55	52

Due to the nature of the processes involved, noise levels will vary both with time, and distance as the construction contractor progresses along the pipeline route. Neighbouring residents will not, therefore, be continually exposed to the noise levels shown above for extended periods.

17.4.1.2 Specialist Pipeline Construction

Specialist teams will work along the pipeline route in advance of or following behind the main construction team. These are teams for initial preparation and final reinstatement works (walls, hedges, fences, etc.) and for special works such as road, railway and river crossings. Particular aspects of construction related noise are described in greater detail below. The precise crossing methods for

watercourses, roads and railways have yet to be decided as they are the result of detailed engineering assessments.

17.4.1.3 Non-Open Cut (Bored and Tunnelled Crossings)

These methods may be required for:

- main road crossings;
- rail crossings;
- large water mains;
- rivers.

These crossing are likely to be achieved using a thrust boring, auger boring or pipe jack/ concrete tunnel technique depending on ground conditions.

In some areas, sheet piling will be required at driving and reception pits as part of this process. This is the dominant noise for this operation which can give rise to relatively high, although intermittent, levels of noise and vibration (**Table 17.3**).

It should also be noted that, by definition, road and rail crossing locations are areas with elevated ambient noise levels, and hence the impact of piling over ambient noise will be less significant. Sheet piling gives rise to impulsive noise and using information presented in BS 5228 the following noise levels can be expected. An 'on-time' of 50% has been assumed, since piling operations are seldom continuous.

Table 17.3: Noise Levels ($L_{Aeq,\,1hour}$ dBA) Associated With Sheet Piling

Distance from source (metres)	50 m	150 m	250 m	350 m	450 m
Noise Level $L_{Aeq,1hour}$ dBA	76	66	62	59	57

The type and size of pile required and equipment used have a marked affect on noise levels generated. The piling contractor will be required to submit noise data for the proposed operation and to demonstrate that the impact is minimised as far as practical. Should sheet piling be required for cofferdams, similar noise levels can be expected depending upon the construction method used.

Once the piling is complete, the excavation and boring activities can be expected to emit noise at levels commensurate with standard construction techniques. In normal circumstances, it is not intended that boring activities continue at night.

However, where there are technical difficulties with stopping mid-bore/tunnel, boring or tunnelling activity may have to continue all night. Database information provided in **Table 17.4** indicates that this will give rise to noise levels of:

Table 17.4: Noise Levels Generated from Standard Excavation and Boring Techniques (dB $L_{Aeq,\,1hour}$)

Distance from source (metres)	50 m	150 m	250 m	350 m	450 m
Noise Level $L_{Aeq,1hour}$ dB	67	57	53	50	48

In some areas this could lead to excessive noise levels during night-time working. The contractor will give consideration to noise reducing methods such as barriers. If night-time working is required (i.e. after 8pm) the contractor will liaise with nearby residents.

In order to reduce noise levels as far as possible, maintenance of site equipment will be undertaken at regular intervals to ensure its efficient working, operated in accordance with the manufacturer's instructions and where possible exhaust silencers will be fitted.

Removal of piles and backfilling will generate similar noise levels to the excavation process, over a period of several days.

17.4.1.4 Microtunnelling

No Microtunnelling operations are proposed at this stage, but they may be employed at any road, rail or watercourse crossing.

The tools, plant and power source required for the boring and jacking are held within a fully insulated operations container, which enables the Operator and/or their Contractors to achieve acceptable noise levels. The pipe jacking operations can be continuous, 24 hours per day. The time taken to complete jacking varies depending upon the nature of the prevailing geology.

17.4.1.5 Horizontal Directional Drilling

This technique may be employed at road, rail or watercourse crossings, depending on ground conditions.

This is a relatively quiet technique for crossing wide obstacles to pipeline routing. The bulk of the equipment will be located on one side of the crossing. This may need to be a continuous operation, with work taking place outside of normal working hours. Again, prior notification would be given for out-of-hours operations.

17.4.1.6 Road Traffic Noise

Construction traffic associated with the pipeline construction will be routed via main roads as far as is possible. Due the rural nature of the area, however, some minor roads will have to be used for access. These routes will be agreed with the relevant County Councils and are subject to a separate traffic study.

The increase in traffic movements on minor roads is likely to cause a noticeable increase in daytime noise levels, however this effect will be localised and temporary, and will be restricted to the construction phase of the scheme.

17.4.1.7 Blasting

A large proportion of the pipeline trench will be constructed in relatively soft peat, which poses difficult engineering challenges but is likely to result in relatively low levels of noise and vibration. Some areas of the route, where the rock is at the surface, or at a very shallow depth, will require rock breaking or the controlled blasting of bedrock. This will produce significant levels of both noise and vibration. The contractors will determine the extent, nature and depth of any blasting from the detailed borehole survey prior to construction.

Once the details for blasting operations are known, it will be possible to include mitigation measures to minimise the potential for damage and nuisance. These measures will include the limitation of peak particle velocity by expert design of explosive charges and control of ground propagation where possible. Noise levels generated by blasting operations cannot yet be assessed, as the detailed requirements are unknown at this stage.

Special consideration will be given to any blasting proposed in close proximity to residential properties and sensitive or historic buildings.

The extent of blasting operations will be minimised by using alternative excavation techniques such as mechanical rock breakers or impact rippers wherever possible, although blasting cannot be avoided in all cases. Where blasting is required, the frequency of blasting operations will be minimised and blasting times will be restricted to normal working hours and will avoid weekend working.

The appointed contractors will provide adequate notice to nearby residents.

17.4.2 Commissioning and Testing

Rigorous commissioning and testing of the pipeline will be undertaken prior to commencing operations. This includes hydrostatic over-pressure testing of the whole pipeline section by section.

These tests, which will be continuous for several days and nights, are unlikely to give rise to significant noise levels along the pipeline itself, but pumps and compressors are needed to fill and pressurise the pipeline at the test end. Generators will also be required at selected locations along the route for security lighting at night.

The combined noise levels for one diesel pump and one generator predicted from BS 5228 are shown in **Table 17.5** below:

Table 17.5: Combined Noise Levels from One Diesel Pump and One Generator

Distance from source (m)	50 m	150 m	250 m	350 m	450 m
Noise Level $L_{Aeq,15min}$ dB	70	60	56	53	50

Appropriate noise control measures will be implemented to minimise noise emissions from the test sites and residents in the immediate vicinity of the test areas will be notified prior to the commencement of tests.

The pipeline will be swabbed on completion of the hydrostatic tests by propelling a pipeline integrity gauge (pig) using compressed air or water, through the pipe. The venting of air from the pipeline during this operation will generate a degree of noise.

Venting will take place over relatively short periods of time. However it can give rise to high noise levels. In order to minimise disturbance, whenever possible venting will only be carried out during normal working hours or using silencers.

Following the 'pigging' activity, the pipeline will be dried using vacuum drying. One small compressor driven unit will be used; the location of which will be established on site. The unit will be attenuated in line with the guidance given in BS 5228.

17.4.3 Operation

17.4.3.1 Pipeline Operation

Once operational, no appreciable noise or vibration will be generated by the pipeline itself. The pipeline's mechanical integrity will be tested from time to time using an intelligent pig that travels through the pipeline with the normal gas flow.

17.4.3.2 Pigging tests

Pig traps will be located at each end of the line and at the mid-stations only for launch and retrieval of the 'intelligent pig' monitoring equipment involving de-pressurisation of the trap. These occasional operations generate noise levels that are generally considered to be acceptable during the daytime hours when they are carried out.

17.4.3.3 Road Traffic Noise

Occasional road traffic movements associated with maintenance and testing of the pipeline will be insignificant in terms of flows on local roads and resultant noise levels.

17.4.3.4 Air Traffic Noise Levels

Airborne pipeline inspections will be carried out periodically to ensure the integrity and safety of the pipeline during its operational life. The helicopter flights are unlikely to be of sufficient frequency or duration to attract particular attention or cause undue disruption.

17.5 Mitigation Measures

In consideration of the likely noise and vibration levels to be generated during the various phases of the pipeline scheme, the following mitigation measures will be adopted to minimise the impacts on neighbouring residents.

- the selected contractors will be required to submit detailed information on the noise levels which will be generated by the specific methods and equipment to be used once these details are finalised, including actions required to minimise the noise impact;
- noise and vibration target levels for blasting operations will be agreed with BGE's construction manager, and compliance with regulations will be monitored in the most sensitive areas;
- the requirements of BS 5226:1997 will be complied with;
- normal working hours are provisionally set at 0700-1900 hours Monday to Friday and 0700-1600 hours on Saturdays. Sunday working should be avoided, but cannot be entirely excluded. If extended working hours are required, they will be discussed with nearby residents before operation begins;
- in noise-sensitive areas, controls may be imposed which are stricter in the early morning, evening and at weekends, than they will be during the daytime;
- a limited number of construction activities may have to continue on a 24-hour basis. These include horizontal directional drilling (HDD) which is a relatively high noise activity and pipeline cleaning and hydrostatic pressure testing, which are low noise activities;
- where appropriate, residents living near to the pipeline construction activities will be kept informed of the contractors proposed working schedule and will be advised of the times and duration of any abnormally noisy activity (e.g. blasting) likely to cause concern;
- the contractor will instructed to avoid unnecessary noise from the sites, particularly at night.

17.5.1 Noise Control Target Levels

Control of noise from the normal activities associated with pipeline construction will be achieved by restricting working hours, and by the best practicable means mitigation measures described

above.

Blasting operations, however, must be controlled against absolute limits due to high levels of sound energy involved, which can be intrusive, startling and in extreme cases pose a threat of damage to hearing.

Guidance is taken from the EPA document *Guidance Note for Noise in Relation to Scheduled Activities, 1995* which states in section 3 that 'Blasting should not give rise to air overpressure values at sensitive locations which are in excess of 125 dB (Lin) $_{max\ peak}$. Compliance with this absolute limit shall be the responsibility of the blasting contractor, and will require monitoring in sensitive locations.

In any situation where blasting requirements are such that compliance with this limit is impossible, consideration must be given to alternative mitigation options, such as temporary relocation of affected residents.

17.5.2 Vibration Control Target Levels

Only blasting activities are considered likely to give rise to vibration levels of sufficient magnitude to warrant absolute threshold limits. The guidance given in *Guidance Note for Noise in Relation to Scheduled Activities, 1995* is as follows;

'In the case of quarrying and mining operations, the vibration levels from blasting should not exceed a peak particle velocity of 12 mm/sec, measured in any three mutually orthogonal directions at a receiving location when blasting occurs at a frequency of once per week, or less. For more frequent blasting the peak particle velocity should not exceed 8 mm/sec. These levels are for low frequency vibration, i.e., less than 40 Hertz.'

Although blasting operations associated with the pipeline construction may occur more frequently than once per week, the EPA guidance is intended for permanent or semi-permanent sites (mines and quarries). In the context of the transitory pipeline construction process, it is considered appropriate to use the higher of the two limits given above.

17.6 Impact Assessment

An appreciable daytime noise impact is likely to be experienced by residents whose properties are located within the 100 m of the proposed pipeline route. It has been estimated that this will apply to approximately 90 households based on 1:10,000 scale OS mapping. The impact will only be significant during the noisier phases of activity, and will be relatively short-lived at each location.

Night-time working will not be permitted without prior agreement from the local authority. This should only be sought when absolutely necessary for technical or safety reasons.

At properties located between 100 m and 200 m of the route, a lesser impact will be experienced which residents may occasionally find intrusive. This is estimated to apply to approximately 105 households based on 1:10,000 scale OS mapping.

At greater distances from the proposed centre line, lower noise levels will occur which, although audible at times should not be particularly intrusive. At distances greater than 500 m, it is assumed that no noise impact occurs.

The pipeline contractor shall be required to make every effort to minimise noise impacts, and local residents shall be forewarned of significant events. Close liaison with the local authority will be required to ensure that the impact of inevitable noise associated with the pipeline construction is minimised.

Vibration levels associated with bedrock blasting are likely to generate the only significant vibration impact. This will be controlled according to the targets outlined in 17.5.2.

High noise levels are also associated with blasting operations, and will be controlled according to absolute targets outlined in 17.5.1.

17.7 Summary

The noise and vibration impacts of a proposed pipeline between Bellanaboy Bridge and Craughwell have been considered and assessed.

It has been determined that some residents may be adversely affected, albeit temporarily, within close proximity of the pipeline, and mitigation measures have been put in place to minimise this impact.

Particular attention will be paid to rock blasting activities, for which noise and vibration targets are specified in relation to the closest residential properties.

18 EMISSIONS

18.1 Introduction

This Section considers the emissions which will result from the construction, commissioning and operational phases of the proposed pipeline. The five major sources of emissions are noise, vibration, liquid effluent, light, air emissions and solid waste.

An assessment of the expected noise from construction operations has been prepared (**Section 17**). It should, however, be noted that this assessment has been developed using the current best estimate of activities, scheduling, plant and plant utilisation based on the experience from similar pipeline installations. It may, therefore be subject to amendment during the detailed design phase.

18.2 Liquid Effluent And Spillages During Construction

18.2.1 Site Drainage Water

The open pipe trench may be subject to accumulation of rainwater and percolating groundwater. In areas where groundwater is likely to cause problems with trench-side stability, localised dewatering may be required (see **Section 13.0**). This involves pumping water from the trench before pipe laying, and disposing of it in accordance with recommendations from the relevant County Council.

If any areas of contaminated land are crossed, trench water will be disposed of in accordance with the relevant waste legislation and Environmental Protection Agency guidance.

To avoid water accumulation in the trench and foundations, the pipeline construction contractor(s) will, where appropriate, install header drains prior to construction.

18.2.2 Fuels

Fuel quantities used will be registered at the site offices and will be stored in designated areas. Fuel tanks will be imperviously bunded to contain 110% capacity of the largest container. Accumulated rainwater will be routinely emptied and disposed of at a suitably licensed liquid waste disposal facility.

Machinery used on the working width will be refuelled via portable bowsers. Generally the bowser will be returned to the construction base overnight and stored on a hard impervious standing. Its use during the day will be continually supervised and appropriate measures will be taken e.g. use of drip trays or oil absorbent pads, to prevent ground contamination when the bowser is used on the working width.

Fuel and oil containers will not be stored unbunded along the working width, and drip trays will be placed under standing plant. If a spillage occurs, it will be contained; as much material as possible will be recovered in order to prevent it reaching the groundwater or entering the drainage system, and appropriate clean-up techniques will be employed. Oil absorbers and grab packs will be available at clearly identified locations throughout the working width and the workforce will be instructed in their use during induction.

No re-fuelling or fuel storage will occur within 20m from a watercourse. All spillages will be reported and recorded as part of construction procedures.

All plant will be inspected for fuel and oil leaks before being accepted for delivery onto the working width. Thereafter, regular maintenance inspections will be carried out to minimise the risk of ground contamination from leaking machinery.

Prior to the start of construction, the contractor will prepare a spill management and contingency plan as part of the detailed design phase.

18.2.3 Sewage

Portable toilets will be provided on the working width and at the site offices. They will be emptied regularly by a specialist contractor and disposed of in accordance with the appropriate regulations.

18.2.4 Dust and Mud

Inevitably a certain amount of dust will be produced during dry weather conditions but every effort will be made to keep this to a minimum. Where appropriate, this will be achieved by locally spraying the working width with water to dampen the dust down. Vehicle speeds will be restricted along the working width to minimise dust.

Precautions will be taken to minimise the deposit of mud and dust on the roads, but this cannot be avoided completely. Any such deposits will be removed regularly.

18.3 Air Emissions During Construction

Most machinery used on site will be powered by diesel engines. In order to control the emission of excessive exhaust fumes and smoke, the contractor will ensure that all items of plant and equipment are correctly adjusted and maintained.

18.4 Light Emissions During Construction

Portable lighting units will be used where necessary to ensure safe working and/or site security. They will be positioned in such a way as to minimise glare and noise from generators. The working width will be generally unlit.

18.5 Solid Wastes During Construction

Table 18.1 summarises the types of wastes that will be generated during construction of the pipeline and indicates the most appropriate method of disposal. The contractor will produce a Waste Management Plan.

Table 18.1: Potential Wastes Generated by the Construction of the Pipeline.

Activity	Waste Generation	Disposal Recommendation
Pipeline Construction Base		
Site preparation	Likely to be negligible	-
Operation	Office rubbish, paper, packaging, canteen refuse etc.	Recycle or send licensed waste disposal site.
	Rubbish from yard and site.	Collect in covered skips or tipper trucks and send to a licensed waste disposal site.
	Scrap metal.	Sell as scrap.
	Sewage.	Cesspit emptied regularly.

Activity	Waste Generation	Disposal Recommendation
Site reinstatement	Workshop waste, e.g. paints, oil etc.	Collect in covered skips or tipper trucks and send to a licensed waste disposal site.
	Concrete foundations etc.	Send to a licensed waste disposal site.
Pipeline Construction		
Working width preparation	Hedges, timber, brash, fence posts, wire etc.	In accordance with landowners requirements.
Pipe-stringing and bending	Pipe-bands and end caps.	Collect in covered skips or tipper trucks and send to licensed waste disposal site.
Welding, testing and coating	Spent welding rods, grinding wheels, visors, and shot-blast.	Collect in covered skips or tipper trucks and send to licensed waste disposal site.
Trenching, lowering and laying	Pumping discharge.	Pump into adjacent ditch using suitable filtration/ settlement techniques.
Backfilling and grading	Surplus spoil and rock.	Subject to landowner/ occupier's agreement, take to licensed waste disposal site.
Reinstatement	Temporary stone roads. Temporary fencing, gates, troughs etc.	Subject to agreement with the relevant County Council. Re-use elsewhere within landholding.
Construction through areas of peat	Pumping discharge.	Pump into adjacent ditch / field using suitable filtration/ settlement techniques.
Microtunnelling	Slurry/Spoil.	Passed through desander, slurry recycled and ultimately disposed of using road truck tankers to licensed waste disposal site.
Auger-boring and pipe jacking	Spoil and rock cuttings.	Disposed of using road truck tankers to licensed waste disposal site.
Drill and Grout	Spoil grout and flush water.	Spoil disposal to licensed waste disposal site. Water used for flushing disposed of in accordance with the relevant County Council requirements either by filtration to land or off-site, if contaminated.

Activity	Waste Generation	Disposal Recommendation
Mess huts, misc., etc.	Canteen refuse, safety equipment etc.	Collect in covered skips and send to licensed waste disposal site.
Mobile site toilets	Sewage.	Disposal by appointed waste management contractor.

18.6 Emissions During Testing And Commissioning

18.6.2 Noise

See **Section 17**.

18.6.3 Liquid Effluent and Spillages

During testing the pipeline will be filled with water. The abstraction sources will be discussed with the relevant County Council. The preferred location will be agreed during detailed design and the appropriate consents will be obtained to assure safe abstraction and disposal of the test water. The water will be tested for contaminants prior to and after testing.

18.6.4 Air Emissions

BGÉ and its contractors will ensure that plant and equipment used for testing and commissioning are correctly maintained to minimise the emission of exhaust fumes.

18.6.5 Light Emissions

None predicted.

18.6.6 Solid Wastes

Typical solid wastes from the pigging operation will be mill scale, weld splatter, rust and other such debris. Arrangements will be made at the test locations to contain and collect this waste for subsequent disposal to an appropriately licensed facility.

18.7 Emissions During Operation

18.7.2 Noise

See **Section 17**.

18.7.3 Liquid Effluent and Spillages

None predicted.

18.7.4 Air Emissions

The pipeline operates as a completely closed system; in normal operation there will be no releases of gas to the atmosphere.

In the unlikely event of a major release of natural gas from the pipeline, the concentration would be high in the immediate vicinity of the leak. The gas will be dispersed into the atmosphere by diffusion and wind action, and should pose no major threat to the environment, except for a

localised cooling effect. The most immediate risk would be that of an explosion or fire should the natural gas ignite.

18.7.5 Light Emissions

None predicted.

18.7.6 Solid Wastes

None predicted.

18.8 Impact Assessment

The pipeline contractor shall be required to make every effort to minimise emissions arising from the construction of the pipeline. Appropriate working methods to dispose of liquid and solid waste will be adopted. Regular maintenance of machinery will minimise air emissions from plant and equipment. Night-time working will be restricted except to ensure safe working conditions.

Once commissioned the presence and use of the pipeline will have almost zero associated emissions.

19 SOCIO-ECONOMIC IMPACTS

19.1 General

This section assesses the socio-economic environment in the area around the pipeline, and considers the potential impact of the construction and operation of the proposed pipeline on it.

19.2 Strategic Population Context

19.2.1 Current Population

Table 19.1 outlines the population of Counties Mayo and Galway between 1986 and 1996 and shows that both Counties have experienced population growth in the most recent intercensal period.

The 0.7% growth in County Mayo was however less than the national average of 2.4%. The growth in Galway, which was considerably stronger, was accounted for in the most part by the growth of Galway City (1996: 57,241 -+ 12.6%).

Table 19.1: Populations Context

	1986	1996	Absolute Change 1986 -1996	% Change 1986 -1996
Mayo	110,713	111,524	+811	+0.7%
Galway	180,364	188,854	+8490	+4.7%
State	3,540,643	3,626,087	+85444	+2.4%

Source: Census of Population 1996

The population density of both Counties in 1996 in relatively low (Mayo 20 persons/sq. km and Galway 31 persons/sq. km) and is below the national average (State 52 persons/sq. km).

19.2.2 Historical Population Context

Generally, the west of Ireland is characterised as a disadvantaged rural area with a weak urban base and poor infrastructure relative to the rest of the country. The area has suffered from continual decline stretching aback to the early 1800s.

The 1986-1996 period was the first period of growth in County Mayo since the beginning of the census records and halted a decline that has seen the population of the County fall from almost 390,000 in 1841 and from almost 200,000 in 1901.

County Galway has also experienced a dramatic decline in population from over 440,000 in 1841 to 192,000 in 901. The cycle of decline in County Galway, however, was arrested at an earlier stage and the county has experienced growth since the 1960s.

19.2.3 Rural Population

Despite the increasing population in recent times, however, most of the rural areas, particularly in Mayo, are continuing to decline with the urban centres accounting for recent population growth.

19.2.4 Urban Population

Galway City and its immediate hinterland form the largest urban concentration in the region. The towns close to the pipeline are Ballina, Castlebar, Westport, Claremorris, Ballinrobe and Tuam. The degree of urbanisation in each county can be seen in **Table 19.2** below.

Table 19.2: Urbanisation in Counties Mayo and Galway - Population in Cities/Towns of 1,500 or more persons

	1991	1996	Actual Change	Percentage Change
Mayo				
Ballina	8,190	8,762	572	6.5
Castlebar	7,643	8,532	889	10.4
Westport	3,456	4,520	1,064	23.5
Claremorris	1,992	1,914	-78	-4.1
Swinford	1,197	1,386	189	13.6
Ballinrobe	1,270	1,309	39	3
Ballyhaunis	1,338	1,287	-51	-4
Crossmolina	1,250	1,103	-147	-13.3
Belmullet	1,033	954	-79	-8.3
Foxford	1,033	944	-89	-9.4
Kiltimagh	982	917	-65	-7.1
Killala	674	657	-17	-2.6
Charlestown-Bellaghy	676	597	-79	-13.2
Total Mayo	**30,734**	**32,882**	**2,148**	**6.5**
Galway				
Galway City	47,104	57,363	10,259	17.9
Ballinasloe	6,140	5,654	-486	-8.6
Tuam	6,039	6,627	-412	-7.3
Loughrea	6,140	3,335	-25	-0.7
Athenry	1,642	1,614	-28	-1.7
Oranmore	1,064	1,410	346	24.5
Gort	1,021	1,182	161	13.6
Portumna	1,062	984	-78	-7.9
Clifden	896	920	24	2.6
Oughterard	682	751	69	9.2
Moycullen	366	601	235	39.1
Headford	675	574	-101	-17.6
Mount Bellew	519	547	28	5.1
Ballygar	472	546	74	13.6
Total Galway	**71,042**	**81,108**	**10,066**	**12.4**

While a number of the larger urban centres have experienced growth in the ten year period of 1986-1996, the population of most of the small to medium towns in both Counties Mayo and Galway has actually declined.

19.3 Employment Context

The level and growth in employment in the 'Western Counties' (i.e. those west of the River Shannon) is shown in **Table 19.3** and gives a context within which to view the employment performance of Counties Mayo and Galway. The figures shown that, while the region has experienced employment growth, the level of growth in Counties Mayo, Roscommon and Leitrim, in particular, is considerably below the national average. Galway has performed quite well and this can be accounted for to a large extent by the growth of Galway City as a regional centre.

Table 19.3: Employment Growth in the 'West' 1991-1996 (Persons aged 15 and over at Work)

County/Region	1991	1996	% Change
Mayo	**33,664**	**36,583**	**8.7**
Galway	**58,816**	**67,497**	**14.8**
Donegal	35,134	39,811	13.3
Sligo	17,992	20,204	12.3
Leitrim	8,012	8,518	6.3
Roscommon	17,493	18,559	6.1
Clare	30,735	34,572	12.5
Total 'West'	201,846	225,744	11.8
Ireland	1,149,080	1,307,236	13.8
Leinster	620,666	715,137	15.2

Source: Indecon International (1999) and CSO

Poor employment growth is a feature of lagging economic development generally in the West and there is a correlation between this measure and the poor state of the region's infrastructure, low labour force participation rates and higher rates of outward migration.

19.4 Economic Performance

The most common measure for gauging differences in the level of economic development across a Country or Region is Gross Value Added (GVA). GVA is a measure of output per capita for an area, equivalent to Gross Domestic Product (GDP) at market prices.

Table 19.4 below shows that per capita output for the 'west' amounted to only 73% of the national average. County Mayo as well as Donegal, Leitrim and Roscommon are particularly weak in this regard.

Table 19.4: Indicative Estimates for GVA per Capita (CSO)

County/Region	Total GVA per Capita £	Index State = 100	Index EU = 100
Mayo	**6,800**	**67.3**	**61.9**
Galway	**8,100**	**80.2**	**73.7**
Donegal	6,100	60.4	55.5
Sligo	7,700	76.2	70.1
Leitrim	5,200	51.5	47.3
Roscommon	5,600	54.4	50.1
Clare	9,600	95.0	87.4
Total 'West'	7,348	72.7	66.9
Ireland	10,106	100.0	100.0

Source: Indecon International (1999) and CSO

19.5 Social and Economic Impacts of Proposed Pipeline

The construction of the proposed pipeline and fibre optic links will help to contribute to the regional development of the Western Region and County Mayo, in particular, by acting as a catalyst to economic development and encouraging investment in industry and commerce and promoting migration into the region. The pipeline will therefore contribute to reducing the outflow of population from rural areas while also consolidating and strengthening the expanding urban areas. As such it is anticipated that there will be both social and economical benefits to the urban centres of Ballina, Castlebar, Westport, Claremorris, Ballinrobe, Tuam, Athenry and Galway City

and suburbs and associated spin-off benefits for their rural hinterland areas.

While Galway City will to be connected to the national gas network following completion of the pipeline to the West it is less likely that a connection to County Mayo would materialise in the absence of the current proposal.

An estimated 500 people will be employed during construction and reinstatement, many of whom will be specialists brought in for the period.

There will be short-term benefit to local communities in terms of increased income in shops, pubs, cafes/restaurants and accommodation as a result of pipeline construction activities. The additional business resulting from the pipeline construction will be particularly beneficial during the off-peak season. Local direct and indirect employment benefits will be created through the hiring of local workers and the use of local sub-contractors.

In terms of the likely social impacts, people living near the proposed route will experience some impacts during the construction and reinstatement phases. Every effort will be made to keep noise and other activity to an absolute minimum; however, some nuisance effects are unavoidable.

Pipeline construction is a transient process and therefore, any impacts on the social and economic structure of the local community are themselves transient in nature.

Road users may be affected by the presence of construction traffic or by delays at road crossings, especially on National Secondary and Regional roads. **Section 16** deals with Traffic issues and includes measures to reduce the negative effects associated with construction traffic. All roads to be crossed will be kept open as much as possible during construction and appropriate signs erected.

As much of the pipeline is through agricultural land, there will be significant impacts on the operation of farms along the route. These impacts can be minimised however through consultation between BGÉ's liaison team and the affected landowners/occupiers.

Increased noise levels and delays at road crossings during the main construction period may affect tourists. However, the pipeline has been routed so as to avoid any significant tourist attractions and major tourist routes.

Once the main workforce has left the area, the social situation will revert to its previous state and there will be no long-term effects.

19.6 Summary

At a macro level, the proposed gas pipeline and fibre optic cables will bring considerable socio-economical benefits to the Counties of Mayo and Galway and the West of Ireland in general. Through increasing the attractiveness of towns and cities in the area of the inward investment, the pipeline will help to consolidate and strengthen existing urban areas. Increased economic activity and productivity will also help increase the general affluence of the 'West' and contribute to regional development.

The pipeline proposal will also provide additional more localised benefits for the duration of the construction period. These include increased trade in local shops and service industries and temporary accommodation providers, as well as indirect employment.

Construction and reinstatement impacts on local populations will not be significant. This is due to the transient nature of the construction process and the routing of the development to avoid built-up areas and attractions.

The overall socio-economic impact of the proposed development will be positive, and no significant negative impacts are predicted.

20 USE OF NATURAL RESOURCES

20.1 Introduction

The proposed pipeline will use a number of natural resources during its construction. The principal resources are detailed below and include those used in pipeline manufacture and distribution. Allied to this issue is the disposal of surplus resources as well as other wastes, such as excavated soil. These issues are explored in **Section 20.3**.

20.2 Use Of Natural Resources

20.2.1 Pipeline Manufacture

IS 328 'Code of Practice for Design and Installation of Gas Transmission Pipelines' 1989, the national standard for high-pressure gas pipelines, stipulates the use of steel pipelines for transporting gas. This is the most suitable material to withstand the long-term stresses of high-pressure gas transport and to resist corrosion and external damage.

Information on manufacture has been supplied by British Steel based upon Life Cycle Analysis of ten worldwide sites undertaken by the International Iron and Steel Institute. The manufacture of pipe sections involves considerable use of resources, both in the form of energy and in the materials used. Pipe sections are formed from steel plate which is manufactured principally from iron ore, coal, dolomite and ferrous scraps with natural gas and oil used as fuels and water required for process purposes. **Table 20.1** gives indicative values for the amounts of the major resources that are used in the production of a kilogram of steel plate, as well as the approximate energy use. These figures include inputs relating to extraction of resources, electricity generation and transport costs. However, it should be noted that additional amounts of energy are required to form the plate into pipe sections and for transport of the plate to the plant where this final process is undertaken, and from there to site.

Table 20.1: Indicative Resource Inputs for the Production of 1 kg of Steel Plate

Input (Raw Material, Energy etc.)	Average (per 1 kg)
Coal	0.645 kg
Dolomite	0.0282 kg
Iron ore	1.48 kg
Natural gas	0.0395 kg
Oil	0.0394 kg
Ferrous scraps	0.061 kg
Water	10.8 litres
Total primary energy (includes inputs above)	26.2 MJ

As steel pipelines must be used for gas transportation, the manufacturing impacts above will be unavoidable, and will be broadly the same for any pipeline of a similar length.

The amount of pipe used depends on the pipeline route but this has to be balanced against the need to avoid significant environmental, engineering and health and safety impacts. The constraints that applied during the routing process, such as avoidance of archaeological sites and ecologically sensitive areas were generally weighted as more important than the potential environmental impact of using more linepipe.

It should perhaps be noted that the total amount of energy used in the manufacture and construction of the pipeline is a minute fraction of that which will be conveyed through the pipeline during its operational life.

20.2.2 Pipeline Construction

20.2.2.1 Soil

A large amount of topsoil and subsoil will be excavated during pipeline construction. Some may be used on the working width, for example to lessen steep slopes at the lee of floodbanks to enable vehicle/machinery access. Various measures are in place to ensure that topsoil and subsoil are not mixed, and that topsoil is not imported or exported from the site (**Section 6.0**).

20.2.2.2 Sand

Where the pipeline is to run through an area of rock, it is usually bedded in a layer of sand to protect its coating from possible damage (which could lead to enhanced rates of corrosion). The construction contractor(s) will seek to minimise the use of imported sand and order only as much as is required.

To minimise pollution and distribution costs, use will be made wherever possible of local suppliers of sand.

20.2.2.3 Timber and Temporary Gates

Timber is used for temporary fencing and bog mats are used to minimise compaction in areas of soft ground or over tree roots. Temporary fences and gates will be offered to landowners for re-use on completion of construction.

20.2.2.4 Stone and Hard Core

The need for stone and hard core to surface the temporary construction site and any access roads required to the working width will be minimised by using existing metalled roads and hard surfaced areas as far as possible. Any stone and hard core used will be offered to landowners or to other construction sites in the area for re-use, subject to the provisions of relevant planning and waste legislation.

20.2.2.5 Energy Use

Energy use in pipeline construction falls into three categories:

- fuel for vehicles/ machinery used on the site;
- transport of materials to the site;
- electricity used for lighting, site offices etc;

Once the pipeline is laid, energy use will be minimal.

As detailed in **Section 6**, a variety of items of machinery are needed during the construction phase to ensure that the pipeline is laid safely and efficiently. However, only when detailed design work is complete will precise requirements be known. All plant will be serviced regularly to minimise emissions and inspected before being allowed on site.

Pipe manufacture is a highly specialised task and there are very few manufacturers world-wide. They are therefore geographically remote the construction site of this pipeline, and so it is difficult to reduce the energy used in transport of the pipe. However, marine and rail transport will be used as far as possible to bring the sections of pipe to the site.

Use will be made as far as possible of local suppliers of other materials such as sand and fencing to minimise transport requirements.

Electricity usage for lighting and heating of construction site offices and working areas is expected to be minimal, as most work will be carried out in daylight hours.

20.2.2.6 Water Use

Water is used in small quantities for cleaning and toilet facilities and vehicle washing etc. The major use of water is in hydrotesting the pipeline, (**Section 6**) and this is usually returned to its source.

20.2.3 Pipeline Operation

The use of natural resources during pipeline operation will be largely limited to operations at any associated AGIs. At these sites, natural gas will be used to power valves. These are essential to the safe operation of the system. Other power sources such as electricity, nitrogen and compressed air are not used because they are more likely to suffer supply interruptions.

The Operator will ensure that the requirement for venting gas during maintenance is kept to the absolute minimum.

Transport is limited to maintenance visits as the pipeline and the AGIs are remotely operated.

20.3 Waste

20.3.1 Pipeline Manufacture

Pipeline manufacture produces various air and waterborne wastes, including metals such as zinc, nickel and lead and carbon dioxide and monoxide, at the mineral extraction site and the mill. Once again, since steel pipelines must be used to transport gas, these wastes are unavoidable. As pipe has been sourced to date from within the EU, similar pollution controls have applied to all mills involved.

20.3.2 Pipeline Construction

Pipeline construction produces a number of solid waste types. **Section 18** summarises the types of wastes generated and the steps taken to maximise re-use of construction materials.

In addition, hedgerow sections removed are chipped for use as mulch when the hedges are replanted. Paper and card are recycled if possible, although this depends on the local market. Scrap metal is separated and sold for scrap, if not re-usable.

Engine oil is recycled via the established schemes.

20.3.3 Pipeline Operation

There is no practical method of avoiding or reducing the small amount of natural gas vented to atmosphere when the pipeline is pigged and the very small quantity of solid waste produced by this operation (**Section 18**).

20.4 Forests

The pipeline route goes through a number of commercial forestry plantations, particularly in the northern section. To facilitate pipeline construction the trees will be felled earlier than they

would otherwise. This will increase the vulnerability of the adjoining trees to wind throw. When the rest of the forest is felled and replanted, the pipeline wayleave cannot be replanted. Impacts And Mitigation

20.5 Impacts and Mitigation

20.5.1 Impacts on Natural Resources

- The use of resources and energy in steel manufacture is an indirect, significant but unavoidable impact. However, BGÉ will seek to ensure that wastage is minimised;
- the requirement for stone and hardcore will be minimised as far as possible by attention to the siting of temporary construction sites and by maximising the use of existing roads and tracks to gain access to the pipeline, a requirement which is considered carefully during routing of the pipeline;
- the use of other raw materials will be minimised as far as possible;
- energy use in the form of fuel and oil for distribution vehicles and construction plant will be minimised by proper maintenance of equipment and the use of local suppliers where possible. However, pipe and specialist equipment will have to be transported over longer distances.

20.5.2 Waste

- The production of waste during pipeline steel manufacture is significant, but such pipe is likely to be sourced within the EU where similar standards of pollution control apply;
- all opportunities to recycle or re-use materials will be exploited as described above.

20.5.3 Forests

The impact of the pipeline construction on the commercial forestry through which it passes is to:

- cut the trees along the working width earlier,
- increase the vulnerability of adjoining trees to wind throw,
- then reduce the area available for replanting.

The main mitigation measure is to minimise the length of pipeline routed through forestry. Other measures include felling the minimum number of trees and avoiding damage to the remaining trees.

21 Other Impact Headings and Interactions

21.1 Introduction

The EIA Regulations list the environmental issues which should be assessed in an EIS, (see Section 2). The regulations also require a description of the likely significant environmental interactions between these environmental effects. This section addresses the environmental aspects that are not specifically addressed in the individual sections of the EIS and also identifies the main interactions between different effects.

Only topics, which could logically be linked to the project, have been examined in detail. Accordingly, where a topic is not mentioned, the authors have concluded that no potential for impact exists.

21.2 Other Impact Headings

21.2.1 Human Beings

Human Beings are addressed throughout the EIS, but not specifically in one section. The economic and social considerations are detailed in Section 19, Land Use issues are addressed in Section 5 and 12, and Health and Safety issues have been considered in Section 6 and 21. The effects of the development on human beings with regard to Landscape and Visual (Section 15), Traffic (Section 16), Noise (Section 17) and Environmental Emissions (Section 18) are also addressed.

21.2.2 Residential Amenity

The impact of the proposed development on the amenity of the areas close to the pipeline route has been addressed in a number of sections of this EIS, particularly Sections 15, 16 and 17, Landscape and Visual, Traffic and Noise.

The development will create significant employment during construction phase (Section 19). These potential employment opportunities are seen as a significant beneficial effect of the scheme.

21.3 Interaction Of Effects

There are some quite significant interactions of effects in different environmental media, which will result from the construction of the pipeline.

For example, construction methodology for the route in general will determine noise and vibration emissions and traffic generation, utilisation of stone for temporary roads and of sand for pipe bedding. The construction methodology adopted in the blanket bog and karst areas will determine the interaction between soils and geology, ground water movement and flora and fauna impacts

and recovery over the short and long term. The method of gaining access to the soft ground areas will determine the amount of stone required for temporary roads, which will affect traffic generation on these roads and consequent noise. Road and river crossing methodology will affect the generation and impact of traffic, surface and ground water movement and noise emissions. The construction methods chosen in forest areas will determine the visual and landscape impact in these areas and also affect generation of traffic and waste.

The interaction of effects in different environmental media has been addressed in the most relevant sections.

22 SUMMARY OF POTENTIAL ENVIRONMENTAL EFFECTS

22.1 Introduction

This Section summarises the potential environmental effects associated with the proposed Mayo to Galway pipeline. It lists the general potential consequences associated with the project, such as:

- physical presence of the pipeline and its associated facilities;
- atmospheric emissions;
- discharges to water;
- solid waste;
- accidental events.

These consequences may have one or more of the following interactions with the environment:

- disturbance of habitat (e.g. disturbance to breeding birds, otters and badgers, blanket bogs, and agricultural farmland) as well as interaction with farmers and the local community as a result of its physical presence;
- impact on air quality from atmospheric emissions;
- impact on water quality;
- land use for waste disposal;
- impact on the environment from accidental releases;
- the requirement for use of natural resources.

The planned activities have the potential to affect the receiving environment in the vicinity of the pipeline from the Bellanaboy Bridge Terminal, County Mayo to its termination point at Craughwell in County Galway. Any upset conditions and accidental events could affect a wider geographic area.

This Section presents the evaluation of the relative significance of the environmental effects with particular reference to the sensitivities of the key environmental components.

For each activity the associated source and pathway of effect has been identified. As far as practical the sources of effect have been quantified. The mitigation or prevention measures incorporated into the project design or operating strategy have then been identified and the relative significance of the residual effects has been evaluated.

In practice the assessment of residual environmental effects is an iterative process involving the review and modification, as required, of the project through the full design process.

22.2 Evaluation of Relative Ecological Significance

In order to place the potential effects from the project into context a set of criteria for assessing the ecological significance of effects or hazards have been established. **Table 21.1** provides a summary of criteria applied.

This evaluation considers the vulnerability, temporal sensitivity and recoverability of the receiving environment and the geographical extent of the effect.

Table 21.1: Criteria for Assessing Significance of Effect or Hazard

Significance Category	Severity of Impact (after implementation of appropriate mitigation measures/actions)
Significant	Substantial adverse changes in an ecosystem. Changes are well outside the range of natural variation and unassisted recovery could be protracted.
Moderate	Moderate adverse changes in an ecosystem. Changes may exceed the range of natural variation. Potential for recovery within several years without intervention is good; however, it is recognised that a low level of impact may remain.
Minor	Minor adverse changes in an ecosystem. Changes might be noticeable, but fall within the range of normal variation. Effects are short-lived, with unassisted recovery occurring in the near term. However, it is recognised that a low level of impact may remain.
Negligible	Changes in an ecosystem that are unlikely to be noticeable (i.e. well within the scope of natural variation).
Beneficial	Changes resulting in positive, desirable, or beneficial effects on an ecosystem.
Notes: 1. The definitions are intended to categorise residual effects. Residual effects are impacts expected following the implementation of mitigation measures or controls. An effect that would have been 'Significant' without action by the Project may be assessed to be 'Moderate', 'Minor', or 'Negligible' after effective mitigation or control measures are in place. 2. The term 'ecosystem' in the above table can be taken to mean the physical environment and the biological communities that live within that environment. Typically impacts to populations and communities are considered rather than impacts to individuals. However, in certain cases involving threatened or endangered species, impacts to individuals may be of greater concern.	

A screening assessment of the sources of impacts associated with normal operations is presented in **Table 21.2**. This provides a summary of the control and mitigation measures incorporated into the execution, the nature of the residual effect and the relative significance categories.

Table 21.3 presents a matrix for risk assessment used in determining the likely risk of the upset condition and accidental events that could occur.

A screening assessment for upset conditions and accidental events is presented below:

22.3 Screening Assessment of the Sources of Impacts and the Residual Effects

Table 21.2 presents a summary of the findings of the screening assessment for the sources of potential impact for each of the component activities and operations for:

- use of natural resources;
- transport of goods and materials;
- temporary loss of agricultural land;
- construction noise and lighting disturbances;
- visual impact;

- noise and vibration;
- flora and fauna;
- archaeology;
- generation of wastes;
- use of local services;
- presence of the pipeline;
- hydrotest and commissioning of the pipeline;
- decommissioning.

Table 21.2: Assessment of Potential Effects and Proposed Mitigation Measures

PIPELINE - CONSTRUCTION

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
Use of Natural Resources -		
• Including steel, fuel, gas, and sand.	**Design:** • Selection of pipeline considered to be the best available technique for transport of gas compared to use of natural resources or other forms of transport (LPG shipping, other pipeline routes). **Construction:** • Import and backfill of sand to protect pipeline in trench to be obtained from a local licensed source and quantities restricted to minimum required. • Efficient planning of vehicle and vessel movements will minimise fuel usage.	**MINOR** • Use of steel for pipeline. • Import of sand bedding.

Generation of Waste		
• Generation of waste and use of raw materials including, fuel, paper, foul and grey water, food, slops, office waste, silty water, coating, shot blast, wrapping, fencing, pads, pipe caps, wooden skids, pipeline test and cleaning water. • Transportation of wastes will generate emissions comprising greenhouse gases, VOCs. • Use of finite landfill space and generation of CH_4 as waste breaks down in landfill.	**Design:** • Agreement for re-use of excavated material to be agreed with Mayo and Galway County Councils. **Construction:** • Contractor to develop a Waste Management Plan in line with the Waste Management Duty of Care-code of practice and waste minimisation and recycling in Construction. The plan will determine the source, methods for recording quantities, quantities, on site storage and disposal method for all wastes. Consideration to be given to the segregation of waste, re use and recycling. Audits to be carried to ensure compliance with plan. • Daily inspections of working areas to ensure vehicles are not leaking and there are no offsite effects of litter or spillages. • Waste disposal contractors to be audited to ensure they have the correct licences to carry and dispose of waste. • Procedures to be rationalised between the contractors working on adjacent sites to minimise transport effects. Plan to be audited prior to construction and twice during construction period. • All site personnel to receive training and tool box talks on the Waste Management Plan.	**MODERATE** • Short term, temporary increase of greenhouse gas emissions from landfill.

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
Hydrotest and Commissioning of the Pipeline:		
• Abstraction of hydrotest water. • Noise from pumps over several days. • Discharge of hydrotest water into aquatic environment.	• Noise disruption will be localised and short term. • Discharge of hydrotest water will be controlled through discharge consents.	**NEGLIGIBLE / MINOR** • Negligible effect on aquatic life. • Minor localised impact.
Pipeline Construction Noise		
• Requirement for ripping and rock excavation for pipeline construction. • 24-hour working will be required for short periods during cleaning, water filling, and pressure testing of the pipeline.	**Design** • Location of pipeline away from houses. • Wildlife temporal sensitivities identified in **Section 9.0**. **Construction** • Contractor to provide a Method Statement for noise control for acceptance by BGÉ and Mayo and Galway County Councils. To include provisions for out of hours working, notification of residents, timing of blasting, location of equipment and acoustic screening bunds. • All generators/equipment to be maintained in good working order with effective silencers.	**MINOR** • Temporary, short term effects. • No long term effects.

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
Visual Impact of the Pipeline		
• Temporary visual impact (July 2001-Sept July 2002) from fenced working widths, haul roads, site compounds removal of hedgerows and walls, and clearance of forestry. • Long-term – AGIs.	**Design** • Location of compounds, pipeline route and haul roads to avoided rock outcrops where practicable. • Landfall location selected to avoid excavation within area of exposed geology. • Woodland areas are generally avoided. **Construction** • Contractor to make provision for the collection of litter and to maintain site in tidy condition. • Field marker posts to be installed at changes of direction, field boundaries and road/rail crossings. Aerial markers to be placed within selected field boundaries. • All walls to be re-constructed in original stone in Vernacular style. • Hedges replanted using indigenous species. • Method statement to be provided for the reinstatement of blanket bog, walls and hedges to ensure no long term visual effect.	MODERATE • Temporary visual effects of site facilities and working widths during twelve month construction period. • AGIs will be a permanent feature of the landscape. • Forestry traversed by the pipeline will not be replanted over the route.

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
Transport of Goods and Materials to Site		
• Increased traffic caused by delivery of pipe, plant, equipment, fencing, hardcore, sand padding and supplies to construction areas and along the proposed route and removal temporary facilities on completion. • Conflicts with local road users, mud on road. • Disturbance from noise of traffic movements to area via the haul roads.	**Design** • Traffic route to be agreed with Mayo and Galway County Councils. **Construction** • Speed to be restricted where required. Passing places to be improved and hedgerows to be kept trimmed for duration of works. • Temporary improvements to be made to lay bys on the existing roads. • Maintain engines to ensure optimal operation and use 'greener' fuels where practicable. • Efficient planning of vehicle and vessel movements will minimise fuel usage and generation of global warming gases. • Contractor to provide a Traffic Management Plan to identify access routes, signage, numbers and types of loads, one way systems and haul roads provisions for wheel cleaning, cleaning of mud on roads and control of dust from vehicle movements. Plan to be agreed with Mayo and Galway County Councils before works commence. • All hauliers to comply with contractors Traffic Management Plan. Regular checks to be made to ensure hauliers follow the designated routes and that their vehicles are roadworthy; exhausts are in good order • Procedures to be rationalised between the contractors working on adjacent sites to minimise transport effects.	**MODERATE** • Temporary short-term effects of construction traffic over 24 month construction period.

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
Use of Local Services		
• Construction period.	• Increase in use of Bed and Breakfast, self catering accommodation and local services.	**BENEFICIAL** • Contractor to employ local people wherever possible with the appropriate skills and use local suppliers. • Beneficial increase in trade for local suppliers and services over the construction period.
Disturbance to Local Residents		
• Disturbance from construction works.	• Contractor to notify and erect signage to inform recreational users and visitors of construction works and access or other restrictions.	**MINOR** • Short term temporary effects during the construction period.
Flora and Fauna - Disturbance / Loss of Habitat		
• Crosses areas of semi natural habitats including peat bog, base rich fen woodland and limestone pavement, including designated areas. • Protected bird species, badgers, otters and bats all known to be present along the route.	• Routing pipeline to avoid areas of semi-natural habitat. • Appropriate construction techniques. • Appropriate re-instatement techniques. • Timing works to minimise disturbance. • Additional field surveys.	**MODERATE** • Impact can be minimised through suitable construction techniques. All such techniques to be agreed with Dúchas. • Impact on fauna limited to working width during construction period. No long term impacts envisaged.

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
Temporary Loss of Agricultural Land		
• Accommodation of laydown areas and working width. • Crossing of farm water supply lines and water pipes. • Interference with normal farming operations. • Permanent easement over pipeline with rights of access and development restrictions.	**Design** • Optimal size and location selected. Location of haul roads and working width in agreement with landowner. • Landowner compensated for temporary loss of land and permanent easement rights. **Construction** • Preconstruction survey to be undertaken to record the existing condition of the land, road crossing, hedges, walls, drainage and water supply lines. • Method statement to be provided for pipeline construction for acceptance by the Contractor. To include measures to be taken to prevent transmission of agricultural diseases, stock control, access, weed control, soil handling, drainage reinstatement, wall and hedgerow reinstatement and temporary water supplies. • Post construction survey to be carried out with landowner to ensure satisfactory reinstatement. Defects to be made good.	**MINOR** • Temporary short term effects over construction period. Agricultural land reinstated to original condition. • No long term effects.
Movement of Water along Trench		
• Changes to the drainage and associated changes to vegetation.	• Use of clay plugs packed around the pipe on slopes where this is considered to be a likely occurrence.	**NEGLIGIBLE** • No long term effects.
Archaeology		
• The proposed route will affect no known archaeological monuments listed on SMR. • Potential for unknown archaeology in area is high.	• Archaeological probing (agreed with Dúchas) in sensitive areas.	**MINOR / MODERATE** • No impact on known archaeological sites. • Minor, possibly moderate impacts on unknown sites.

PIPELINE - OPERATION

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
Visual Impact of the Pipeline		
• Long term visual impact from aerial markers loss of rocky outcrops and potential for visual effect of trench excavation in exposed rock at landfall.	• Location of aerial markers to be agreed with the Operator. • Method statement to be provided for the reinstatement of blanket bog, walls and hedges to ensure no long term visual effect.	**MINOR** • Short term effect of hedgerow removal, topsoil stripping in working width, haul road and landfall reinstatement. • Long term (minor) effect of aerial markers.
Presence of Pipeline		
• Restriction of development within easement.	• Pipeline buried and land fully reinstated, normal agricultural operations resume over the line. Presence of pipeline restricts certain activities involving excavation and construction within the narrow easement.	**NEGLIGIBLE** • Short term, negligible effects of inspection.
Decommissioning		
A range of effects depending on the decommissioning solution adopted, from the low level long term effects of the physical presence of the pipe if left in-situ to more significant short term effects from the remedial work or trenching.	• Full comparative and environmental assessment to be carried out prior to de-commissioning options.	**MODERATE** • Dependent on de-commissioning options selected.

22.4 Non routine Events

22.4.1 The Environmental Risk Assessment Process

The assessment of risks for abnormal operations and accidental events, collectively called non-routine events, utilises the probability, consequence and risk categories presented in **Table 22.3** below.

Potential hazard scenarios are identified and the likelihood of their occurrence and the subsequent consequences are assessed in terms of impacts on the environment.

Table 22.3: Probability, response requirement / ecological consequence and risk categories used for assessment of the non-routine events

Probability Category / Response Requirement /Ecological Consequence	A Possibility of repeated incidents	B Possibility of isolated incidents	C Possibility of occurring sometime	D Not likely to occur
I (extended duration / full scale response) SEVERE	Higher Risk	Higher Risk	Higher Risk	Medium Risk
II (Serious / significant resource commitment) MAJOR	Higher Risk	Higher Risk	Medium Risk	Medium Risk
III (Moderate / limited response of short duration) MODERATE	Higher Risk	Medium Risk	Medium Risk	Low Risk
IV (Minor / little or no response needed) MINOR / NEGLIGIBLE	Medium Risk	Low Risk	Low Risk	Low Risk

22.4.2 Assessment of Non-Routine Events

Non-routine events include those associated with upset conditions and those associated with emergency / accidental events.

The key scenarios identified as likely to lead to emergency / accidental events are summarised in **Table 21.4** below.

For the purpose of this environmental risk assessment these risk scenarios have been categorised in accordance with the key hazards / sources of effects that would result as a consequence of these hazard scenarios.

Table 21.4: The key hazard scenarios for potential emergency / accidental events

Chemical, waste or fuel spill:
• spillage resulting from rupture of storage tank and failure of the containment system during construction; and
Release of flammable gas
• Release of gas from the pipeline

The summary of the findings of the environmental risk assessment of the sources of effect associated with the key hazard scenarios identified in **Table 21.3** is presented in **Table 21.5** below.

Activities that have been included in this assessment include:

- potential for release of gas;
- use and storage of waste and hazardous material;
- vehicle refuelling;
- drilling operations;
- hazards to wildlife.

A quantitative risk assessment (QRA) of the likely hazards posed by the pipeline has also been carried out.

Table 21.5: Environmental risk assessment of the sources of effect associated with the key hazard scenarios identified for non-routine events for the pipeline

PIPELINE - CONSTRUCTION

Source / Scale of Effect	Control and Mitigation	Environmental Consequence and Overall Risk Category
Pipeline Installation Activities		
• Loss of Equipment.	• All lost equipment should be recovered where possible. • Nature of equipment means low or negligible impact on environment.	• Ecological Consequence Category: **IV** (**MINOR**). • Probability Category: **B**. • Overall Risk Category: **MEDIUM**.
• Loss of stored chemicals (paints, solvents, oils, greases etc) and fuel spills.	• The landfall work sites will be subject to a strict EMP that will be closely monitored to ensure conformance. • All storage areas will be lined and bunded. • All hazards will be stored on spill pallets. • A supply of absorbent materials will be kept near areas where there is the potential for leaks or spillage. • Drip trays positioned under engines to collect any leaks. • Procedures to minimise operational leaks. • Storage areas will be cleared and re-instated to their original condition and appearance immediately upon completion of the construction work at the landfall site.	• Ecological Consequence Category: **IV** (**NEGLIGIBLE**) to **II** (**MAJOR**). • Probability Category: **A** (small spills and leaks) to **D** (large spills or chronic leaks) • Overall Risk Category: **MEDIUM**. • Potential to contaminate ground, ground water and surface waters with knock on effects to aquatic and terrestrial species.

Source / Scale of Effect	Control and Mitigation	Environmental Consequence and Overall Risk Category
Horizontal Directional Drilling if Used.		
• Spill associated with overfilling or rupture of or leak from storage areas. • Leaks from equipment. • Accidental escape of drilling mud through sub surface formations.	• All storage tanks are bunded. • Procedures for handling, storage and transfer of wastes and other materials. • A supply of absorbent materials will be kept near areas where there is the potential for leaks or spillage. • A wet vacuum will be used in mud handling areas to collect mud spillage. • Procedures for loading and unloading • Routine maintenance of equipment • Drip trays positioned under engines to collect any leaks. • Procedures to minimise operational leaks • Use of biodegradable drilling muds with no chemical additives. • HDD using minimal bit pressure.	• Ecological Consequence Category: **II** (**MAJOR**) • Probability Category: **A** (small spills and leaks) to **D** (large spills or chronic leaks) • Overall Risk Category: **MEDIUM** • Overall risk dependent on the nature of the material spilled and the size of the spill • Contamination of terrestrial and aquatic habitats leading to toxic effects from smothering.

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
Vehicle Refueling, Storage of Hazardous Substances		
• Vehicle refueling, storage of hazardous substances and the potential for spillages resulting in contamination of soil and ground water.	**Construction** • No refuelling will be undertaken within 30m of watercourses. • Pollution prevention plan in place with emergency crew on 24-hour standby. Contingency materials to be available on site appropriate to the likely incidents. Suitable arrangements are to be in place for the disposal of contaminated material. • Site personnel to be trained in use and handling of fuel and hazardous substances.	• Ecological Consequence Category: **IV** (**NEGLIGIBLE**) to **II** (**MAJOR**). • Probability Category: **A** (small spills and leaks) to **D** (large spills or chronic leaks). • Overall Risk Category: **MEDIUM**.
Hazards to Wildlife		
• Hazards to wildlife falling in to trench and becoming trapped in welded pipeline.	**Design** • Protected species avoided. **Construction** • Contractor to ensure pipe caps are used for welded sections of pipe. • Protected species runs to be identified and crossings to be provided when trench is open.	• Ecological Consequence Category: **IV** (**NEGLIGIBLE**). • Probability Category: **A** • Overall Risk Category: **MEDIUM**. • Medium likelihood of event occurring. • High likelihood of detecting and provisions made for handling situation. • Minor ecological effect.

PIPELINE - OPERATION

Source / Scale of Effect	Control and Mitigation	Environmental Consequence / Significance Level
An Escape of Gas		
• Potential for incident involving an escape of gas venting from the pipeline.	**Design** • Wall thickness and depth of burial designed to ensure optimal protection in line with current guidelines. **Construction** • Pipeline to be constructed in accordance with specification. **Operation** • Lodge pipeline as built plans with local planning authorities, Emergency Planning officer, and third party undertakers. • Major Accident Prevention Plan (MAPP) to be maintained and exercised. • Internal inspection tool to be used in accordance with best practice.	• Ecological Consequence Category: **III** (**MODERATE**). • Probability Category: **D**. • Overall Risk Category: **LOW**. • Potential for failure low (unlikely during lifetime of the project). • Onshore damage to wildlife habitats and birds likely to be negligible from gas venting.

Appendix 9.1: Method Statements For Flora And Fauna Impact Assessment On The Downstream (Onshore) Section.

A. GENERAL HABITATS, VEGETATION AND FLORISTIC COMPONENTS

Desk Study:

The habitats through which the proposed pipeline will be routed will be identified through the use of aerial video (Geofilm). Using the Geofilm aerial images it will be possible to divide the route up into discrete sections based on the dominant habitat types present. Habitat types will be classified according to a modified version of the system used during the re-survey of ASIs for the purpose of NHA designations. This methodology was selected in view of the fact that close reference will be made to the NHA file material for sites designated as Special Areas of Conservation (SACs) and proposed Natural Heritage Areas (pNHAs). This file material is held at National Parks and Wildlife - Dúchas, The Heritage Service in Dublin.

Field Survey:

Emphasis will be placed on sites of national importance (SACs - candidate and designated and/or proposed NHAs) through which the pipeline route passes, or where it passes in such close proximity that it may also have an environmental impact e.g. on the local hydrology. Key areas of the route will have been identified during the desk study from the preliminary appraisal of known designated conservation areas and other habitats using the Geofilm video. In addition to this, it is proposed that a number of core interest areas receive a field survey. Priority survey will be given to pNHA/SAC areas which are traversed by the pipeline routes, adjacent to or occur within 1km of the proposed routes. In addition it is proposed that other areas along the route which are suspected to contain Annex 1 habitats, such as raised bog, blanket bog and turlough, receive a field survey along the following lines:

- A basic description of the habitat present within a 50 metre corridor on either side of the route mid-point. Ground photographs of habitats and vegetation will be taken for descriptive purposes. The extent of these habitats along the route will be indicated by accompanying colour-coded maps.
- The dominant/characteristic plant species present within the habitat will be listed and the relative abundance of these species will be assessed. Due to time constraints this species list cannot be exhaustive, however it will be sufficiently detailed so that judgements regarding the ecological value of the area can be made.
- In addition to describing the dominant/characteristic plant species present additional information regarding the habitat will be noted including condition (e.g. whether the area is heavily grazed or cutaway) naturalness and conservation value.
- During the survey, particular attention will be paid to the possible occurrence of rare plant species. Much of the rare plant interest along the proposed routes will probably occur in the blanket bog landscape of north-west Mayo.

- In areas where the vegetation along the proposed route is found to be of high ecological interest, an alternative route will be suggested and a brief description of the vegetation along the alternative route will be given.

Reporting:

- Propose methods to minimise negative impacts of pipeline construction on ecologically sensitive areas and ensure that potential reinstatement of habitat is maximised.
- Identify deficiencies in the survey and outline work to be carried out at a later date and prior to pipeline construction.
- Produce a final report

Summary of Methodology - Habitats/Vegetation/Floristic Components

Desk Study:

- Using Geofilm - Identify the range of habitats along the proposed pipeline route.
- Consultation with Dúchas personnel and other relevant parties, e.g. County recorders, experts in particular habitats, to ensure that key sites have been covered and establish their concerns.
- Consultation with NHA file material
- Identify key sites of habitat/botanical interest (SAC, NHA, rare plants, etc.).
- Carry out a literature survey.

Field Survey:

- Assessment of the quality of the habitat for 50m either side of the proposed pipeline route.
- Description and species composition of potentially sensitive habitats.
- Evaluation of potential impact on habitat and suggest ways of ensuring minimal impact on area of scientific interest.

Reporting:

- Propose methods to minimise negative impacts of pipeline construction on ecologically sensitive areas and ensure that potential reinstatement of habitat is maximised.
- Identify deficiencies in the survey and outline work to be carried out at a later date and prior to pipeline construction.
- Produce a final report

B MAMMALS AND BIRDS SURVEY

Methodology:

The methodology employed in the mammal and bird survey components of the EIA will include a desktop study, a literature review, consultation with Dúchas - the heritage service, a field survey and report writing phases.

Desktop Study/Literature Review:

This will entail assessments of maps and route options for both routes, including reviewing the Geofilm. The literature review entails assessing published records/ studies on species and their habitats relevant to the routes. This includes consultation with such reports as the latest Irish Wetlands Bird Survey published in February 2000. Dúchas data on fauna of designated sites will be reviewed.

Consultation:

A consultation will be undertaken with Dúchas staff - both management and research branches - with a view to ascertaining the Heritage Service's perspectives and preferences. It is an aim of the consultation to seek agreement of Dúchas to the scope and remit of the survey as planned.

Field Survey:

Due to access and time limitations, the field survey will focus on key sites and species. Where possible, designated sites which may be affected by the pipeline routes will be examined. The survey will concentrate on the habitats on either side of the pipeline routes.

The mammal survey will consist of an assessment of habitat quality/suitability for species and a field survey for mammal signs (tracks, faeces, paths, resting sites) and sightings. Key species to be considered include Badger and Otter. The bird survey will consist of compiling lists of species present and where possible bird counts. Recording of species will be undertaken using telescope and binoculars.

Note: Trapping of small mammals will not be undertaken during the survey. In addition, river crossings (other than designated sites) and their relative importance to Otters will not be considered. If required, this will be considered in a later detailed study which would also include a broader Badger survey.

Finally appraise the survey and outline work required to be carried out at a later date and prior to pipeline construction.

C. FRESHWATER ECOLOGY

Desk Study:

- Examine maps and itemise all the main crossings.
- Contact the relevant fisheries boards and or riparian owners in question seeking information on the rivers in question.
- Contact county recorders and *Dúchas* for relevant aquatic vegetation/ macroinvertebrate records for areas/rivers in question.
- Check EPA River Water quality databases for the areas of the crossings.
- Hold meetings with fisheries boards, owners and anglers where necessary.
- Carry out field-work as appropriate.

Field survey as appropriate:

- Visit principal river crossing points and carry out a short survey at each.
- Field survey would consist of a description of the physical nature of the watercourse and its bankside and in-channel habitat characteristics.
- A general description of the bankside vegetation and in-channel vegetation kick samples or net sweep survey in order to describe the principal aquatic macroinvertebrates present.
- A description of the fisheries potential of each of the stretches, based on (i) habitats present and (ii) information supplied by the fisheries board or anglers

Reporting:

- List of main crossings.
- Site descriptions where appropriate with recommended centre-line of crossing.
- List of impacts.
- Suggested mitigation measures.
- Finally, appraise the survey and outline work required to be carried out at a later date and prior to pipeline construction, including recommendations where appropriate relating to the use of electric fishing.

APPENDIX 9.2 HABITAT SURVEY RESULTS

FROM BELLANABOY TO CRAUGHWELL

This survey includes habitats on, adjacent to and near the proposed route.

Bellanaboy to east of Owenboy

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 3

Grid reference (beginning and end of section) – F 8634 3254 to F 8657 3210

Length of section – 490m

Elevation of section (range) – 15 to 25m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Agricultural grassland

Characteristic plant species -

Holcus lanatus - A	*Cynosurus cristatus* - O
Bellis perennis - A	*Ranunculus acris* - O
Trifolium repens - A	*Alopecurus genticulatus* - O
Poa pratensis - A	*Rumex obtusifolius* - O
Agrostis stolonifera - F	*Anthoxanthum odoratum* - O
Cerastium fontanum - O	*Lolium perenne* - O
Juncus effusus - O	*Juncus bulbosus* - O

Secondary habitat – Cutaway blanket bog
Dominated by *Schoenus nigricans* with frequent *Eriophorum angustifolium* and *Molinia caerulea.*

Composition of field boundaries – Most field boundaries consist of sheep wire with occasional hedges of *Pinus contorta.*

Rare plant species present – None

Conservation value of vegetation – Low

Condition of vegetation – Grazed heavily by sheep and cattle. Blanket bog areas subject to turf cutting.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 3

Grid reference (beginning and end of section) – F 8657 3210 to F 8677 3149

Length of section – 650m

Elevation of section (range) – 20m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Intact blanket bog

Characteristic plant species –

Schoenus nigricans – D	*Pedicularis sylvatica* - O
Molinia caerulea - A	*Myrica gale* - O
Erica tetralix – A	*Potentilla erecta* - O
Sphagnum capillifolium - A	*Calluna vulgaris* - O
Cladonia portentosa - A	*Carex panicea* - O
Eriophorum angustifolium - F	*Dactylorhiza maculata* - R
Narthecium ossifragum - F	*Potentilla erecta* - R
Eriophorum vaginatum - F	

Secondary habitat – Coniferous plantation
Dominated by *Pinus contorta*, the trees are mature.

Composition of field boundaries – None

Rare plant species present – None

Conservation value of vegetation – The intact blanket bog is of moderate conservation value.

Condition of vegetation – Blanket bog heavily grazed by sheep, however erosion is not severe.

Other comments: A bog stream occurs within 200m of the proposed pipeline route. Disturbance to this stream or its grassy banks should be avoided.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 3

Grid reference (beginning and end of section) – F 8677 3149 to F 8675 3130

Length of section – 170m

Elevation of section (range) – 20m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Overgrazed blanket bog

Characteristic plant species -

Nardus stricta - A	*Trichophorum cespitosus* - O
Eriophorum angustifolium - F	*Drosera intermedia* - O
Danthonia decumbens - F	*Narthecium ossifragum* - O
Eleocharis multicaulis - F	*Carex panicea* - O
Campylopus spp. - F	*Calluna vulgaris* - R
Carex binervis - O	*Schoenus nigricans* - R
Potentilla erecta - O	

Secondary habitat – Grassy stream bank

Characteristic plant species -

Iris pseudacorus - A	*Achillea millefolium* - O
Digitalis purpurea - F	*Cirsium palustre* - O
Bellis perennis - F	*Blechnum spicant* - O
Galium saxatile - F	*Jasione montana* - O
Rhododendron ponticum - F	*Senecio aquatica* – O
Juncus effusus – F	*Holcus lanatus* - O

Composition of field boundaries – None

Rare plant species present – None

Conservation value of vegetation – Low

Condition of vegetation – Blanket bog is heavily grazed by sheep and, as a result, is eroded.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 3

Grid reference (beginning and end of section) – F 8675 3130 to F 8689 3088

Length of section – 450m

Elevation of section (range) – 20 to 40m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Cutaway blanket bog

Characteristic plant species -

Molinia caerulea - D	*Eriophorum vaginatum* - F
Schoenus nigricans - A	*Eriophorum angustifolium* - F
Cladonia portentosa - A	*Sphagnum imbricatum* - O
Sphagnum capillifolium - A	*Myrica gale* - O
Sphagnum papillosum - F	*Trichophorum cespitosus* - O
Sphagnum cuspidatum - F	*Sphagnum magellanicum* - O
Erica tetralix - F	*Potentilla erecta* - O

Secondary habitat – Coniferous plantation
Dominated by *Pinus contorta*. The trees are mature.

Composition of field boundaries – None

Rare plant species present – None

Conservation value of vegetation – Low

Condition of vegetation – Blanket bog mostly cutaway by hand and sausage machine, with some small intact areas present.

Other comments: *Rhododendron ponticum* is abundant along lane and in some of the cutaway areas.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 3

Grid reference (beginning and end of section) – F 8689 3088 to F 8684 3069

Length of section – 180m

Elevation of section (range) – 40-50m

SAC/NHA along/within 1km of proposed route – Carrowmore Lake Complex pSAC lies 700m to the west.

Dominant habitat – Cutaway blanket bog

Characteristic plant species -

Molinia caerulea - D	*Calluna vulgaris* - O
Eriophorum angustifolium - A	*Potentilla erecta* - O
Campylopus spp. - A	*Juncus squarrosus* - O
Trichophorum cespitosus - F	*Drosera rotundifolia* - O
Carex panicea - F	*Juncus bulbosus* - R
Rhododendron ponticum - F	*Schoenus nigricans* - R
Nardus stricta - F	

Secondary habitat – Scrub/Hedge dominated by *Rhododendron ponticum*

Composition of field boundaries – *Rhododendron ponticum* hedges c. 2-3 metres tall.

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Blanket bog grazed by sheep and cutaway, however there appears to be little recent cutting.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 3

Grid reference (beginning and end of section) – F 8684 3069 to F 8679 3050

Length of section – 200m

Elevation of section (range) – 50 to 60m

SAC/NHA along/within 1km of proposed route – Carrowmore Lake Complex pSAC lies 600m to the west.

Dominant habitat – Intact blanket bog
Blanket bog occurs on sloping ground and is dominated by *Schoenus nigricans*. It is dry underfoot and Sphagnum cover is low.

Secondary habitat – None

Composition of field boundaries – None

Rare plant species present – None recorded

Conservation value of vegetation – Medium

Condition of vegetation – Grazed rather heavily by sheep and cattle, bare peat covers approximately 30% of the ground.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 3

Grid reference (beginning and end of section) – F 8679 3050 to F 8680 3005

Length of section – 440m

Elevation of section (range) – 50 to 60m

SAC/NHA along/within 1km of proposed route – Carrowmore Lake Complex pSAC lies 600m to the west.

Dominant habitat – Intact blanket bog along forestry firebreak.

Characteristic plant species -

Molinia caerulea - D	*Pleurozium schreberi* - F
Sphagnum capillifolium - D	*Eriophorum vaginatum* - O
Calluna vulgaris - A	*Polytrichum commune* - O
Hylocomium splendens - A	*Potentilla erecta* - O
Hypnum cupressiforme - F	*Luzula multiflora* - R
Cladonia portentosa - F	*Anthoxanthum odoratum* - R
Erica tetralix - F	*Galium saxatile* - R

Secondary habitat - Coniferous plantation
Dominated by *Picea sitchensis*.

Composition of field boundaries – None

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Ungrazed and rank due to fencing of forestry

Other comments: This section is a forestry firebreak with an electricity line running through it.

Route – Broadhaven to Galway

County - Mayo

Section code – 11

Grid reference (beginning and end of section) – F 8680 3005 to F 8700 2954

Length of section – 550m

Elevation of section (range) – 30 to 50m

SAC/NHA along/within 1km of proposed route – Carrowmore Lake Complex pSAC lies 400m to the west.

Dominant habitat – Heavily grazed blanket bog

Characteristic plant species –

Molinia caerulea - A	*Trichophorum cespitosus* - A
Eriophorum angustifolium - A	*Calluna vulgaris* - F
Schoenus nigricans - F	*Sphagnum papillosum* - O
Eriophorum vaginatum - F	*Narthecium ossifragum* - O
Sphagnum capillifolium - F	*Drosera rotundifolia* - O
Sphagnum cuspidatum - F	*Pedicularis sylvatica* - O
Erica tetralix - F	*Carex panicea* - O

Secondary habitat – Acid/neutral flush dominated by *Juncus effusus* and *Sphagnum*

Characteristic plant species -

Juncus effusus - D	*Eriophorum angustifolium* - O
Sphagnum recurvum - D	*Carex panicea* - O
Agrostis stolonifera - F	*Carex echinata* - O
Menyanthes trifoliata - F	*Juncus bulbosus* - O
Ranunculus flammula - F	*Eleocharis multicaulis* - O
Hydrocotyle vulgaris - F	*Myrica gale* - R

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Medium

Condition of vegetation – The blanket bog appears to be recovering from recent overgrazing.

Other comments: There are also small areas of semi-improved pasture, dominated by *Juncus effusus,* close to the river.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 3

Grid reference (beginning and end of section) – F 8700 2954 to F 8733 2894

Length of section – 680m

Elevation of section (range) – 20 to 30m

SAC/NHA along/within 1km of proposed route – Carrowmore Lake Complex pSAC lies 500m to the west.

Dominant habitat – Intact blanket bog

Characteristic plant species –

Schoenus nigricans – D	*Potentilla erecta* - F
Molinia caerulea - F	*Myrica gale* - F
Eriophorum angustifolium - F	*Trichophorum cespitosus* - O
Eriophorum vaginatum - F	*Narthecium ossifragum* - O
Sphagnum capillifolium - F	*Carex panicea* - O
Sphagnum cuspidatum - F	*Pedicularis sylvatica* - O
Erica tetralix - F	*Melampyrum pratense* - R

Secondary habitat – None

Composition of field boundaries – None present

Rare plant species present – None recorded, however the occurrence of *Melampyrum pratense* on blanket bog is relatively uncommon.

Conservation value of vegetation – High

Condition of vegetation – Lightly grazed by sheep

Other comments: A very nice area of intact lowland blanket bog, which is in good condition. It is recommended that this area of blanket bog should be avoided because of its intact nature by routing the pipeline further to the west, close to the agricultural grassland close to the road.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 3

Grid reference (beginning and end of section) – F 8733 2894 to F8745 2831

Length of section – 620m

Elevation of section (range) – 30m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Coniferous forestry
Dominated by *Pinus contorta*. The trees are tall and mature.

Secondary habitat – Intact blanket bog
The vegetation along this section of the route is dominated by *Molinia caerulea* with *Calluna vulgaris* prominent in places.

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Ungrazed, due to fencing off of the forestry.

Other comments: Swamp dominated by *Carex paniculata* dominates the narrow stream between the forestry and the intact blanket bog.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 3 and 4

Grid reference (beginning and end of section) – F8745 2831 to F 896 267

Length of section – 2800m

Elevation of section (range) – 30 to 100m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Forestry track

Characteristic plant species -

Juncus effusus - A	*Holcus lanatus* - O
Juncus bufonius - F	*Rhytidiadelphus squarrosus* - O
Juncus bulbosus - F	*Pinus sylvestris* seedlings - O
Agrostis stolonifera - F	*Carex demissa* - O
Anthoxanthum odoratum - F	*Nardus stricta* - O
Polytrichum commune - F	*Epilobium brunnescens* - O
Calluna vulgaris - O	*Plantago major* - R

Secondary habitat – Coniferous forestry
A mixture of mature *Pinus contorta* and *Picea sitchensis*. There are substantial areas of clearfell.

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Sparse vegetation along forestry tracks due to traffic and compact stony nature of substrate.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 4

Grid reference (beginning and end of section) – F 8971 2664 to F 9014 2641

Length of section – 480m

Elevation of section (range) – 100m

SAC/NHA along/within 1km of proposed route – Slieve Fyagh (542) to the north and Carrowmore Lake Complex (476) to the south are both within 1km of the route.

Dominant habitat – Marshy grassland dominated by *Juncus effusus*

Juncus effusus - A	*Succisa pratensis* - F
Anthoxanthum odoratum - A	*Potentilla erecta* - F
Sphagnum palustre - A	*Holcus lanatus* - F
Carex echinata - F	*Rumex acetosa* - O
Juncus squarrosus - F	*Polytrichum commune* - O
Pedicularis sylvatica - F	*Plantago lanceolata* - O

In places this grassland is transitional to unimproved upland grassland.

Secondary habitat – None

Composition of field boundaries – Mainly earthen banks topped with sheep wire

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – This area is heavily grazed by sheep

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 4

Grid reference (beginning and end of section) – F 9014 2641 to F 9051 2621

Length of section – 420m

Elevation of section (range) – 100m

SAC/NHA along/within 1km of proposed route – Slieve Fyagh (542) to the north and Carrowmore Lake Complex (476) to the south are both within 1km of the route.

Dominant habitat – Coniferous forestry

Characteristic plant species -
The main species planted is *Picea sitchensis.*

Secondary habitat – None

Composition of field boundaries – Mainly earthen banks topped with sheep wire

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – This area of forestry is ungrazed, due to fencing.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 4

Grid reference (beginning and end of section) – F 9051 2621 to F 9070 2612

Length of section – 210m

Elevation of section (range) – 100m

SAC/NHA along/within 1km of proposed route – Slieve Fyagh (542) to the north and Carrowmore Lake Complex (476) to the south are both within 1km of the route.

Dominant habitat – Marshy grassland dominated by *Juncus effusus*

Secondary habitat – Cutaway blanket bog

Composition of field boundaries – Mainly earthen banks topped with sheep wire

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Grassland areas are heavily grazed by sheep

Other comments: There are also some areas of Rhododendron scrub present.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 4

Grid reference (beginning and end of section) – F 9070 2612 to F 9104 2599

Length of section – 360m

Elevation of section (range) – 110m

SAC/NHA along/within 1km of proposed route – Slieve Fyagh (542) to the north and Carrowmore Lake Complex (476) to the south are both within 1km of the route.

Dominant habitat – Coniferous forestry

Characteristic plant species -
The main species planted is *Picea sitchensis*.

Secondary habitat – None

Composition of field boundaries – Mainly earthen banks topped with sheep wire

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – The forestry is ungrazed due to fencing.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 4

Grid reference (beginning and end of section) – F 9104 2599 to F 9160 2570

Length of section – 600m

Elevation of section (range) – 110m

SAC/NHA along/within 1km of proposed route – Slieve Fyagh (542) to the north and Carrowmore Lake Complex (476) to the south are both within 1km of the route.

Dominant habitat – Marshy grassland dominated by *Juncus effusus*

Secondary habitat – Overgrazed blanket bog

Composition of field boundaries – Mainly sheep wire fences

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – This section of the route is heavily grazed by sheep, which has resulted in the erosion of blanket bog present.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 4 and 5

Grid reference (beginning and end of section) – F 9160 2570 to F 9296 2464

Length of section – 1700m

Elevation of section (range) – 110 to 145 m

SAC/NHA along/within 1km of proposed route – This portion of the route passes through the Carrowmore Lake Complex pSAC (476).

Dominant habitat – Intact blanket bog

Characteristic plant species -

Schoenus nigricans - D	*Erica tetralix* - F	
Molinia caerulea - D	*Calluna vulgaris* - F	
Eriophorum angustifolium - A	*Hypnum cupressiforme* - F	
Eriophorum vaginatum - A	*Racomitrium lanuginosum* - O	
Trichophorum cespitosus - A	*Potentilla erecta* - O	
Sphagnum capillifolium - A		
Sphagnum pappillosum - A		

Secondary habitat – Marshy grassland dominated by *Juncus effusus*
Small areas of grassland are semi-improved and thus have little *Juncus effusus*.

Composition of field boundaries – Wire fences

Rare plant species present – None recorded

Conservation value of vegetation – High

Condition of vegetation – Mostly in good condition, however the lower parts of this section have been eroded by excessive levels of sheep grazing.

Other comments: An area of wet largely intact blanket bog with a high cover of *Sphagnum* moss. A narrow bog stream is also present.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 5

Grid reference (beginning and end of section) – F 9296 2464 to F 9419 2405

Length of section – 1350m

Elevation of section (range) – 120 to 150 m

SAC/NHA along/within 1km of proposed route – Carrowmore Lake Complex pSAC (476) lies to the south of this area of forestry.

Dominant habitat – Coniferous plantation
The main species appears to be *Pinus contorta*. The trees are mature.

Secondary habitat – None

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Fenced off from grazing animals

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 5

Grid reference (beginning and end of section) – F 9419 2405 to F 9418 2275

Length of section – 1250m

Elevation of section (range) – 100 to 120m

SAC/NHA along/within 1km of proposed route – Carrowmore Lake Complex pSAC (476) occurs along the western side of the road .

Dominant habitat – Industrial cutaway blanket bog
Very sparse vegetation cover on active cutaway, the area was being worked at the time of survey. Occasional clumps of *Juncus effusus* are present.

Secondary habitat – Intact blanket bog
Occurs as a narrow strip between the road and industrial cutaway

Characteristic plant species -

Molinia caerulea - D
Myrica gale - F
Eriophorum angustifolium - F
Eriophorum vaginatum - F
Sphagnum capillifolium - F

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – No vegetation present in cutaway areas. Existing blanket bog is ungrazed.

Other comments: The active cutaway bog is owned and developed by Bord na Mona.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 5

Grid reference (beginning and end of section) – F 9418 2275 to F 9470 2175

Length of section – 1050m

Elevation of section (range) – 85 to 100m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Intact blanket bog
The blanket bog in this section is mostly intact with some small areas of active cutaway along the road. The surface is undulating and dominated by *Molinia caerulea.*

Secondary habitat – None

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Medium

Condition of vegetation – Lightly grazed and largely intact.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 5

Grid reference (beginning and end of section) – F 9470 2175 to F 9713 2045

Length of section – 2750m

Elevation of section (range) – 80m to 95m

SAC/NHA along/within 1km of proposed route – Bellacorrick Bog Complex (1922) lies approximately 500m to the south.

Dominant habitat – Industrially cutaway blanket bog

Characteristic plant species -

Juncus effusus - O	*Eriophorum angustifolium* - R
Juncus bulbosus - O	

Secondary habitat – None

Composition of field boundaries – None

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Very little vegetation present.

Other comments: This actively cut bog is owned and developed by Bord na Mona. The section runs behind Bellacorrick power station.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 5

Grid reference (beginning and end of section) – F 9713 2045 to F 9721 2040

Length of section – 90m

Elevation of section (range) – 80m

SAC/NHA along/within 1km of proposed route – Bellacorrick Bog Complex (1922) lies approximately 500m to the south.

Dominant habitat – Improved/semi-improved grassland

Characteristic plant species -

Holcus lanatus - D	*Trifolium repens* - F
Ranunculus acris - A	*Trifolium pratense* - O
Anthoxanthum odoratum - A	*Cerastium fontanum* - O
Ranunculus repens - A	
Plantago lanceolata - F	
Poa pratensis - F	
Cynosurus cristatus - F	

Secondary habitat – None

Composition of field boundaries – Wire fence

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Tall grassy vegetation. It seems likely that the field will be cut for hay or silage in the near future.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 5

Grid reference (beginning and end of section) – F 9721 2040 to F 9724 2039

Length of section – 30m

Elevation of section - 80m

SAC/NHA along/within 1km of proposed route – Bellacorrick Bog Complex (1922) lies approximately 500m to the south.

Dominant habitat – River
At this point the Oweniny river is shallow (<40cm deep) and its bed is dominated by sandstone pebbles of varying size. There is very little emergent or submerged vegetation apart from the moss *Fontinalis antipyretica* and *Juncus bulbosus*.

Secondary habitat – None

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Low, however the river itself is of considerable conservation value.

Condition of vegetation – Little vegetation present

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 6

Grid reference (beginning and end of section) – F 9724 2039 to F 9760 2019

Length of section – 400m

Elevation of section (range) – 80m

SAC/NHA along/within 1km of proposed route – Bellacorrick Bog Complex (1922) lies approximately 200m to the south.

Dominant habitat – Marshy grassland dominated by *Juncus effusus*

Characteristic plant species -

Juncus effusus - D	*Calliergon cuspidatum* - F
Polytrichum commune - A	*Anthoxanthum odoratum* - F
Holcus lanatus - F	*Carex echinata* - O
Cirsium palustre - F	*Juncus articulatus* - O
Salix aurita - F	*Aulacomium palustris* - O
Ranunculus flammula - F	*Agrostis stolonifera* - O
Eriophorum angustifolium - F	*Platanthera bifolia* - R

Secondary habitat – Coniferous plantation
A small band of forestry, c. 10m wide, occurs in the middle of the zone.

Composition of field boundaries – None

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Light grazing and poaching by cattle

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 6

Grid reference (beginning and end of section) – F 9760 2019 to F 9805 1995

Length of section – 450m

Elevation of section (range) – 80m

SAC/NHA along/within 1km of proposed route – Bellacorrick Bog Complex (1922) is approximately 50m away on the southern side of the Crossmolina to Belmullet road.

Dominant habitat – Industrially cutaway blanket bog

Characteristic plant species -

Juncus effusus - F
Juncus bulbosus - F
Agrostis stolonifera - O

Secondary habitat – None

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Very little vegetation present due to the working of the surface.

Other comments: Owned and cut by Bord na Mona.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 6

Grid reference (beginning and end of section) – F 9805 1995 to F 9889 1956

Length of section – 910m

Elevation of section (range) – 80m

SAC/NHA along/within 1km of proposed route – Bellacorrick Bog Complex (1922) is approximately 20m away on the southern side of the Crossmolina to Belmullet road.

Dominant habitat – Coniferous plantation

Secondary habitat – None

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Ungrazed due to fencing off of plantation.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 6

Grid reference (beginning and end of section) – F 9889 1956 to F 9897 1951

Length of section – 120m

Elevation of section (range) – 80m

SAC/NHA along/within 1km of proposed route – Bellacorrick Bog Complex (1922) is approximately 20m away on the southern side of the Crossmolina to Belmullet road.

Dominant habitat – Improved/semi-improved grassland

Characteristic plant species -

Holcus lanatus - D	*Rhododendron ponticum* - O
Anthoxanthum odoratum - A	*Cynosurus cristatus* - O
Plantago lanceolata - A	*Bellis perennis* - O
Lolium perenne - F	
Agrostis capillaris - F	
Ranunculus acris - F	
Juncus effusus - O	

Secondary habitat – None

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Recently mown on the day of survey

Other comments: This section is the front of the Bellacorrick Bog railway offices and there is a weather station present here.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 6

Grid reference (beginning and end of section) – F 9897 1951 to F 9952 1934

Length of section – 580m

Elevation of section (range) – 80m

SAC/NHA along/within 1km of proposed route – Bellacorrick Bog Complex (1922) is approximately 50m away on the southern side of the Crossmolina to Belmullet road.

Dominant habitat – Conifer plantation
Tall and mature.

Secondary habitat – None

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Tall conifer trees

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 6

Grid reference (beginning and end of section) – F 9952 1934 to G 0010 1898

Length of section – 1550m

Elevation of section (range) – 80 to 90m

SAC/NHA along/within 1km of proposed route – Bellacorrick Bog Complex (1922) is approximately 50m away on the southern side of the Crossmolina to Belmullet road.

Dominant habitat – Cutaway blanket bog

Characteristic plant species -

Molinia caerulea - D	*Drosera rotundifolia* - F
Erica tetralix - A	*Sphagnum cuspidatum* - F
Eriophorum angustifolium - A	*Rhynchospora alba* - F
Trichophorum cespitosus - A	*Eriophorum vaginatum* - O
Calluna vulgaris - A	*Sphagnum papillosum* - O
Sphagnum capillifolium - A	*Potentilla erecta* - O
Narthecium ossifragum - F	

Secondary habitat – Intact blanket bog
A small area of intact blanket bog, dominated by *Molinia caerulea* occurs on sloping ground just to the east of the ruined cottage, close to the eastern end of the section..

Composition of field boundaries – None present

Rare plant species present – None recorded, however the hybrid heather *Erica x stuartii*, has been recorded from this area recently (A-M. Mckee pers. comm.).

Conservation value of vegetation – Low to medium

Condition of vegetation – A small amount of the cutaway is active and the area is lightly grazed by sheep.

Other comments: Lough Dahybaun, the only site in Co. Mayo for the protected plant species *Najas flexilis*, is situated 100-200m north of this section of the proposed route.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 6

Grid reference (beginning and end of section) – G 0010 1898 to G 0148 1880

Length of section – 500m

Elevation of section (range) – 80m

SAC/NHA along/within 1km of proposed route – Bellacorrick Bog Complex (1922) is approximately 50m away on the southern side of the Crossmolina to Belmullet road.

Dominant habitat – Improved/semi-improved grassland

Characteristic plant species -

Lolium perenne - A	*Cerastium fontanum* - O
Cynosurus cristatus - A	*Juncus effusus* - O
Trifolium repens - F	*Bellis perennis* - O
Anthoxanthum odoratum - F	
Poa pratensis - F	
Holcus lanatus - F	

Secondary habitat – Cutaway blanket bog
Occurs on northern side of road, much recent sausage machine activity.

Composition of field boundaries – Wet ditches and wire fences

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Grassland grazed intensively by sheep at time of survey

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 6

Grid reference (beginning and end of section) – G 0148 1880 to G 0189 1873

Length of section – 410m

Elevation of section (range) – 80m

SAC/NHA along/within 1km of proposed route – The Bellacorrick Bog Complex (1922) lies to the north-east and south of this section of the route.

Dominant habitat – Cutaway blanket bog

Characteristic plant species -

Schoenus nigricans - D	*Salix aurita* - F
Eriophorum angustifolium - A	*Carex demissa* - O
Myrica gale - F	*Pinguicula lusitanica* - O
Molinia caerulea - F	*Carex panicea* - O
Sphagnum capillifolium - F	*Erica tetralix* - O
Calluna vulgaris - F	*Narthecium ossifragum* - O
Cladonia portentosa - F	*Trichophorum cespitosus* - O

Secondary habitat – Marshy grassland dominated by *Juncus effusus.*

Characteristic plant species -

Juncus effusus - D	*Festuca pratensis* – O
Rubus fruticosus - F	*Galium palustre* - R
Potentilla palustris - F	*Ranunculus acris* - R
Holcus lanatus - F	*Lychnis flos-cuculi* - R
Carex nigra - O	*Equisetum fluviatile* - R
Agrostis stolonifera - O	

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – The blanket bog area is cutaway by sausage machine and heavily grazed by sheep.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 6

Grid reference (beginning and end of section) – G 0189 1873 to G 0219 1865

Length of section – 300m

Elevation of section (range) – 80m to 90m

SAC/NHA along/within 1km of proposed route – The Bellacorrick Bog Complex (1922) lies to the north-east and south of this section of the route.

Dominant habitat – Coniferous plantation
Less than 10 years old, dominated by *Picea sitchensis.*

Secondary habitat – None

Composition of field boundaries – Wire fences

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Ungrazed due to fencing of forestry.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 6

Grid reference (beginning and end of section) – G 0219 1865 to G 0235 1857

Length of section – 180m

Elevation of section (range) – 80m

SAC/NHA along/within 1km of proposed route – The Bellacorrick Bog Complex (1922) lies 150m north of this section of the route.

Dominant habitat – Intact blanket bog
Dominated by *Schoenus nigricans* with prominent *Myrica gale.*

Secondary habitat – Rhododendron hedge
Mostly lining the track indicated on the map

Composition of field boundaries – *Rhododendron ponticum* bushes.

Rare plant species present – None recorded

Conservation value of vegetation – Medium

Condition of vegetation – Little grazing damage to blanket bog, however there is some marginal peat cutting.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 6

Grid reference (beginning and end of section) – G 0235 1857 to G 0261 1843

Length of section – 280m

Elevation of section (range) – 80m

SAC/NHA along/within 1km of proposed route – The Bellacorrick Bog Complex (1922) lies 100m north-east of this section of the route.

Dominant habitat – Marshy grassland dominated by *Juncus effusus*. This area is very rank and overgrown due to a lack of grazing and the wet soil conditions. Numerous bushes of *Salix aurita* and *Salix cinerea* are present.

Secondary habitat – None

Composition of field boundaries – Occasional *Salix* bushes

Rare plant species present – None recorded

Conservation value of vegetation – Low to medium.

Condition of vegetation – Ungrazed and rank.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 6

Grid reference (beginning and end of section) – G 0261 1843 to G 0274 1850

Length of section – 140m

Elevation of section (range) – 80m

SAC/NHA along/within 1km of proposed route – The Bellacorrick Bog Complex (1922) lies to the east, adjoining this section of the route.

Dominant habitat – Improved/semi-improved grassland
This area contains small fields of grassland which vary in terms of agricultural improvement, ranging from semi-improved hay meadow to more improved areas dominated by *Lolium perenne*.

Secondary habitat – None

Composition of field boundaries – Occasional *Salix* bushes

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – One field cut for silage, the remainder for either hay or silage.

Other comments:

Route - Broadhaven to Galway

County - Mayo

1:10,000 Map number - 7

Grid reference (beginning and end of section) - G 0274 1850 to G 0322 1861

Length of section - 470m

Elevation of section (range) - 80m

SAC/NHA along/within 1km of proposed route - This section of the route cuts through the Bellacorrick Bog Complex (1922).

Dominant habitat - Overgrazed blanket bog
An area of blanket bog close to the road which has been overgrazed and poached by sheep and possibly cattle. As a result the vegetation has a very hummocky appearance with much bare peat present (c. 30% cover).

Secondary habitat - Marshy grassland dominated by *Juncus effusus.*

Composition of field boundaries - None present

Rare plant species present - None recorded

Conservation value of vegetation - Medium

Condition of vegetation - Heavily grazed and trampled by sheep.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 7

Grid reference (beginning and end of section) – G 0322 1861 to G 0362 1872

Length of section – 520m

Elevation of section (range) – 90m

SAC/NHA along/within 1km of proposed route – This section of the route cuts through the Bellacorrick Bog Complex (1922).

Dominant habitat – Coniferous plantation
Plantation on blanket bog less than 10 years old, dominated by *Picea sitchensis*. *Molinia caerulea* is still conspicuous in open areas.

Secondary habitat – None

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Ungrazed due to exclusion of sheep by fencing.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 7

Grid reference (beginning and end of section) – G 0362 1872 to G 0386 1880

Length of section – 210m

Elevation of section (range) – 90m

SAC/NHA along/within 1km of proposed route – The Bellacorrick Bog Complex (1922) lies immediately to the north and west of this section of the route.

Dominant habitat – Damp grassland dominated by *Juncus effusus* and *Holcus lanatus.*

Characteristic plant species -

Juncus effusus - A	*Cerastium fontanum* - O
Holcus lanatus - A	*Carex ovalis* - O
Anthoxanthum odoratum - F	*Ranunculus acris* - O
Ranunculus repens - F	
Plantago lanceolata - F	
Trifolium repens - F	
Bellis perennis - F	

Secondary habitat – Cutaway blanket bog

Composition of field boundaries – Mostly wire fences.

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Grazed by sheep.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 7

Grid reference (beginning and end of section) – G 0386 1880 to G 0404 1880

Length of section – 170m

Elevation of section (range) – 80-90m

SAC/NHA along/within 1km of proposed route – The Bellacorrick Bog Complex (1922) lies immediately to the north and south of this section of the route.

Dominant habitat – Overgrazed blanket bog

Characteristic plant species -

Molinia caerulea - D
Calluna vulgaris - A
Potentilla erecta - F
Juncus squarrosus - F
Polygala serpyllifolia - F
Juncus effusus - O
Erica tetralix - O

Secondary habitat – None

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Heavily grazed by sheep and cattle with resultant severe erosion of peat.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 7

Grid reference (beginning and end of section) – G 0404 1880 to G 0436 1877

Length of section – 300m

Elevation of section (range) – 90m

SAC/NHA along/within 1km of proposed route – The Bellacorrick Bog Complex (1922) lies immediately to the east of this section of the route.

Dominant habitat – Improved/semi-improved grassland

Characteristic plant species -

Holcus lanatus - A
Cynosurus cristatus - A
Ranunculus repens - A
Plantago lanceolata - A
Cerastium fontanum - F
Cirsium arvense - O
Juncus effusus - O

Secondary habitat – Coniferous plantation

Composition of field boundaries – Low hedges with *Crataegus monogyna, Prunus spinosa, Salix cinerea* and *Fraxinus excelsior.*

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Intensively grazed by sheep and cattle.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 7

Grid reference (beginning and end of section) – G 0436 1877 to G 0528 1850

Length of section – 950m

Elevation of section (range) – 80-90m

SAC/NHA along/within 1km of proposed route – Parts of this section of the route cut through the Bellacorrick Bog Complex (1922).

Dominant habitat – Improved/semi-improved grassland
At the time of survey most of these areas had been recently cut for silage and/or hay.

Secondary habitat – Intact blanket bog

Characteristic plant species -

Schoenus nigricans - D	*Sphagnum capillfolium* - F
Erica tetralix - A	*Sphagnum papillosum* - F
Molinia caerulea - F	*Narthecium ossifragum* - O
Calluna vulgaris - F	*Pedicularis sylvatica* - O
Eriophorum angustifolium - F	

Composition of field boundaries – Ditches and low earthen banks with occasional *Salix cinerea* and *Crataegus monogyna.*

Rare plant species present – None recorded

Conservation value of vegetation – Low to medium

Condition of vegetation – There is a small amount of turf cutting taking place in the areas of blanket bog.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 7

Grid reference (beginning and end of section) – G 0528 1850 to G 0549 1840

Length of section – 240m

Elevation of section (range) – 80m

SAC/NHA along/within 1km of proposed route – This section of the route cuts through the Bellacorrick Bog Complex (1922).

Dominant habitat – Base-rich blanket bog flush

Characteristic plant species -

Schoenus nigricans - D	*Campylium stellatum* - F
Juncus subnodulosus - F	*Fissidens adianthoides* - F
Chara spp. - F	*Eriophorum latifolium* - O
Erica tetralix - F	*Pinguicula vulgaris* - O
Eriophorum angustifolium - F	*Molinia caerulea* - O
Cladium mariscus - F	*Succisa pratensis* - O
Drepanocladus revolvens - F	*Dactylorhiza incarnata* - R

Secondary habitat – None

Composition of field boundaries – None present

Rare plant species present – *Eriophorum latifolium, Vaccinium oxycoccus, Homalothecium nitens.* All of the species are locally rare in the west of Ireland.

Conservation value of vegetation – High

Condition of vegetation – Little evidence of grazing.

Other comments: An area of very high conservation value, which should be avoided by re-routing the pipeline to the north of the road.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 7

Grid reference (beginning and end of section) – G 0549 1840 to G 0590 1818

Length of section – 450m

Elevation of section (range) – 80m

SAC/NHA along/within 1km of proposed route – This section of the route cuts through the Bellacorrick Bog Complex (1922).

Dominant habitat – Intact blanket bog
Nice intact blanket bog dominated by *Schoenus nigricans* with some old cutaway along its northern edge.

Secondary habitat – None

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – High

Condition of vegetation – Little evidence of grazing.

Other comments: An area of very high conservation value, which should be avoided by re-routing the pipeline to the north of the road.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 7

Grid reference (beginning and end of section) – G 0590 1818 to G 0616 1801

Length of section – 310m

Elevation of section (range) – 70m

SAC/NHA along/within 1km of proposed route – This section of the route cuts through the Bellacorrick Bog Complex (1922).

Dominant habitat – Coniferous plantation.
Planted on blanket bog, dominated by *Picea sitchensis.*

Secondary habitat – None

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – No grazing due to fencing of forestry.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 7

Grid reference (beginning and end of section) – G 0616 1801 to G 0662 1768

Length of section – 540m

Elevation of section (range) – 70m

SAC/NHA along/within 1km of proposed route – Bellacorrick Bog Complex (1922) lies 100m to the north-east.

Dominant habitat – Damp grassland dominated by *Juncus effusus* and *Holcus lanatus*.

Characteristic plant species -

Juncus effusus - D	*Trifolium repens* - O
Holcus lanatus - A	*Bellis perennis* - O
Anthoxanthum odoratum - F	
Ranunculus acris - F	
Carex ovalis - F	
Rumex acetosa - O	
Plantago lanceolata - O	

Secondary habitat – Cutaway blanket bog

Composition of field boundaries – Hedges with *Crataegus monogyna, Prunus spinosa, Alnus glutinosa* and *Fraxinus excelsior.*

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Mostly grazed by sheep and cattle.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 7

Grid reference (beginning and end of section) – G 0662 1768 to G 0730 1710

Length of section – 1010m

Elevation of section (range) – 60 to 70m

SAC/NHA along/within 1km of proposed route – Bellacorrick Bog Complex (1922) lies 100m to the north-east.

Dominant habitat – Improved/semi-improved grassland

Secondary habitat – None

Composition of field boundaries – Hedges with *Crataegus monogyna, Prunus spinosa, Alnus glutinosa* and *Fraxinus excelsior.*

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Mostly grazed by sheep and cattle. A number of fields are cut for silage and hay.

Other comments:

Massbrook Lower (G 1608 0535) to 0.5 km south of Gort (G 1807 0098).

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 9

Grid reference (beginning and end of section) – G 1608 0535 to G 1620 0520

Length of section – 200m

Elevation of section (range) – 30m

SAC/NHA along/within 1km of proposed route – Lough Conn (NHA no. 519) lies 500 metres to the north-east

Dominant habitat – Damp grassland dominated by *Juncus effusus* and *Holcus lanatus*

Characteristic plant species -

Juncus effusus - D
Holcus lanatus - A
Ranunculus acris - F
Anthoxanthum odoratum - F
Carex ovalis - F
Agrostis capillaris - F
Cynosurus cristatus - F

Secondary habitat – Tall hedge

Characteristic plant species -

Salix cinerea - D	*Lonicera periclymenum* - F
Ilex aquifolium - A	*Sorbus aucuparia* - O
Crataegus monogyna - A	*Pteridium aquilinum* - O
Betula pubescens - F	*Hedera helix* - O
Rubus fruticosus - F	*Corylus avellana* - O

Composition of field boundaries – Well grown hedges. See description above

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Some sheep grazing

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 9 and 10

Grid reference (beginning and end of section) – G 1620 0520 to G 1632 0502

Length of section – 220m

Elevation of section (range) – 30m

SAC/NHA along/within 1km of proposed route – Lough Conn (NHA no. 519) lies 500 metres to the north-east

Dominant habitat – Cutaway blanket bog

Characteristic plant species -

Schoenus nigricans - A	*Drosera rotundifolia* - O
Myrica gale - A	*Pedicularis sylvatica* - O
Molinia caerulea - A	*Trichophorum cespitosus* - O
Eriophorum angustifolium - A	
Erica tetralix - F	
Calluna vulgaris - F	

Secondary habitat – None

Composition of field boundaries – Well grown hedges. See description in previous section

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Good condition due to low levels of active peat cutting and sheep grazing.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 10

Grid reference (beginning and end of section) – G 1632 0502 to G 1701 0407

Length of section – 1180m

Elevation of section (range) – 30 to 70m

SAC/NHA along/within 1km of proposed route – Lough Conn (NHA no. 519) lies 800 metres to the north-east

Dominant habitat – Improved/semi-improved grassland

Characteristic plant species -

Lolium perenne - A	*Rumex crispus* - F
Holcus lanatus - A	*Cerastium fontanum* - F
Cynosurus cristatus - A	*Taraxacum officinale* - F
Trifolium repens - A	*Cirsium vulgare* - O
Plantago lanceolata - F	*Senecio jacobea* - O
Bellis perennis - F	
Poa pratensis - F	

Secondary habitat – Hedge
The composition of hedges is variable, ranging from species-rich (see description in previous sections) to sparse, species-poor stretches dominated by *Crataegus monogyna.*

Composition of field boundaries – See description above

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Most areas of grassland grazed by cattle and sheep. Silage and hay fields also common.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 10

Grid reference (beginning and end of section) – G 1701 0407 to G 1719 0395

Length of section – 220m

Elevation of section (range) – 70 to 90m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Overgrazed blanket bog

Characteristic plant species -

Molinia caerulea - D	*Trichophorum cespitosus* - O
Myrica gale - A	*Drosera rotundifolia* - O
Eleocharis multicaulis - A	*Narthecium ossifragum* - O
Eriophorum angustifolium - F	
Erica tetralix - F	
Sphagnum capillifolium - F	

Secondary habitat – Scrub woodland

Characteristic plant species -
Dominated by low *Betula pubescens.*

Composition of field boundaries – Mainly stone walls and earthen banks.

Rare plant species present – None recorded

Conservation value of vegetation – Medium

Condition of vegetation – Poor due to heavy levels of sheep grazing resulting in localised erosion.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 10

Grid reference (beginning and end of section) – G 1719 0395 to G 1752 0375

Length of section – 380m

Elevation of section (range) – 90 to 100m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Damp grassland dominated by *Juncus effusus* and *Holcus lanatus*.

Secondary habitat –None

Composition of field boundaries – Mainly stone walls and wire fences.

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Some sheep grazing.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 10

Grid reference (beginning and end of section) – G 1752 0375 to G 1795 0271

Length of section – 1440m

Elevation of section (range) – 90 to 130m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Intact blanket bog

Characteristic plant species -

Eriophorum angustifolium - A	*Sphagnum papillosum* - F
Molinia caerulea - A	*Myrica gale* - F
Schoenus nigricans - A	*Calluna vulgaris* - F
Erica tetralix - A	*Trichophorum cespitosum* - O
Sphagnum capillifolium - F	*Narthecium ossifragum* - O
Eleocharis multicaulis - F	*Drosera rotundifolia* - O
Sphagnum auriculatum - F	*Potentilla erecta* - O

Secondary habitat – Heath dominated by *Calluna vulgaris*.

Characteristic plant species -

Calluna vulgaris - D	*Sphagnum capillifolium* - F
Erica cinerea - A	*Carex binervis* - O
Potentilla erecta - A	*Eriophorum angustifolium* - O
Juncus squarrosus - F	*Eriophorum vaginatum* - O
Hypnum cupressiforme - F	*Erica tetralix* - O
Rhytidiadelphus loreus - F	*Trichophorum cespitosum* - O

Composition of field boundaries – None present

Rare plant species present – None recorded

Conservation value of vegetation – Medium

Condition of vegetation – Generally good, however there is moderately heavy sheep grazing and some evidence of past cutting within blanket bog areas.

Other comments: Rock outcrops are common, thus suggesting a thin cover of peat in places.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 10

Grid reference (beginning and end of section) – G 1795 0271 to G 1800 0223

Length of section – 500m

Elevation of section (range) – 90 to 130m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Coniferous plantation

Characteristic plant species -
Picea sitchensis is the main species planted. In general trees are less than 4 metres tall.

Composition of field boundaries – Wire fences and earthen banks

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Ungrazed due to fencing of forestry.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 10

Grid reference (beginning and end of section) – G 1800 0223 to G 1808 0207

Length of section – 180m

Elevation of section (range) – 80 to 90m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Wet grassland dominated by *Juncus effusus*

Secondary habitat – Coniferous plantation

Composition of field boundaries – Stone walls and wire fences

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Poor due to the rather heavy grazing of sheep.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 10

Grid reference (beginning and end of section) – G 1808 0207 to G 1807 0168

Length of section – 380m

Elevation of section (range) – 90m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Intact blanket bog/wet heath

Characteristic plant species –

Calluna vulgaris - A	*Carex panicea* - O
Trichophorum cespitosum - A	*Eriophorum vaginatum* - O
Cladonia portentosa - A	*Potentilla erecta* - O
Sphagnum capillifolium - A	*Succisa pratensis* - O
Molinia caerulea - F	*Dactylorhiza maculata* - R
Eriophorum angustifolium - O	*Myrica gale* - R
Erica tetralix - O	*Juncus squarrosus* - R

Composition of field boundaries – Stone walls

Rare plant species present – None recorded

Conservation value of vegetation – Medium

Condition of vegetation – Moderately heavy sheep grazing, however erosion of peat is not too severe.

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 10

Grid reference (beginning and end of section) – G 1807 0168 to G 1807 0098

Length of section – 800m

Elevation of section (range) – 60 to 90m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Damp grassland dominated by *Juncus effusus* and *Holcus lanatus.*

Secondary habitat – Improved/semi-improved grassland.

Composition of field boundaries – Discontinuous hedge dominated by *Crataegus monogyna* and *Salix cinerea,* with stone walls.

Rare plant species present – None recorded

Conservation value of vegetation – Low

Condition of vegetation – Most fields are grazed by cattle and/or sheep.

Other comments:

Cunnagher North (M 1800 9943) to Sranalee (M 1715 9591)

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 8

Grid reference (beginning and end of section) – M 1800 9943 to M 1800 9883

Length of section (m) – 600

Elevation of section (range) – 60

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Cutaway blanket bog

Characteristic plant species -

Molinia caerulea - A
Erica tetralix - A
Eriophorum angustifolium - F
Trichophorum cespitosum - F
Sphagnum capillifolium - F
Potentilla erecta - F
Calluna vulgaris - O

Secondary habitat – None

Composition of field boundaries – None present

Rare plant species present – None recorded

Condition of vegetation – Cutaway, though relatively little recent cutting

Conservation value of vegetation – Low

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 8

Grid reference (beginning and end of section) – M 1800 9883 to M 1800 9873

Length of section (m) – 100

Elevation of section (range) – 60

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Semi-improved grassland

Secondary habitat – None

Composition of field boundaries – Stone walls

Rare plant species present – None recorded

Condition of vegetation – Lightly grazed by sheep

Conservation value of vegetation – Low

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 8

Grid reference (beginning and end of section) – M 1800 9873 to M 1800 9850

Length of section (m) – 230

Elevation of section (range) – 60

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Wet heath

Characteristic plant species -

Molinia caerulea - D
Calluna vulgaris - A
Erica tetralix - F
Myrica gale - F
Succisa pratensis - O
Sphagnum capillifolium - O
Potentilla erecta - O
Hypnum cupressiforme - O

Secondary habitat – None

Composition of field boundaries – None present

Rare plant species present – None recorded

Condition of vegetation – Ungrazed, with small areas of old cutaway

Conservation value of vegetation – Medium

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 8

Grid reference (beginning and end of section) – M 1800 9850 to M 1800 9802

Length of section (m) – 480

Elevation of section (range) – 60m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Raised bog within a blanket bog area.

Characteristic plant species -

Calluna vulgaris - A	*Eriophorum angustifolium* - F
Erica tetralix - A	*Eriophorum vaginatum* - F
Trichophorum cespitosum - A	*Cladonia portentosa* - F
Rhynchopsora alba - A	*Cladonia uncialis* - F
Narthecium ossifragum - A	*Sphagnum fuscum* - O
Sphagnum capillifolium - A	*Drosera rotundifolia* - O
Sphagnum papillosum - A	*Sphagnum magellanicum* - O
Hypnum cupressiforme - F	*Sphagnum imbricatum* - O

Secondary habitat – Bog pools

Sphagnum cuspidatum - A	*Drosera intermedia* - O
Rhynchopsora alba - A	*Menyanthes trifoliata* - O
Eriophorum angustifolium - F	

Composition of field boundaries – None present

Rare plant species present – None recorded

Condition of vegetation – Ungrazed, but appears to have been burned within the last 10 years.

Conservation value of vegetation – High

Other comments: This area of bog in unusual in that it has a structure and vegetation similar to that of raised bog. Such areas of relatively intact bog are very rare this far west in the country. It is surrounded by blanket bog on shallow peat, dominated by *Molinia caerulea*. The condition is generally good apart from some recent burning. The pipeline should be re-routed to the west of this area of peatland to avoid damage.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 8

Grid reference (beginning and end of section) – M 1800 9802 to M 1789 9745

Length of section (m) – 560

Elevation of section (range) – 50-60m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Agricultural grassland
Some fields intensively managed and some rather unimproved.

Secondary habitat – Hedges
Mostly dominated by *Crataegus mongyna* and *Prunus spinosa.*

Composition of field boundaries – See above

Rare plant species present – None recorded

Condition of vegetation – Mostly grazed by cattle and sheep, with a few recently cut for silage.

Conservation value of vegetation – Low

Other comments:

Route - Broadhaven to Galway

County - Mayo

1:10,000 Map number - 8

Grid reference (beginning and end of section) - M 1789 9745 to M 1779 9725

Length of section (m) - 210

Elevation of section (range) - 70m

SAC/NHA along/within 1km of proposed route - None

Dominant habitat - Wet grassland dominated by *Juncus effusus.*

Secondary habitat - Hedges
Mostly dominated by *Crataegus mongyna* and *Prunus spinosa.*

Composition of field boundaries - See above

Rare plant species present - None recorded

Condition of vegetation - Ungrazed and dominated by tall, rank *Juncus effusus.*

Conservation value of vegetation - Low

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 8

Grid reference (beginning and end of section) – M 1779 9725 to M 1762 9698

Length of section (m) – 310

Elevation of section (range) – 70-80m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Agricultural grassland, improving to varying degrees.

Secondary habitat – Patchy scrub dominated by *Ulex europaeus*

Composition of field boundaries – Mostly dominated by *Crataegus monogyna* and *Prunus spinosa.*

Rare plant species present – None recorded

Condition of vegetation – Grazed lightly by cattle and sheep..

Conservation value of vegetation – Low

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 8

Grid reference (beginning and end of section) – M 1762 9698 to M 1715 9591

Length of section (m) – 1160

Elevation of section (range) – 60-80m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Cutaway blanket bog
Wet heath dominated by *Trichophorum* and /or *Molinia* is generally dominant.

Trichophorum cespitosum - D	*Hypnum cupressiforme* - F
Erica tetralix - A	*Cladonia portentosa* - F
Molinia caerulea - A	*Calluna vulgaris* - O
Potentilla erecta - A	*Eriophorum angustifolium* - O
Sphagnum capillifolium - A	*Carex panicea* - O
Sphagnum papillosum - A	

Secondary habitat – Dry heath dominated by *Calluna vulgaris*

Calluna vulgaris - D	*Potentilla erecta* - O
Hypnum cupressiforme - F	*Erica tetralix* - O
Sphagnum capillifolium - F	*Eriophorum vaginatum* - O
Eriophorum angustifolium - F	*Polytrichum commune* - O
Cladonia portentosa - O	*Molinia caerulea* - R

Composition of field boundaries – None present

Rare plant species present – None recorded

Condition of vegetation – Ungrazed. Moderate levels of peat cutting, mostly by sausage machine.

Conservation value of vegetation – Medium. Especially in areas which haven't been cut for a considerable time.

Other comments: Many parts of this cutaway have been revegetated by nice areas of wet heath and dry heath.

Rockfield (M 1807 9406) to Derrynacross (M 1938 9109)

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 8 and 9

Grid reference (beginning and end of section) – M 1807 9406 to M 1845 9342

Length of section (m) – 600

Elevation of section (range) – 40 to 50m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Improved agricultural grassland

Characteristic plant species -

Lolium perenne - A
Holcus lanatus - A
Ranunculus acris - A
Plantago lanceolata - A
Poa pratensis - F
Cerastium fontanum - F
Centaurea nigra - F

Secondary habitat – None

Composition of field boundaries – Hedges mostly dominated by *Crataegus monogyna* and *Prunus spinosa* with occasional tall trees of *Fraxinus excelsior.*

Rare plant species present – None recorded

Condition of vegetation – Grazed by cattle

Conservation value of vegetation – Low

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 9

Grid reference (beginning and end of section) – M 1845 9342 to M 1853 9342

Length of section (m) – 150

Elevation of section (range) – 50m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Coniferous forestry

Secondary habitat – None

Composition of field boundaries - None

Rare plant species present – None recorded

Condition of vegetation – Conifer trees c. 6m to 8m tall

Conservation value of vegetation – Low

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 9

Grid reference (beginning and end of section) – M 1853 9342 to M 1866 9320

Length of section (m) – 260

Elevation of section (range) – 40m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Wet grassland dominated by *Juncus effusus*

Secondary habitat – *Ulex europaeus* scrub

Composition of field boundaries - None

Rare plant species present – None recorded

Condition of vegetation – Grazed by cattle

Conservation value of vegetation – Low

Other comments:

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 9

Grid reference (beginning and end of section) – M 1866 9320 to M 1910 9263

Length of section (m) – 720

Elevation of section (range) – 20 to 40m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Improved agricultural grassland

Secondary habitat – Hedge
Well-grown hedges present mostly dominated by *Crataegus monogyna* and *Prunus spinosa* with occasional tall trees of *Fraxinus excelsior* and *Acer pseudoplatanus.*

Composition of field boundaries – See above

Rare plant species present – None recorded

Condition of vegetation – Mostly grazed by cattle with occasional fields cut for silage

Conservation value of vegetation – Low

Other comments: The Castlebar river runs through the middle of this section.

Route – Broadhaven to Galway

County - Mayo

1:10,000 Map number – 9

Grid reference (beginning and end of section) – M 1910 9263 to M 1938 9109

Length of section (m) – 1,650

Elevation of section (range) – 40 to 50m

SAC/NHA along/within 1km of proposed route – None

Dominant habitat – Improved agricultural grassland

Secondary habitat – Hedge
Well-grown hedges present mostly dominated by *Crataegus monogyna* and *Prunus spinosa* with occasional tall trees of *Fraxinus excelsior* and *Acer pseudoplatanus.*

Composition of field boundaries – See above

Rare plant species present – None recorded

Condition of vegetation – Mostly grazed by cattle with occasional fields cut for silage

Conservation value of vegetation – Low

Other comments:

Appendix 9.3: Fauna

A FIELD SURVEY AND DESK STUDY RESULTS

1. Carrowmore Lake

This is a large shallow lake with surrounding blanket bog. Bird species recorded during the survey are as follows:

Species	Latin name	Habitat Type	Comment
Reed Bunting	*Emberiza schoenidus*	Reedbed/grassland	Perching
Meadow Pipit	*Anthus pratensis*	Grassland/bog	Flying
Starling	*Sturmus vulgaris*	Grassland	Flying
Mute Swan	*Cygnus olor*	Open water	-
Cormorant	*Phalacrocorax carbo*	Open water	-

This site is known to support a number of bird species which are considered of international conservation significance and which are listed on Annex I of the European Birds Directive. In winter, Greenland White-Fronted Geese utilise the site. In summer, Merlin and Golden Plover breed within the site. An Irish Tern survey (1984) revealed that Sandwich Term (164 pairs) and Arctic Tern (18 pairs) formerly bred within the site, though terns have not bred in recent years. An island within the lake supports an important colony of Common Gulls (600 individuals, 1993). A variety of wildfowl also occur - Tufted Duck and Pochard. Goosander, a very rare species in Ireland, has been recorded in summer but no young have been seen.

2. Lough Dahybaun

This is a lough near the Bellacorrick SAC but outside it. It was examined for birds but the only species recorded during the survey was Mute Swan. It is likely to be host to overwintering birds.

3. Glencullin Upper

The Glencullin River is the southern boundary of the Slieve Fyagh bog SAC. The area contains mountain and lowland blanket bog. Bird species recorded as follows:

Species	***Latin name***	**Habitat Type**	**Comment**
Blue Tit	*Parus caeruleus*	Hedgerow	Perching
Chaffinch	*Fringilla coelebs*	Hedgerow	Perching
Swallow	*Hirundo rustica*	Hedgerow	Flying
Starling	*Sturmus vulgaris*	Open bog	Flying
Kestrel	*Falco tinnunculus*	Open bog	Flying
Golden Plover	*Pluvialis apricaria*	Open bog	Calling

Mammals recorded were Irish Hare and Fox. The bogland was considered of low importance to other mammals.

4. Bellacorrick Bog Complex SAC

This relatively large site is dominated by blanket bog habitat along with young conifer plantations in places. Bird species recorded as follows:

Species	***Latin name***	**Habitat Type**	**Comment**

Swallow	*Hirundo rustica*	Open bog	Flying
Hooded Crow	*Corvus corone*	Open bog	Flying
Goldfinch	*Carduelis carduelis*	Open bog	Flying
Redpoll	*Acanthis flammea*	Willow cover	Perching
Stonechat	*Saxicola torquata*	Open bog	Flying

The habitat has the potential to host other bird species such as Curlew, Golden Plover, Merlin, Hen Harrier, Grouse, Snipe, Skylark and Meadow Pipit.

The Bellacorrick complex incorporates the Owenboy Nature Reserve which is important for birds.

Mammals recorded were Otter, Mink, Fox and Hare. Otters and Mink were recorded along a tributary of the Deel River bordering the SAC. One Mink road traffic casualty was noted. Vegetation cover along the tributary included Willow and Gorse. The tributary was considered of likely moderate importance to otters.

The large expanse of open bog was however considered of low importance to mammals other than those recorded.

5. Ballinloughaun

The habitat features of this site are essentially cutaway bog and conifer plantation. As these habitat types occur regularly on the northern section of the route, this site was selected for a sample field survey also. Bird species recorded as follows:

Species	*Latin name*	Habitat Type	Comment
Swallow	*Hirundo rustica*	Open bog	Flying
Hooded Crow	*Corvus corone*	Open bog	Flying
Meadow Pipit	*Anthus pratensis*	Open bog	Flying
Blue Tit	*Parus caeruleus*	Conifers	Perching
Goldcrest	*Regulus regulus*	Conifers	Perching

Otters were confirmed on the nearby Owenbeg River. Hares may occur but likely at low density. In general, it is a poor site for most mammals.

6. Lough Conn

Lough Conn is of national importance for its waterfowl population. Lough Conn holds nationally important numbers of breeding Common Scoter (32, average maximum in 1987). This species is at its southern European limit in Ireland and is listed in the Irish Red Data Book as an endangered species. There are nationally important numbers of Pochard (1,410 average maximum, 1984/85-1986/87), Mute Swan (130 average maximum, 1984/85-1986/87) and Greenland White-Fronted Geese (138 average maximum, 1984/85-1986/87). These last ones are an Annex I species in the EU Birds Directive. Areas of wet grassland and dense emergent vegetation on the lake shore are their favoured feeding grounds. Teal, Wigeon, Mallard, Whooper Swan, Coot, Golden Plover, Lapwing, Goldeneye and Tufted Duck also frequent this site.

7. Gort (G1800 0145) To Sranalee (M1708 9590)

Assessment: field visit

General description of route section

This section is located several kilometres to the west and south-west of Lough Cullin and, whilst relatively complex in topography, may be summarised as comprised of mountain, hill, upland peat and low-level peat. The underlying geology of the section is principally granite, with schists and gneiss at the south. Granite is commonly exposed in elevated (northern sections), but through much of this section bedrock is overlain by blanket bog. There are pastures in the central portion of the route (Ross West) on drumlin hillock formations, with mineral soils. The land use capability is mostly very limited or extremely limited, with central pastures of limited capability.

Rainfall in this section will vary with elevation and is estimated at between 1150mm and 1300mm, with mean minimum January temperatures of c. 7.4^{o}C and mean maximum July temperature of 17.9^{o}C.

Fauna potential

Upland habitats such as those present in this section tend to be poor in distribution and abundance of mammalian species. Nevertheless, the relative variety of habitats present would allow for several common species to be present, whilst their abundance is likely to be low. Of the larger species, fox *Vulpes vulpes* and Irish hare *Lepus timidicus hibernicus* will be most frequent. The long-tailed field mouse *Apodemus sylvaticus* is ubiquitous, and the pygmy shrew *Sorex minutus*, the hedgehog *Erinaceous europaeus*, and the brown rat *Rattus norvegicus* are likely, especially in farmland. Squirrels are unlikely to occur, with an absence of mature woodland in the area. No signs of badger were noted. No species of deer nor feral goat are anticipated. Otters *Lutra lutra*, an Annexe II species (EU Habitats Directive) are anticipated in the general area and will forage in or traverse through open upland countryside. Tentative signs of the pine marten *Martes martes* were noted.

No locations for bat roosts were observed along the pipeline route, whilst the wetland and farmland habitats do provide feeding areas. Species likely to occur in the vicinity are the common pipistrelle *Pipistrellus pipistrellus*, the soprano pipistrelle *Pipistrellus pygmaeus* and the brown long-eared bat *Plecotus auritus*.

Bird species typical of upland habitat were observed, with common species of pasture farmland and woodland edge present also. Noted were skylark *Alauda arvensis*, meadow pipit *Anthus pratensis* - species very frequent on heaths and moor; also the wren *Troglodytes troglodytes*, dunnock *Prunella modularis*, pied wagtail *Motacilla alba yarrelli*, blackbird *Turdus merula*, robin *Erithacus rubecula*, magpie *Pica pica* and hooded crow *Corvus corone corone*. Likely to occur in the area are stonechat *Saxicola torquata*, snipe *Gallinago gallinago*, songthrush *Turdus philomelos*, cuckoo *Cuculus canorus*, great tit *Parus major*, swallow *Hirundo rustica* and raven *Corvus corax*. Birds of prey such as sparrowhawk *Accipiter nisus*, kestrel *Falco tinnunculus* and merlin *Falco*

columbarius would be anticipated; prey species would be relatively abundant on the heaths and bogs. Similarly, the habitat is suitable for hen harrier *Circus cyaneus* (Annex I, EU Birds Directive) and golden plover *Pluvialis apricaria* (Annex I species).

Frogs *Rana temporaria* are certain to be present, with plentiful breeding pools or ponds. The common lizard *Lacerta vivipara* is also likely to be frequent.

Scientific assessment

This upland habitat is mainly composed of modified blanket bog but includes or fringes a variety of other habitats, including wet grassland, improved pastures, scrub and scrub woodland, coniferous plantation, and raised bog. In general, however, the habitats and the vertebrate species present or likely to occur would be typical of many parts of Co. Mayo and the West. The relatively undisturbed areas of heath and the raised bog areas are of moderate to high conservation value, providing feeding areas and refuges for a variety of vertebrates, particularly birds, and may also harbour invertebrate species of interest. Open heath provides a habitat for scarce birds of prey such as merlin and hen harrier and also golden plover (the latter two species are Annex I species, EU Birds Directive). However, further afforestation of the heath areas is likely to occur in future.

8.North-West Of Rockfield (M1805 9385) To Derrynacross (M1915 9110)

Assessment: field survey

General description of route section

The section is located east of Castlebar, with the Clydagh River at the north and Derynacross crossroads to the south. The route crosses the Castlebar River.

The Clydagh River marks a pronounced transition from exposed acidic bedrocks (sandstone, schists and gneiss) with blanket bog to the north from the glacial till, largely drumlin, landscape to the south. Most of the section south of the Castlebar River is within the drumlin area, with grey brown podzolics on limestone glacial till overlying Carboniferous limestone; interdrumlin areas are peaty and wet. Limestone bedrock is occasionally exposed to surface. Land use capability is limited.

The landscape is gently undulating, varying in elevation from c. 53m asl at Rockfield to c. 42m asl at Derrynacross (Clydagh River at c. 40m asl; Castelbar River at c. 29m asl). The pipeline route crosses near a small southward flowing stream west of Lickeen and another stream north of Derrynacross.

Rainfall in the area is estimated at 1220mm, with mean minimum January temperature of 7.7^{o}C and mean maximum July temperature

of 18.0°C.

Existing fauna potential

The landscape is one principally of pasture grassland, bounded by limestone rock walls and scrub/hedgerow cover of variable quality. These habitats support a number of common vertebrate species typical of woodland edge in the main.

Of note are the various areas of scrub woodland near the route, mainly on peaty inter-drumlin soils, and the blocks of hazel-ash woodland on exposed limestone bedrock. These woodland areas provide cover and feeding for a variety of faunal species. Mammal species noted were badger *Meles meles*, fox and rabbit *Cuniculus oryctolagus*. Many Irish species would be present also, including hedgehog, pygmy shrew, Irish hare, long-tailed field mouse, brown rat, house mouse *Mus musculus* and Irish stoat *Mustela erminea hibernica*. Red squirrel *Sciurus vulgaris* would be occasional. The areas of scrub also provide habitat for the pine marten, a species that occurs in this part of Co. Mayo. Otters (Annexe II) are certainly present on both the major rivers in this section.

The area includes a number of mature deciduous treelines and buildings; with suitable roosting sites, bat species are likely to be well represented, and would include the common and soprano pipistrelle, brown long-eared bat, Leisler's bat *Nyctalus leisleri*, Daubenton's bat *Myotis daubentoni* (at rivers), and possibly the lesser horseshoe bat *Rhinolophus hipposideros* (an Annexe II species).

The adjacent woodland and scrub habitats also provide for a variety of bird species. Noted were hooded crow, magpie, wren, coal tit *Parus ater*, great tit, blue tit *Parus caeruleus*, chaffinch *Fringilla coelebs*, robin, wood pigeon *Columba palumbus*, song thrush *Turdus philomelos* and pheasant *Phasianus colchicus*. Herons *Ardea cinerea* were observed on both rivers. Woodcock *Scolopax rusticola* are seasonally present (pers. comm.). Other common species expected would include blackbird, willow warbler *Phylloscopus trochilus*, rook *Corvus frugilegus*, jackdaw *Corvus monedula*, starling *Sturnus vulgaris*, and swallow. Sparrowhawk and kestrel would also be expected. The kingfisher *Alcedo atthis* is potential (Annex I species, EU Birds Directive).

Suitable habitat for frogs was identified mainly at interdrumlin areas. The common lizard would also occur at woodland edges.

Scientific assessment

Generally, the principal landscape component - improved grassland - is of low conservation value, whilst hedgerows do provide habitat for a variety of faunal species. The principal habitats of interest that serve as wildlife refuge in the vicinity of the pipeline include the ash-hazel woodland near the pipe route, the willow scrub woodland (some of which will be affected by the route), and in particular the two major rivers.

Otters (Annexe II, EU Habitats Directive) are certainly present along

the river systems, and pine marten are likely in scrub woodland. Badgers are also present. Kingfisher (Annex I, EU Birds Directive) may be present.

9. South Of Ballinavoash (M1955 9015) To Manulla (M2190 8765)

Assessment: Geofilm

General description of route section

This route section is located c. 5km east of Castlebar. The underlying geology is one of Carboniferous Limestone, overlain with limestone glacial tills in gently undulating drumlin landscape. Mineral soils are interspersed with interdrumlin peats and peaty gleys. Landuse capability is limited.

Elevation of the route varies from c. 25m asl to c. 48m asl, skirting drumlin peaks of max. 54m asl. The major watercourse in the area is the Manulla River, with one tributary stream.

Rainfall is estimated at 1200mm/annum, with mean minimum January temperature of 7.7°C and a mean maximum July temperature of 18.0°C.

Existing fauna potential

This landscape is not dissimilar to the section visited north of Derrynacross, but lacks substantial scrub woodland or woodland cover. There is a mix of improved pasture grasslands on dry mineral soils with wet grassland on low-lying peaty soils. A narrow wildlife corridor is provided by the railway line. The Manulla River and its tributary provide a habitat for species such as otter (Annex II species). There are few large mature trees and no buildings affected by the pipeline route.

The principal common mammal species are anticipated in this section; these would include rabbit, Irish hare, fox, badger, hedgehog, pygmy shrew, field mouse, and brown rat. The Irish stoat would be occasional. Otters are likely to be present on the river system. The common bat species would also be anticipated to feed in the area, but it is unlikely that roosting sites would be affected by the development. Both the frog and the common lizard are likely to occur.

Birds typical of grassland pastures and wet meadows would be expected, and riparian species such as heron and kingfisher (latter is Annex I species).

Scientific assessment

Assessment of Geofilm aerial photography does not indicate any habitats of especial value for wildlife, whilst the hedgerow and scrub boundaries provide refuge and wildlife corridors.

The principal habitat of interest is the Manulla River and tributary streams, with otters likely to be present, and potentially kingfisher. The wetland habitats west of Manulla and in the vicinity of Manulla Bridge should be checked by field visit; there may be impacts; an

adjoining lake could also be affected (M213 877).

10. Cloonsheen (M3282 5500) To Caltragh (M3480 4800)

Assessment: Geofilm

General description of route section

This section is located approximately 11km west of Tuam. The underlying geology is Carboniferous Limestone. This is an area of flat to undulating lowland with parent limestone glacial till: principally dry mineral soils (brown earths, grey-brown podzols, interspersed with peaty gleys and gleys). Land use capability is somewhat limited.

Elevation is c. 25m asl to c. 35m asl with little variation. There is only one principal watercourse: the Togher River.

Mean annual precipitation is estimated at 1160mm, with mean minimum January temperature of 7.6^{0}C and mean maximum July temperature of 18.4^{0}C.

Existing fauna potential

The relatively uniform landscape of improved grassland and stone wall and scrub boundaries is of low value for wildlife. There is little additional scrub. The principal area of interest is the extent of bog to the west of the pipeline, west of Beagh More.

Ubiquitous mammalian and avian species are likely to be present. There are few trees and no buildings affected by the development, so impacts on bat roosts are unlikely. However, the pipeline appears to fringe limestone bedrock north-west of Caltragh, where OS map indicates a cave. There is potential for roosts of lesser horseshoe bats in caves in this area, which would require further investigation. The abundance of frogs is likely to be low in much of this area. Otters may utilise the Togher River and wetlands in the vicinity.

Scientific assessment

The conservation value of this area appears low, with a uniform grassland landscape, and some limited wet grassland and scrub in the vicinity of the River Togher.

There is potential for lesser horseshoe bats in this area and potential caves should be checked for bat presence, near Caltragh.

11. Carrowkeel Turlough

Carrowkeel is a moderate sized turlough with a high diversity of vegetation. It has permanent water in part. It is subject to grazing pressure. Bird species recorded during the survey are as follows:

Species	Latin name	Habitat Type	Comment
Magpie	*Pica pica*	Hedgerow	Flying
Rook	*Corvus frugilegus*	Hedgerow	Flying
Wren	*Troglodytes troglodytes*	Hedgerow	Perching
Robin	*Erithacus rubecula*	Hedgerow	Perching
Swallow	*Hirundo rustica*	Open turlough	Flying
Lapwing	*Vanellus vanellus*	Rushes	Calling
Woodpigeon	*Columba palumbus*	Open turlough	Flying
Moorhen	*Gallinula chloropus*	Rushes	Calling
Curlew	*Numenius arquata*	Rushes	Calling
Pheasant	*Phasianius colchicus*	Rushes	Calling

Other species of bird to be expected in the Ash/Hawthorn edges bordering the site are Blue Tit, Chaffinch and Song Thrush. In addition to the above, Lapwing were recorded during the vegetation survey perching in rushes and calling at the north-eastern end of the turlough.

The hedgerows bordering the site are considered of likely low to moderate importance to mammals. Elsewhere is considered suitable for Pygmy shrew, but generally unsuitable for other mammal species.

12. Greaghan's Turlough

Greaghan's Turlough is a relatively small site which is moderately grazed. Two streams enter the turlough. Bird species recorded during the survey are as follows:

Species	Latin name	Habitat Type	Comment
Swallow	*Hirundo rustica*	Open turlough	Flying
Rook	*Corvus frugilegus*	Green field	Foraging
Chaffinch	*Fringilla coelebs*	Hedgerow	Perching

Greaghan's Turlough is notable for its use in winter by swans - 40 Whooper Swans, a species listed on Annex I of the EU Birds Directive, were recorded in 1986 on the site.

The site has very little vegetation cover, either in clumps or hedgerows, surrounding the site which is dominated by improved pasture. As such the site offers very little potential for mammals.

13. Turlough O'Gall

Turlough O'Gall is a relatively moderate sized turlough situated east of Caherlistrane. The site includes small pasture fields/meadows with relatively good surrounding hedgerows. Bird species recorded during the survey are as follows:

Species	Latin name	Habitat Type	Comment
Swallow	*Hirundo rustica*	Hedgerow	Flying
Blackbird	*Turdus merula*	Hedgerow	Flying
Wren	*Troglodytes troglodytes*	Hedgerow	Perching
Chaffinch	*Fringilla coelebs*	Hedgerow	Perching
Blue Tit	*Parus caeruleus*	Hedgerow	Perching
Woodpigeon	*Columba palumbus*	Hedgerow	Flying
Robin	*Erithacus rubecula*	Hedgerow	Perching
Rook	*Corvus frugilegus*	Open turlough	Flying

The small meadows have potential for Corncrake (*Crex crex*), though a May survey is required to confirm this. The site is also likely to attract overwintering birds.

Mammals confirmed on site are Irish Hare and Rabbit. The site is also likely to be used by foxes with woodmice and Pygmy shrews utilising the drier site margins.

14. Kilgill (M 3772 3960) To Cahernashilleeny (M4160 3355)

Assessment: Geofilm

General description of route section

This section is located c. 6km north-east of Claregalway. It is flat to undulating lowland of limestone glacial till overlying Carboniferous Limestone bedrock. Soils are principally shallow brown earths, with grey-brown podzolics, gleys and peat. Land use capability is somewhat limited.

Elevation is generally in the range 20 - 30m asl, with an elevated section at Knockdoe (pipeline skirts west of mound, elevation 70m asl). There are no major watercourses in the area.

Mean annual precipitation is estimated at 1050mm, with mean minimum January temperature of 7.8°C and mean maximum July temperature of 18.7°C.

Existing fauna potential

The relatively uniform landscape of improved grassland and stone wall is of low value for wildlife. There is little additional scrub in these grassland areas. Ubiquitous mammalian and avian species are likely to be present. The abundance of frogs is likely to be low in much of this area. There are few trees and no buildings affected by the development, so impacts on bat roosts are unlikely.

The prime area of interest is the limestone pavement and deciduous scrub woodland on limestone in the central portion of the section at Knockdoe. This area may have high conservation value, and merits further investigation by field survey. There is potential for roosts of lesser horseshoe bats and Natterer's bats in caves or crevices in this area, which would also require further investigation. This area is also likely to be prime habitat for pine marten, a protected species. The habitats also provide refuge for a diversity of bird species and invertebrates of interest.

Scientific assessment

The conservation value of much of this section appears low, with a uniform grassland landscape, bounded in the main by bare stone walls.

The limestone pavement and scrub woodland present at Knockdoe is potentially of relatively high conservation value (Annex I Habitat, EU Habitats Directive), and merits additional field study. Pine marten are likely to be present and there is potential for lesser horseshoe bats in this area and potential cave and crevice roosts sites should be checked for bat presence. Bat survey is recommended.

15. Cregmore (M4195 3315) To Craughwell (Garracloon South) (M5265 2135)

Assessment: Geofilm and field survey

General description of route section

The pipeline section is located to the south-east, south-west, west and north-west of Athenry. It is flat to undulating lowland of limestone glacial till overlying Upper and Lower Carboniferous Limestone bedrock. Soils are principally shallow brown earths, with grey-brown podzolics, gleys and peat. Land use capability is somewhat limited.

Elevation over much of the area is c. 25-30m asl, but rising to c. 70m asl at Knocknacreeva and maintaining an elevation of 50m to the south-east (Rathmorrisey). There are no major watercourses in the northern portion of the route, but to the south-west and south of Athenry, the pipeline crosses the Lavally River, the Eiscir River and Dooyertha River. The Clare River is at the northern extent of this section.

Estimated annual precipitation is 1050mm, with mean minimum January temperature of 7.60C and mean maximum July temperature of 18.50C.

Existing fauna potential

A substantial portion of the landscape of this section is relatively uniform improved grassland with boundaries of bare stone walls and low scrub or low hedgerow. These areas are of relatively low value for wildlife. Common mammalian and avian species are likely to be present.

However, unlike the previous section assessed above, there is greater habitat diversity, with substantial areas of scrub, scrub woodland, and also mature treelines and areas of estate woodland. Grassland on thin soils over limestone is associated with encroaching or adjacent scrub and woodland, forming habitat mosaics of wildlife interest. Pine marten are likely to be present in some of these area and badger presence was observed at Garracloon South also. A variety of mammal species would be present also, including fox, Irish stoat, rabbit, Irish hare, hedgehog, pygmy shrew, field mouse and brown rat. Red squirrel *Sciurus vulgaris* is potential. All rivers were suitable for otter (Annex II species), and American mink *Mustela vison* would also be anticipated.

A variety of bat species would be expected in this area, and, as this

section does include mature tree lines, there are potential bat roosts affected by the development. Species anticipated include common pipistrelle, soprano pipistrelle, brown long-eared bat, Leisler's bat, Daubenton's bat (rivers), lesser horseshoe bat (Annex II species) and Natterer's bat.

The diverse scrub habitats also provide refuge for bird species and invertebrates of interest. Bird species noted included wren, robin, blue tit, blackbird, dunnock, pheasant, magpie, and hooded crow. Elsewhere, wood pigeon and black-headed gull *Larus ridibundus* were also noted. Several large rivers are present, so species such as mallard, moorhen, grey heron and kingfisher are expected to occur (the latter is an Annex I species).

Scientific assessment

Whilst much of this section is composed of grassland pastures with boundaries of stone wall, and is of low scientific interest, the pipeline route does pass through a variety of habitats, more varied than some other sections of the route in Co. Galway. In portions, the grasslands are bounded by mature low hedgerow or mature treeline of ash and also estate planting.

The principal areas of wildlife interest are the 4 rivers, and also the larger areas of scrub and scrub woodland; that at Garraghcloon South is associated with semi-improved calcareous grassland; this diversity provides a refuge for vertebrates and invertebrates. Two principal species protected by Directives are likely to occur: otter and kingfisher.

B LIST OF VERTEBRATES AND ADJUDGED STATUS (EXCLUDING BIRDS)

Areas

1 Gort to south-west of Sranalee
2 North-west of Rockfield to Derrynacross
3 South of Ballinavoash to south of Manulla
4 Cloonsheen to Caltragh
5 Kilgill to Cahernashilleeny
6 Cregmore to Craughwell

Presence/absence/status

P present/certain
A absent
T potential
L likely
U unlikely

Status in Study area

Mammals		**1**	**2**	**3**	**4**	**5**	**6**	**north Mayo**	**east Mayo/ Galway**
Insectivora									
Hedgehog	*Erinaceous europaeus*	P	P	P	P	P	P	P	P
Pygmy shrew	*Sorex minutus*	P	P	P	P	P	P	P	P
Chiroptera									
Common pipistrelle	*Pipistrellus pipistrellus*[1]	L	P	P	P	P	P	P	P
Soprano pipistrelle	*Pipistrellus pygmaeus*	L	P	P	P	P	P	P	P
Nathusius's pipistrelle	*Pipistrellus nathusii*	A	A	A	A	A	A	A	A
Brown long-eared	*Plecotus auritus*	L	P	P	P	P	P	P	P
Leisler's	*Nyctalus leisleri*	T	L	L	L	L	L	L	L
Lesser horseshoe	*Rhinolophus hipposideros*	A	A	A	T	T	T	U	L
Whiskered	*Myotis mystacinus*	U	T	T	T	T	T	T	T
Natterer's	*Myotis nattereri.*	U	T	T	T	T	T	T	T
Daubenton's	*Myotis daubentoni*	U	L	L	U	A	P	L	P
Lagomorpha									
Rabbit	*Oryctolagus cuniculus*	P	P	P	P	P	P	P	P
Irish hare	*Lepus timidus hibernicus*	P	P	P	P	P	P	P	P
Rodentia									
Red squirrel	*Sciurus vulgaris*	A	T	T	T	T	T	T	T
Grey squirrel	*Sciurus carolinensis*	A	A	A	A	A	A	A	A
Bank vole	*Clethrionomys glareolus*	A	A	A	A	A	A	A	A
Long-tailed field mouse	*Apodemus sylvaticus*	P	P	P	P	P	P	P	P
House mouse	*Mus musculus*	L	L	L	L	L	L	L	L
Black rat	*Rattus rattus*	A	A	A	A	A	A	A	A
Brown rat	*Rattus norvegicus*	P	P	P	P	P	P	P	P

[1] Two species of Pipistrelle bat are present in Ireland, recent taxonomic revision. The species are identified by the frequency they use for echolocation (46Hz [Common] and 55Hz [Soprano]), and both are common and occur in similar habitats, whilst distribution is not well known in the West.

List of Irish mammals, vertebrates and amphibians

		1	2	3	4	5	6	north Mayo	east Mayo/ Galway
Carnivora									
Fox	*Vulpes vulpes*	P	P	P	P	P	P	P	P
Badger*	*Meles meles*	L	P	L	L	L	P	L	P
Pine marten	*Martes martes*	L	L	U	U	L	L	L	L
Irish stoat	*Mustela erminea hibernica*	T	T	T	T	T	T	T	T
Otter	*Lutra lutra*	L	P	P	L	A	P	P	P
American mink	*Mustela vison*	T	T	T	T	T	P	P*2	P
Artiodactyla									
Red deer	*Cervus elaphus*	A	A	A	A	A	A	A	A
Sika deer	*Cervus nippon*	A	A	A	A	A	A	A	A
Red/Sika hybrids	*Cervus elaphus/nippon*	A	A	A	A	A	A	A	A
Fallow deer	*Dama dama*	A	A	A	A	A	A	A	A
Feral goat	*Capra*	A	A	A	A	A	A	A	A
Amphibians									
Smooth newt	*Triturus vulgaris*	A	A	A	A	A	A	A	A
Frog	*Rana temporaria*	P	P	P	P	T	P	P	P
Natterjack toad	*Bufo calamita*	A	A	A	A	A	A	A	A
Reptiles									
Common Lizard	*Lacerta vivipara*	P	T	T	T	T	T	P	P

*** Badger densities**

Co. Mayo 0.28 social groups/km^2
Co. Galway 0.25 social groups/km^2
Note: densities are for entire counties, including western upland areas, and would generally be considerably higher (e.g. c. 0.5 social groups/km^2) in the grassland areas of pipeline route sections 2-6.

from Smal, C.M. 1995 *The Badger and Habitat Survey of Ireland.*

*2 additional records from L. O'Sullivan, August 2000.

C BIRD SPECIES

Areas

1 Gort to south-west of Sranalee
2 North-west of Rockfield to Derrynacross
3 South of Ballinavoash to south of Manulla
4 Cloonsheen to Caltragh
5 Kilgill to Cahernashilleeny
6 Cregmore to Craughwell

Presence/absence

P present/certain (this survey)
T potential (this survey)
• species also recorded in 1km square survey squares in generally similar landscape types
see notes below (following table)
*2 additional records from pipeline route, L. O'Sullivan, August 2000, for *both Mayo and Galway.*

Status in Study area

		1	2	3	4	5	6	north Mayo	east Mayo/ Galway
skylark	Alauda arvensis	P						P*	T*
meadow pipit	Anthus pratensis	P				T	T	P**2	T**2
great tit	Parus major	T	P	T		T	T	T	P*
blue tit	Parus caeruleus		P	T		T	P	T**2	P**2
coal tit	Parus ater		P	T		T	T		P*
goldcrest	Regulus regulus		T			T	T	T*2	T**2
treecreeper	Certha familiaris		T	T			T		T*
wren	Troglodytes troglodytes	P	P	T	T	T	P	P**2	P**2
dunnock	Prunella modularis	P		T		T	P	P*	P*
chaffinch	Fringilla coelebs		P	T		T	T	T**2	P**2
greenfinch	Carduelis chloris		T	T	T	T	T		T*
goldfinch	Carduelis carduelis		T			T	T	*2	T**2
house sparrow	Passer domesticus	T	T			T	T	T*	T
sand martin	Riparia riparia							*	
linnet	Carduelis cannabina	T						T*	
chiffchaff	Phylloscopus collybita		T	T		T	T		T*
blackcap	Sylvia atricapilla								*
wheatear	Oenanthe oenanthe							*	
stonechat	Saxicola torquata	T						T**2	*2
pied wagtail	Motacilla alba yarrelli	P					T	P*	
grey wagtail	Motacilla cinerea							*	
blackbird	Turdus merula	P	P	T	T	T	P	P**2	P**2
fieldfare	Turdus pilaris		T				T		T*
mistlethrush	Turdus viscivorus		T				T		T*
songthrush	Turdus philomelos	T	P	T		T	T	T	P*
starling	Sturnus vulgaris		T	T			T	**2	T**2

Bird species (cont.)

		1	2	3	4	5	6	north Mayo	east Mayo/ Galway
Robin	Erithacus rubecula	P	P	T	T	T	P	P**2	P**2
Redpoll	Acanthis flammea							*2	**2
spotted flycatcher	Muscicapa striata		T				T		T*
Whitethroat	Sylvia communis		T			T	T		T*
reed bunting	Emberiza schoeniclus							*	*
sedge warbler	Acrocephalus schoenobaenus						T	*	T*
Grasshopper warbler	Locustella naevia					T	T	*	T*
willow warbler	Phylloscopus trochilus	T	T			T	T	T*	T*
Cuckoo	Cuculus canorus	T						T*	
Pheasant	Phasianus colchicus		P	T		T	P	*2	P**2
wood pigeon	Columba palumbus		P				P	**2	P**2
Collared dove	Streptopelia decaocto								*
Swallow	Hirundo rustica	T	T	T		T	T	T**2	T**2
snipe	Gallinago gallinago	T		T			T	T*	T*
Woodcock	Scolopax rustica		P			T			P
grey heron	Ardea cinerea		P	T			T		P*
Magpie	Pica pica	P	P	T	T	T	P	P**2	P**2
hooded crow	Corvus corone corone	P	P			T	P	P**2	P**2
Rook	Corvus frugilegus		T	T			T	*2	T**2
Jackdaw	Corvus monedula		T	T			T	*	T*
Raven	Corvus corax	T					T	T	
Sparrowhawk	Accipiter nisus	T	T			T	T	T	T
kestrel	Falco tinnunculus	T	T			T	T	T*2	T**2
Merlin	Falco columbarius	T						T*	
hen harrier	Circus cyaneus	T						T	
great black-backed gull	Larus marinus							*	
black-headed gull	Larus ridibundus						P	*	P*
Common gull	Larus canus							*	
Lapwing	Vanellus vanellus								*
golden plover	Pluvialis apricaria	T						T**2	**2
Sandwhich tern	Sterna sandvicensis							*	
Cormorant	Phalacrocorax carbo							*	
Teal	Anas crecca							*	
Moorhen	Gallinula chloropus							*2	*2
Curlew	Numenius arquata							*2	*2
mute swan	Cygnus olor							*2	*2
Kingfisher	Alcedo atthis		T	T		A	T		T

Bird Census data
lowland
M4030 [Galway, nr. route section 6], April/June 2000
M5020 [Galway, nr. route section 6], April/June 2000
M3080 [Mayo, south-east of route section 3], April/June 2000;

upland
F8030 [Mayo, route nr. Broadhaven/Carrowmore Lake], May/June 200
G0030 [Mayo, east of route, south-east of Glenamoy], May/June 1999
F9030 [Mayo, south of route, south of Glenamoy], May/June 2000

APPENDIX 9.4 HABITAT TYPES WHICH OCCUR ON OR NEAR THE PROPOSED PIPELINE ROUTE

(note: * indicates an Annex I priority habitat type under the EU Habitats Directive 1992)

The composition and ecology of the main habitat/vegetation types encountered along, adjacent to, and within 1 km. of the proposed route is outlined below. The equivalent habitat in the JNCC Phase 1 Survey Guidelines is given where possible, as are the phytoscociological affinities of the vegetation and the Irish habitat type (according to Fossitt, 2000).

(1) Coniferous plantation

Equivalent Phase 1 survey habitat classification: Coniferous plantation (A1.2.2) and recently-felled coniferous woodland (A4.2)
Fossitt: Conifer plantation (WD4)
Substantial sections of the proposed pipeline route in Co. Mayo are dominated by coniferous forestry on blanket peat. These areas of forestry are at various stages of development ranging from saplings of less than 2 metres to mature trees in excess of 10m in height. The main tree species in these plantations are *Pinus contorta* and *Picea sitchensis*. In areas of mature plantation there is little vegetation present due to the shade cast by the trees, however in areas of plantation less than 10 years old the original blanket bog vegetation can still be seen, albeit in a drained and ungrazed state. In such circumstances *Molinia caerulea* and *Calluna vulgaris* are typically the dominant plant species. The habitat is of low ecological interest.

(2) Wet grassland dominated by Juncus effusus

Equivalent Phase 1 survey habitat classification: Neutral grassland (B2) and Marsh/marshy grassland (B5)
Phytosociological synonymy: Holco-Juncetum effusi *Page 1980*
Equivalent N.V.C. community: *Holcus lanatus-Juncus effusus* rush pasture (MG10)
Fossitt: Wet grassland (GS4)
This type of wet grassland is very commonly encountered in the damp acid soils of Co. Mayo and is especially common in revegetating areas of cutaway blanket bog and abandoned wet pastures. The dominant plant species is the tall rush *Juncus effusus* and in many instances the cover of the species can be so complete that few other plant species co-occur. Vegetation where there is a very high cover of *Juncus effusus* coupled with saturated soils corresponds to the marsh/marshy grassland habitat outlined in Phase 1 survey guidelines. In slightly better drained and more open situations *J. effusus* is generally accompanied by species such as *Holcus lanatus, Agrostis stolonifera, Ranunculus acris, Ranunculus repens, Rumex acetosa, Anthoxanthum odoratum, Cardamine pratensis, Trifolium repens* and *Poa trivialis*. This type of more species-rich *Juncus effusus* grassland corresponds to the neutral grassland category (B2) outlined in the Phase 1 Survey guidelines and is transitional to the semi-improved grassland described in the next section. The vegetation of the habitat is generally of low ecological interest due to its rather species-poor nature and the general absence of rare plant species.

(3) Improved/semi-improved grassland dominated by Holcus lanatus and Lolium perenne

Equivalent Phase 1 survey habitat classification: Semi-improved neutral grassland (B2.2) and Improved grassland (B4)
Phytosociological synonymy: Lolio-Cynosuretum cristati *Braun-Blanquet et De Leeuw1950*
Equivalent N.V.C. community: *Lolium perenne – Cynosurus cristatus* grassland (MG6).
Fossitt: Improved agricultural grassland (GA1).

This grassland type encompasses the better-drained, more agriculturally productive grasslands encountered during the pipeline route survey in Counties Mayo and Galway. In north-west Mayo many areas of this grassland occur on recently reclaimed blanket bog and thus have a damp, acid soil. The dominant species in the vegetation is usually either *Holcus lanatus* or *Lolium perenne* however *Cynosurus cristatus* and *Poa pratensis* can also be locally dominant. Other common and ubiquitous species include *Plantago lanceolata, Trifolium repens, Ranunculus acris, Bellis perennis, Taraxacum officinale, Cerastium fontanum* and *Agrostis capillaris*. In the more intensively managed examples of this grassland type ruderal species such as *Rumex obtusifolius, R. crispus, Cirsium arvense* and *C. vulgare*, are frequently conspicuous. Areas of grassland which have been recently reseeded and are subject to heavy manuring tend to be dominated by floristically poor swards of *Lolium perenne* with few other grass species present. The habitat is generally of low ecological interest due to its species-poor composition, however in some areas of Mayo where pastoral agriculture is of a less intensive nature the grassland vegetation can approach that of unimproved hay-meadow.

(4) Heath dominated by Calluna vulgaris

Equivalent Phase 1 survey habitat classification: Acid dry dwarf shrub heath (D1)
Phytosociological synonymy: Carici binervis – Ericetum cinereae *Braun-Blanquet et Tüxen 1950,*
Equivalent N.V.C. community: *Calluna vulgaris – Erica cinerea* heath (H10).
Fossitt: Dry siliceous heath (HH2).

This low-growing heath vegetation is characterised by the dominance of the dwarf shrub *Calluna vulgaris*. The vegetation is confined to areas where the peat depth is generally less than 1 metre in depth. Although *Calluna* is generally dominant, it is frequently accompanied by *Erica cinerea, Carex binervis, Juncus squarrosus, Potentilla erecta, Galium saxatile, Anthoxanthum odoratum, Agrostis canina* and *Potentilla erecta*. Mosses are relatively frequent however species diversity is not high with *Hypnum cupressiforme, Rhytidiadelphus squarrosus, Hylocomium splendens* and *Pleurozium schreberi* locally common. Along the proposed pipeline route between Pullatomish and Oranmore this habitat is confined to high ground to the south-west of Pontoon where the route traverses a gap through the hills. A habitat of some ecological interest, particularly in view of the recent reduction of both the extent and quality of *Calluna* heath in the west of Ireland due to overgrazing by sheep.

(5) Blanket bog

Equivalent Phase 1 survey habitat classification for intact areas: Blanket bog (E1.6.1)
Equivalent Phase 1 survey habitat classification for cutaway or overgrazed areas: Wet modified bog (E1.7)
Equivalent Phase 1 survey habitat classification for industrially cutaway areas: Bare peat (E4)
Phytosociological synonymy: Pleurzio purpureae – Ericetum tetralicis *Braun-Blanquet et Tüxen 1952.*
Equivalent N.V.C. community: *Scirpus cespitosus – Eriophorum vaginatum* blanket mire (M17).
Fossitt: Upland blanket bog (PB2); Lowland blanket bog (PB3); Cutover bog (PB4); Eroding blanket bog (PB5).

Lowland blanket bog vegetation is frequently encountered along the proposed route of the pipeline in Co. Mayo. Generally the vegetation is dominated by either *Molinia caerulea* or *Schoenus nigricans,* with the low-growing shrubs *Erica tetralix* and *Calluna vulgaris* also frequent. Other common vascular plant species in the vegetation include *Potentilla erecta, Carex panicea, Eriophorum angustifolium, Eriophorum vaginatum, Pedicularis sylvatica, Trichophorum cespitosum, Rhynchospora alba, Narthecium ossifragum* and *Polygala serpyllifolia.* In the drier areas of blanket bog, e.g. cutaway banks, species such as *Calluna vulgaris, Carex panicea, Hypnum cupressiforme* and *Leucobryum glaucum* are more prominent in the vegetation. Areas of blanket bog, which have not been grazed for a considerable time, e.g. along fenced-off fire-breaks, tend to be dominated by *Molinia caerulea,* accompanied by conspicuous *Calluna vulgaris,* a grazing sensitive species. Areas of blanket bog subject to overgrazing by sheep and cattle tend to be characterised by a high proportion of bare surface peat and sparse vegetation which is typically dominated *by Nardus stricta, Eriophorum angustifolium, Eleocharis multicaulis* and the moss *Campylopus introflexus.*
Bryophyte cover in lowland blanket bogs is generally well-developed, especially in wet areas. Species such as *Sphagnum capillifolium, Sphagnum papillosum, Campylopus atrovirens, Rhacomitrium lanuginosum* and *Hypnum cupressiforme* are common and ground cover generally exceeds 30%. In the more undisturbed, waterlogged, deep peat areas there can be well-developed Sphagnum carpets (mostly *S. papillosum, S. magellanicum* and *S. cuspidatum*) accompanied by *Eriophorum angustifolium* and *Rhynchospora alba.* One of the most conspicuous cryptogamic species of Atlantic blanket bog is the purple liverwort *Pleurozia purpurea,* one of the character species of the association. Another striking feature of lowland blanket bog is the presence of extensive carpets of mucilaginous algae (*Zygogonium* spp.) in wet hollows. In areas of deep blanket bog there may be pool areas, however no well-developed pool areas occur within 50 metres either side of the proposed pipeline route. The characteristic plant species of pools are *Menyanthes trifoliata, Sphagnum cuspidatum, Sphagnum auriculatum, Drosera anglica, Eriophorum angustifolium* and *Eriocaulon aquaticum.* Intact areas of blanket bog are of high ecological interest.

(6) Blanket bog flush
Equivalent Phase 1 survey habitat classification = Basic flush (E2.2)
Phytosociological synonymy: Schoenetum nigricantis Koch 1926
Equivalent N.V.C. community: *Schoenus nigricans-Juncus subnodulosus* mire (M13).

Between the northern edge of Owenboy Nature Reserve and the Crossmolina-Belmullet road, there is an extensive area of species-rich flush dominated by *Schoenus nigricans.* This area is influenced by base-rich groundwater that upwells from the lower peat layers and provides the necessary conditions for the growth of basephile plant species. Other common plant species in the vegetation include *Cladium mariscus, Carex lasiocarpa Carex rostrata, Carex limosa, Carex panicea, Eriophorum angustifolium, Juncus subnodulosus, Molinia caerulea, Menyanthes trifoliata, Eriophorum latifolium, Pinguicula vulgaris* and *Carex lepidocarpa.* Plant species low in stature such as *Anagallis tenella, Pinguicula lusitanica, Selaginella selaginoides* and *Linum catharticum* occur in the more open areas scoured by flowing water. The bryophyte component of base-rich flushes is typically well-developed and includes *Drepanocladus revolvens, Scorpidium scorpioides, Campylium stellatum, Fissidens adianthoides, Bryum pseudotriquetrum, Philonotis fontana* and the rare *Homalothecium nitens.* This habitat is of very high ecological interest due to the high number of plant species the habitat supports and the presence of locally rare species such as *Eriophorum latifolium, Homalothecium nitens* and *Vaccinium oxycoccus.*

(7) Transitional bog

Equivalent Phase 1 survey habitat classification: Mapped as E1.6.1 Blanket bog
Phytosociological synonymy: Erico-Sphagnetum papillosi Moore (1962) 1968
Equivalent N.V.C. community: *Erica tetralix-Sphagnum papillosum* raised and blanket mire (M18)

An area of peatland transitional, in terms of structure and vegetation, between raised and blanket bog occurs along the proposed pipeline route approximately 800m north-west of Ross West, Co. Mayo. The peatland area can be viewed as a small area of raised bog which is surrounded by a much larger expanse of intact blanket bog dominated by *Molinia caerulea.* The vegetation of the smaller raised bog area is characterised by a high cover of the dwarf shrubs *Calluna vulgaris* and *Erica tetralix,* accompanied by conspicuous low tussocks of *Trichophorum cespitosum.* Cover of *Sphagnum* is also high and includes the relatively unusual hummock-forming species *Sphagnum imbricatum.* A large number of small, shallow pools are also present. These are typically dominated by *Sphagnum cuspidatum* and also support sparse *Rhynchospora alba, Eriophorum angustifolium* and *Menyanthes trifoliata.* Although there has been some recent fire damage within the area the vegetation appears to be recovering well. The area is of high ecological value because of the unusual structure and floristic composition of the peatland area. In addition, the peatland is one of the most westerly examples of a raised bog 'nucleus' in Co. Mayo.

(8) Raised Bogs

Equivalent Phase I survey habitat classification: Raised Bog E1.6.2.
Phytosociological synonymy: Erico-Sphagnetum magellanici *Moore 1968.*
Fossitt: Raised Bog (PB1)

Characterised by the dominance of *Sphagnum,* with *Calluna vulgaris* (ling) and fewer grasses - in particular *Molinia caerulea* (purple moor grass) - than

blanket bogs, raised bogs are noted for their (usually) hummock and hollow structure. The presence of certain differential species ( ) distinguish raised bogs from Atlantic Blanket Bog (*Andromeda polyfolia* and *Vaccinium oxycoccus*) and Mountain blanket bog (*Sphagnum imbricatum, S. Magellanicum, S.fuscum*).

This plant association has been recorded throughout the Irish midlands (White and Doyle, 1982)

*(9) Turloughs**

Equivalent Phase I survey habitat classification: Turloughs do not readily correspond to any of the categories outlined in this classification scheme. A new habitat category has been assigned to distinguish turloughs from other wet and dry grassland communities.
Phytosociological synonymy: The vegetation of turloughs is generally assigned to the Lolio-Potentillion anserinae *Tüxen 1947*, but also the Caricion davalliniae *Klika 1934*.
Equivalent N.V.C. community: ?
Fossitt: Turloughs (FL6).

Turloughs are ephemeral water bodies that are unique to limestone areas in the west of Ireland, particularly in counties Mayo, Roscommon, Galway and Clare. They appear on the landscape as isolated areas of standing water that do not appear to have any water inlets or outlets. In summer, turloughs exist as dry, rich, calcareous grassy hollows. Typically, the floor of a turlough is comprised of an impermeable layer of lake clay or marl, with one or more 'swallow holes' forming connections to the groundwater system. After periods of heavy rainfall, water wells up from the water-table below, emerging through swallow holes in the floor of the turlough. These swallow holes can vary from 0.5 – 3m in diameter. Periods of immersion can last anything from a few days to a few hours and can take place in any season. In general, these areas remain submerged during the winter months. Where sites contain some permanent standing water, conditions can vary from oligotrophic to eutrophic.

The ecology of these wide, grassy hollows is influenced by fluctuations in the local groundwater-table. As a result, the vegetation of turlough basins is a mixture of aquatic, terrestrial and especially amphibious plants, usually forming a distinct and characteristic concentric zonation pattern. The position of a particular plant species is determined by its tolerance to immersion. Species that are indicative of regular inundation include creeping bent (*Agrostis stolonifera*), marsh foxtail (*Alopecurus geniculatus*), floating sweet-grass (*Glyceria fluitans*), amphibious bistort (*Polygonum amphibium*), common spike-rush (*Eleocharis palustris*), heath bedstraw (*Galium palustre*), shoreweed (*Littorella uniflora*), bogbean (*Menyanthes trifoliata*), along with swamp species such as common reed (*Phragmites australis*), *Typha latifolia* and *Equisetum fluviatile*. Where the vegetation is subject to occasional inundation, species such as common sedge (*Carex nigra*), soft rush (*Juncus effusus*), marsh marigold (*Caltha palustris*), silverweed (*Potentilla anserina*), creeping buttercup (*Ranunculus repens*) and meadowsweet (*Filipendula ulmaria*) are characteristic. These species are found growing in conjunction with a number of swamp species and other

species more typical of dry grassland, such as rough meadow-grass (*Poa trivialis*), perennial rye-grass (*Lolium perenne*), daisy (*Bellis perennis*) and ribwort plantain (*Plantago lanceolata*). The outer limit of water inundation is often marked by a ring of small bushes of hazel, blackthorn, gorse and hawthorn, along with the occurrence of two characteristic bryophyte species. The dark green species found on the sides of boulders is *Fontinalis antipyretica,* while the conspicuous black moss that extends to approximately 1-2m above the high water mark, is *Cinclidotus fontinaloides.* Rare plant species found in turloughs include fen violet (*Viola persicifolia*) and Iceland yellowcress (Rorippa islandica).

The vegetative growth that takes place after the water has receded is extremely lush and considered high quality pasture. As a result, grazing is an important feature of these habitats. These rich wet pastures also play host to a variety of wintering wilfowl, further increasing their ecological value. These include teal (*Anas crecca*), wigeon (*Anas penelope*), whooper swan (*Cygnus cygnus*) and occasionally Greenland white-fronted geese (*Anser albifrons flavirostris*).

Turloughs are of high conservation value for botanical, zoological and ornithological reasons. They are listed as a priority habitat type under Annex I of the EU Habitats Directive (1992).

(10) Hedgerows

Equivalent Phase I survey habitat classification: Hedges (J2)
Phytosociological synonymy: includes elements of the Primulo-Crataegetum *Braun-Blanquet et Tüxen 1952,* Corylo-Fraxinetum *Braun-Blanquet et Tüxen 1952,* Blechno-Quercetum *Braun-Blanquet et Tüxen 1952* and Osmundo-Salicetum atrocinerea *Braun-Blanquet et Tüxen 1952.*
Equivalent N.V.C. community: some affinity with *Crataegus monogyna-Hedera helix* scrub (W21), *Prunus spinosa-Rubus fruticosus* scrub (W22) and *Ulex europaeus-Rubus fruticosus* scrub (W23).
Fossitt: Hedgerows (WL1).

Hedgerows encountered on this survey ranged from a few scattered bushes or trees along the edges of field boundaries, to dense linear strips of shrubs and bushes. These may be associated with other landscape features such as earth walls, ditches, banks, stone walls or a combination of these. In general, the hedges along the pipeline route are dominated by the following species: hawthorn (*Cratageus monogyna*), blackthorn (*Prunus spinosa*), whitebeam (*Sorbus aria*), gorse (*Ulex europaeus*) and elder (*Sambucus nigra*), often found in older, unmanaged hedgerows, in association with ash (*Fraxinus excelsior*), oak (*Quercus robur*), rowan (*Sorbus aucuparia*), willows (*Salix* spp.), horse chestnut (*Aesculus hippocastanum*) and sycamore (*Acer pseudoplatanus*). These hedgerows can be quite species-rich and closely resemble woodland edge communities, although they are less than 5m in width.

The field boundaries encountered along the southern end of the pipeline route, in County Galway, are generally comprised of stone walls, with little

or no hedge communities. The occurrence and diversity of the hedges increases as you progress northwards, through County Mayo.

Although hedgerows may not be of particularly high conservation value in terms of their species richness they act as important wildlife corridors. In view of the rapid rate of destruction of our native broadleaf woodlands, those older hedgerows containing trees of a mature age are of increased ecological value.

(11) Hazel scrub over limestone pavement

Equivalent Phase I survey habitat classification: Scrub (A2)
Phytosociological synonymy: Corylo-Fraxinetum *Braun-Blanquet et Tüxen 1952*
Equivalent N.V.C. community: ?

The proposed pipeline route passes through a number of areas of scrub vegetation, with greater than 50% cover of shrubs and/or small trees. These areas of scrub are generally dominated by hazel (*Corylus avellana*) and overlie areas of limestone pavement, which can often be seen outcropping on the ground. Other species that form the canopy cover include blackthorn (*Prunus spinosa*), whitebeam (*Sorbus aria*), hawthorn (*Crataegus monogyna*) and gorse (*Ulex europaeus*). A number of species of willow (*Salix* spp.) and birch (*Betula* spp.) are occasionally found. The scrub is often dense and impenetrable, with some open patches dominated by nettle (*Urtica dioica*), bracken (*Pteridium aquilinum*), grasses and small herbs such as ground ivy (*Glechoma hederacea*) and wood sage (*Teucrium scordonia*). Typical hazel scrub ground flora includes primrose (*Primula* vulgaris), wood sanicle (*Sanicula* europaea), wood aven (*Geum* urbanum), enchanter's nightshade (*Circaea* luetiana), wood sorrel (*Oxalis* acetosella) and slender St. John's wort (*Hypericum* pulchrum), although the density of the canopy and the presence of large rock outcrops may restrict the occurrence of these species. The greatest diversity of species occurs within the bryophytes and lichens present, many of these being epiphytic on the branches of the trees. Areas of hazel scrub are more prevalent along the southern end of the pipeline route, in County Galway.

Apart from their intrinsic botanical value, particularly owing to the rich variety of bryophytes and lichens present, areas of hazel scrub serve as important wildlife refuges, providing shelter for populations of birds and mammals.

(12) Bare limestone pavement

Equivalent Phase I survey habitat classification: Limestone pavement (I1.3)
Phytosociological synonymy: Corylo-Fraxinetum *Braun-Blanquet et Tüxen 1952*
Equivalent N.V.C. community: ?
Fossitt: Exposed calcareous rock (ER2).

Towards the southern of the pipeline route the pipeline crosses close to a number of patches of level or gently sloping limestone pavement. Pavement may consist of smooth and flat, pale grey rock, although the soft nature of

this rock makes it highly susceptible to water erosion. As a result, it is often fissured and shattered, with lots of loose rock present. The plant species grow precariously in pockets of soil that develop in the rock crevices or 'grykes'. Many of the species typically found in this lime-rich soil are calcicoles, or 'lime-loving' plants. Other species that are typically found in areas of hazel scrub inhabit the deeper crevices of the limestone. The most commonly encountered species include herb Robert (*Geranium robertianum*), wood sage (*Teucrium scordonia*), wild thyme (*Thymus praecox*), purple moor-grass (*Molinia caerulea*), sheep's fescue (*Festuca ovina*), ivy (*Hedera helix*), bloody crane's-bill (*Geranium sanguineum*), maidenhair fern (*Adianthum capillus-veneris*), bramble (*Rubus fruticosus*), false brome grass (*Brachypodium sylvaticum*) and hazel (*Corylus avellana*), as well as a host of orchidaceous species.

Notes on known rare plant species occurring along the proposed pipeline route.

Eriophorum latifolium

Eriophorum latifolium (Broad-leaved Cotton Grass) is a rare species of wet, base-rich fens and flushes. Typically the species grows in peaty soils irrigated by water with a high pH (6-8) and high calcium content (15 to 60 mg/l) (Conaghan, 1995). Although the species is widely distributed throughout Ireland, it is nowhere common and is either absent or very rare in a number of counties, especially in the south of the country (Scannell and Synnott, 1987). The species is occasional in the base-rich bog flush to the east of Eskeragh (G 053 185) and a re-routing of the pipeline away from this area of flush and surrounding blanket bog has been advised.

Vaccinium oxycoccus

Although *Vaccinium oxycoccus* is relatively common in Midland raised bogs, the species is rare in the counties along the western seaboard of Ireland. In the blanket bog systems of Co. Mayo the species has been recorded from approximately 15 sites, which are either base-rich flushes or Sphagnum lawns along the margins of blanket bog pools. The species has previously been recorded from the base-rich bog flush to the east of Eskeragh (G 053 185) (Douglas *et al.*, 1989).

Homalothecium nitens

Homalothecium nitens is a moss of base-rich bog flushes and fens. It is rare in Ireland, being previously recorded from only 5, 10 kilometre squares (Hill *et al.*, 1994). The blanket bog flushes of Co. Mayo are the headquarters of the species in Ireland, where it has been recently recorded from 8 sites (Lockhart, 1987) including the base-rich bog flush to the east of Eskeragh (G 053 185).

Najas flexilis

Najas flexilis is a rare aquatic plant species which is protected by the 1999 Flora Protection Order. In addition, due to the rarity of the species in Western Europe, it is listed under Annex 2 of the Habitats Directive, which confers upon it protection under European law. In Ireland the species is largely confined to oligotrophic lakes along the Atlantic seaboard where it has previously been recorded from at least 30 sites (Curtis and McGough, 1988). In Co. Mayo the only known site for the species is Lough Dahybaun

(G 00 20), located approximately 3 km to the west of Bellacorrick and 200 to 400m north of the proposed route of the gas pipeline. Damage to the oligotrophic water habitat of *Najas flexilis* in this lake, due to future construction of a gas pipeline, is not anticipated.

References

Conaghan, J.P. (1995). *The Ecology of* Eriophorum gracile *and* Eriophorum latifolium *in Ireland.* Ph. D. Thesis, National University of Ireland.

Coxon, C.E. (1986). *A study of the hydrology and geomorphology of turloughs.* Unpublished Ph.D. Thesis, Trinity College, Dublin.

Curtis, T.G.F. & McGough, H.N. (1988). *The Irish Red Data Book. 1: Vascular Plants.* The Stationery Office, Dublin.

Douglas, C., Garvey, L., Kelly, L. and O' Sullivan, A. (1989). *A survey to locate blanket bogs of scientific interest in County Mayo.* A report commissioned by The Wildlife Service, Office of Public Works, Dublin.

E.C. (1992*). Council Directive 92/43/EEC of 21 My 1992 on the conservation of natural habitats and of wild fauna and flora.* Official Journal no. L 206, 22/07/92.

Goodwillie, R. (1992). *Turloughs over 10ha: Vegetation Survey and Evaluation.* Unpublished report for the National Parks and Wildlife Service, Office of Public Works, Dublin.

Lockhart, N. D. (1987). The occurrence of *Homalothecium nitens* (Hedw.) Robins. in Ireland. *Journal of Bryology,* **14**, 511-517.

Scannell, M.J.P. and Synnott, D.M. (1987). *Census Catalogue of the Flora of Ireland.* (2nd edition). Stationery Office, Dublin.

DESIGNATED CONSERVATION AREAS

Most of the following sites are: traversed by, adjacent to or are located 1 km. or less from the proposed pipeline route. A few sites are located further than 1km. from the proposed route, but due to their ecological significance are included here in order that they be taken into consideration should the route be altered at a later stage prior to construction.

Carrowmore Lake Complex (SAC no. 476)

This large site, located to the north of Bangor village in Co. Mayo, comprises Carrowmore lake and adjoining areas of blanket bog. The lake itself is a large, shallow, oligotrophic lowland lake which occupies an area of approximately 960 hectares, has a maximum depth of between 2.5 and 3 metres and a circumneutral pH. The vegetation of the lake is typically sparse, reflecting its relatively low productivity. In shallow water along the lake edge plant species such as *Eleocharis palustris, Littorella uniflora, Juncus bulbosus, Hydrocotyle vulgaris, Iris pseudacorus* and *Juncus effusus* are typical. In deeper water there are occasional stands of sparse *Phragmites australis* and *Schoenoplectus lacustris.* The pondweed *Potamogeton perfoliatus* has been recorded from the deeper lake waters. In the heathy transition between lakeshore and surrounding blanket bog, the relatively rare heather *Erica erigena* grows. This species, though locally common in parts of west Mayo, is in Ireland, otherwise only known from a couple of locations in Connemara. The lake and adjoining areas of blanket provides habitat for a number of important bird species including Greenland-White-fronted Goose, Golden Plover and Merlin, all of which are listed on Annex I of the European Birds Directive.

Blanket bog dominates the remainder of the site and the best-developed and most extensive area of the habitat occurs at Largan More, c. 6 km south-east of Carrowmore Lake. Here a wide variety of blanket bog micro-habitats are evident including hummocks, lawns, pools, pool islands and flushes. Typical species of the pools include *Eriocaulon aquaticum, Menyanthes trifoliata, Nymphaea alba* and *Lobelia dortmanna.* The flushed areas contain a wide variety of sedge species such as *Carex limosa, Carex lasiocarpa, Carex rostrata* and *Carex lepidocarpa* and a number also contain *Vaccinium oxycoccus*, a very species in blanket bog regions in the west of Ireland. The very rare and protected plant species *Saxifraga hirculus*, has been recently recorded from blanket bog flushes within the site. The species is listed under Annex II of the European Habitats Directive and within the Republic of Ireland, it is confined to a handful of sites in the blanket bogs of Co. Mayo. The condition of the site is generally good however overgrazing by sheep and turf cutting have locally damaged areas of blanket bog. This damage is particularly evident close to roads and tracks.

The proposed gas pipeline route traverses this site at one point namely Glencullin Upper where the blanket bog is largely intact and is of high quality. Approximately 400 metres of blanket bog in this area will be affected.

Slieve Fyagh Bog (SAC no. 542)

Slieve Fyagh bog is a large area of blanket bog and upland covering an area of approximately 2,300 hectares, located in north-west Co. Mayo. The site is dominated by the mountain of Slieve Fyagh, which reaches a height of just over 300 metres. One of the most noteworthy features of the site is the variation in bog type within the site with examples of mountain, highland and lowland blanket bog present. Mountain blanket bog vegetation on the summit plateau of the mountain is largely intact and is dominated by *Calluna vulgaris, Empetrum nigrum, Vaccinium myrtillus, Eriophorum vaginatum, Rhytidiadelphus loreus* and *Hypnum jutlandicum.* A noteworthy component of the vegetation is the diminutive orchid *Listera cordata,* which is otherwise rare in the county. Along the edges of the summit plateau there is erosion of blanket bog taking place. In addition to the intact mountain blanket bog, the summit contains a number of small oligotrophic lakes and pool systems. Plant colonists of the shallow lake margins include *Carex rostrata* and *Lobelia dortmanna.* The presence of relatively intact mountain blanket bog, along with associated lakes and pools, is a very rare occurrence in County Mayo and thus the site constitutes one of the best- developed areas of this blanket bog type in the county.

The rather steep slopes of Slieve Fyagh are dominated by a mosaic of habitats including acid grassland, wet heath, blanket bog and mountain streams. Due to the combination of steepness of slope and heavy grazing by sheep, this area is somewhat degraded. Below and altitude of 150 metres the terrain is dominated by lowland blanket bog in which *Molinia caerulea, Schoenus nigricans, Erica tetralix, Eriophorum angustifolium, Potentilla erecta, Rhynchospora alba* and *Trichophorum cespitosus* are the characteristic species. These areas of lowland blanket bog also contain numerous pool systems colonised by *Eriocaulon aquaticum, Menyanthes trifoliata* and *Utricularia minor.* The condition of the site at present is variable. Much of the site is has been seriously affected by overgrazing and, in addition, turf-cutting is a problem in some of the low-lying areas of blanket bog. Substantial areas of surrounding peatland have been afforested within the past 30 years.

Although no area of this site will be traversed by the proposed gas pipeline, the pipeline route does come within 150 metres of the margins of the site in the Glencullin valley.

Bellacorrick Bog Complex (SAC no. 1922)

Bellacorrick bog complex is located in the north-west of Co. Mayo and is considered to be the most extensive and best-developed area of blanket bog in the county. Most of the bog is of the lowland type, however some areas have morphological characteristics intermediate between lowland and raised bogs. Most of the landscape features of lowland blanket bog can be seen within the site and within this site they are usually very well-developed. Examples of these features include undifferentiated bog, swallow holes, interconnecting pool systems, pool islands, bog streams and base-rich flushes.

The ombrotrophic blanket bog vegetation is dominated by *Molinia*

caerulea and *Schoenus nigricans,* accompanied by *Erica tetralix, Eriophorum vaginatum, Eriophorum angustifolium, Potentilla erecta, Rhynchospora alba, Trichophorum cespitosus* and *Sphagnum* species such as *S. capillifolium* and *S. papillosum.* Pool areas are particularly well-developed and the site contains many areas of deep quaking peat characterised by large oblong pools. Many of these large pools are almost devoid of vegetation, however some are colonised by *Sphagnum cuspidatum, Eriophorum angustifolium, Eriocaulon aquaticum* and *Menyanthes trifoliata.* Well-developed collapsed swallow-hole systems, fringed by dry heath vegetation, occur frequently, with particularly good examples evident at Srahlahy. One of the most important aspects of blanket bog habitat within the site is the presence of extensive base-rich flushed areas. The vegetation of such areas is typically characterised by a high cover of *Schoenus nigricans* and *Phragmites australis,* with prominent patches of *Cladium mariscus.* Sedges (*Carex* spp.) such as *Carex limosa, Carex hostiana, Carex rostrata* and *Carex lepidocarpa* are a common feature of the vegetation. Flush areas provide the habitat for a large number of rare plant species including *Vaccinium oxycoccus, Eriophorum latifolium, Saxifraga hirculus, Leiocolea rutheana, Paludella squarrosa, Homalothecium nitens, Sphagnum warnstorfii* and *Drepanocladus vernicosus.* Of these species, *S. hirculus, L. rutheana, P. squarrosa* and *D. vernicosus* are protected under the 1999 Wildlife Protection Order, while *S. hirculus* and *D. vernicosus* are, in addition, both listed in Annex 2 of the European Habitats Directive. Although overgrazing is occurring in parts of this site, the blanket bog habitat is generally intact. Turf cutting is also a continuing problem, however this is largely confined to along the sides of roads.

The proposed gas pipeline route traverses this site at a number of points between Eskeragh and the Shanvolahan River. The ecological quality of the site within these areas is variable, ranging from afforested blanket bog to species-rich, blanket bog flush.

Lough Conn and Lough Cullin (Site Code: 519)

Lough Conn (G 18 13) is a large (50km^2) calcareous freshwater lake with several reefs and inshore islands and a shallow shoreline. It is part of the Lough Conn and Lough Cullin Natural Heritage Area (NHA) owing to the fish species utilizing the lakes and the vegetation along the shoreline. The site supports an excellent diversity of flora and fauna and is notably the only Irish site for the protected plant, great burnet (*Sanguisorba oficinalis*). Marginal habitats include fen, freshwater marsh, wet grassland, rocky shoreline, cutover bog and deciduous woodland. It also supports nationally important populations of a number of species of waterfowl

Lough Conn is situated where the Carboniferous limestone of the Central Plain meets the harder, more resistant siliceous rocks (granite, gneiss and schist) of the Connaught Uplands. It discharges southwards to the River Moy, passing through the smaller Lough Cullin. While limestone and granite underlie Lough Conn, Lough Cullin is underlain by the Pre-Cambrian metamorphic rocks of the Ox Mountain Complex. Apart from their different underlying geology and size, these two lakes differ in their water chemistry.

Lough Conn is rated as one of the finest, natural, wild brown (*Salmo trutta*) trout fisheries in Europe. Other fish species known to occur include salmon (*Salmo salar*), pike (*Esox lucius*), perch (*Perca fluviatilis*) and rudd (*Scardinius erythrophthalmus*). Recent agricultural intensification in the surrounding countryside has led to some eutrophication, theatening the water quality of the lake. It is now considered to be mesotrophic in character. Arctic charr (*Salvelinus alpinus*) are thought to be virtually extinct, following a dramatic decline in the late 1980's, as a result of increased eutrophication (McGarrigle et al., 1993).

The limited aquatic flora contains several pondweed species (*Potamogeton spp.),* with occasional bladderwort (*Utricularia intermedia*), water lobelia (*Lobelia dortmanna*), common reed (*Phragmites australis*), water lily (*Nuphar lutea*) and least bur-reed (*Sparganium minimum*). The marginal wetlands support the rare and protected heath cudweed (*Omalotheca sylvatica*). Another protected species, Killarney fern (*Trichomanes speciosum*) has also been recorded (RECENT RECORD?).

The two lakes are divided by a peninsula containing a steep-sided granite-based hillside, covered by one of the best examples of Atlantic oak woodland in the region. This semi-natural woodland is known as Pontoon wood. The canopy of oak (*Quecus petraea*) contains some aspen (*Populus tremula*) and birch (*Betula spp.*) with a well-developed understorey, dominated by holly (*Ilex aquifolium*). Species of note include narrow-leaved helleborine (*Cephalanthera longifolia*) and intermediate wintergreen (*Pyrola media*).

Carrowmore Lough Shore (Site Code: 1492)

Carrowmore Lough (M230885) is a proposed Natural Heritage Area (NHA) owing to the diversity of habitat types and substrate present. It is a relatively deep large lake, lying in a depression in calcareous rocks. The diverse shoreline supports a range of habitats including cutover raised bog, limestone outcrop, fen and mineral marsh. Reed beds do occur, although the marly conditions are thought to limit their development and spread. The ridges of limestone are dominated by hazel (*Corylus avellana*) and willow (*Salix* spp.) scrub. Seasonally flooded parts of the shoreline contain yellow wort (*Blackstonia perfoliata*), mountain everlasting (*Antennaria dioica*) and purging flax (*Linum catharticum*), while the fen contains the clubmoss *Selaginella selaginoides*, creeping willow (*Salix repens*) and meadow thistle (*Cirsium arvense*). The drier areas of grassland are characterised by the presence of carline thistle (*Carlina vulgaris*), bird's foot trefoil (*Lotus corniculatus*), mouse-eared hawkweed (*Hieracium pilosella*), autumn gentian (*Gentianella amarella*) and wild carrot (*Daucus carota*). Royal fern (*Osmunda regalis*) and field gentian (*Gentianella campestris*) are found on the areas of cutover peat, while grass of Parnassus (*Parnassia palustris*) and long-stalked yellow-sedge (*Carex lepidocarpa*) grow closer to the lake. The presence of a variety of waterfowl in significant numbers, including common gull (*Larus canus*), black-headed gull (*L. ridibundus*) and great crested grebe (*Podiceps cristatus*) increases the conservation value of the site.

Carrowkeel Turlough (Site Code: 475)

Carrowkeel Turlough (M302693) is designated as a Special Area of Conservation (SAC) owing primarily to its high botanical diversity and natural state. Despite its relatively small size, the turlough contains a high diversity of habitats and displays a clear zonation in its vegetation, reflecting frequency of immersion, as well as depth and quality of the water. The northern section also contains a small spring, which has led to the development of a scraw community. This vegetation is unique to this turlough and contains the rare narrow-leaved water-plantain (*Alisma lanceolata*). The presence of a variety of nesting birds including coot (*Fulica atra*), little grebe (*Tachybaptus ruficollis*) and mallard (*Anas platyrhynchos*), along with other wildfowl such as snipe (*Gallinago gallinago*) and lapwing (*Vanellus vanellus*) further increases the conservation value of the site.

Carrowkeel Turlough is located approximately 2km from the River Robe, between the towns of Ballinrobe and Claremorris, County Mayo. It differs from other turloughs in the immediate area, which are contained in shallow basins with predominantly grass-covered floors. Carrowkeel Turlough, on the other hand, is contained in a northeast-southwest orientated linear basin that is dominated by a shallow lake, known as Poll Oilean-na-gCorr. This lake is spring fed and spreads to cover a much larger area in winter. Flooding still appears to occur naturally. The turlough is relatively oligotrophic (nutrient-poor) in nature, although slight eutrophication may be linked to the adjacent farms. The catchment area for Carrowkeel turlough is estimated to cover 560 ha (Goodwillie, 1992).

The high habitat diversity is linked to the permanent presence of standing water in parts of the turlough. The scraw at the northern end of the basin consists of floating sweet grass (*Glyceria fluitans*), water horsetail (*Equisetum fluviatile*), bladder sedge (*Carex vesicaria*), fine-leaved water-dropwort (*Oenanthe aquatica*), bogbean (*Menyanthes trifoliata*). A distinct zone of vegetation with common spike-rush (*Eleocharis palustris*), unbranched bur-reed (*Sparganium emersum*), creeping bent (*Agrostis stolonifera*) occurs within this scraw, growing with water-plantain (*Alisma plantago-aquatica*) and the rare narrow-leaved water-plantain (*A. lanceolata*). Areas of open water within the lake contain thread-leaved water-crowfoot (*Ranunculus trichophyllus*), lesser marshwort (*Apium inundatum*) and broad-leaved pondweed (*Potamogeton natans*), while common club-rush (*Scirpus lacustris*), fine-leaved water-dropwort (*Oenanthe aquatica*), amphibious bistort (*Polygonum amphibium*), water horsetail (*Equisetum fluviatile*) and the mosses *Drepanocladus revolvens* and *Calliergon giganteum* are found around the lake edge. The scarce marsh stitchwort (*Stellaria palustris*) is also found scattered throughout the turlough. Cattle and sheep graze the entire area.

Turloughs are of high conservation value for botanical, zoological and ornithological reasons. They are listed as a priority habitat type under Annex I of the EU Habitats Directive (1992).

Greaghan's Turlough (Site Code: 503)

Greaghan's Turlough (M290625) is a proposed Special Area of Conservation (SAC) owing to its variety of well-developed vegetation communities, the occurrence of a rare plant species and a large population of wintering Whooper swan (Cygnus cygnus). Turloughs are rare and threatened habitats that are of high conservation value for botanical, zoological and ornithological reasons. They are listed as a priority habitat type under Annex I of the EU Habitats Directive (1992). Despite its somewhat uniform topography Greaghan's is valuable as an undrained turlough with a variety of well-developed vegetation communities. Goodwillie (1992) rates this turlough of Regional Importance.

Greaghan's Turlough is situated approximately 10km from the town of Ballinrobe. It is the most easterly of a group of five turloughs. Its flattish, oval basin is deepest along the northern edge. Two streams feed the area, one from the northeast and another from the south, the latter being ephemeral. The main swallow hole occurs close to Greaghan's farm.

The wettest areas in the turlough are dominated by amphibious bistort (*Polygonum amphibium*), grading through common sedge (*Carex nigra*), jointed rush (*Juncus articulatus*) and lesser spearwort (*Ranunculus flammula*) into dry grassland. This grassland community is species-rich in the eastern end, but species-poor in the western end, owing to slight nutrient enrichment. Cattle graze the entire area. Where cattle grazing and trampling is intensive an unusual area of vegetation dominated by annual plant species such as water-pepper (*Polygonum hydropiper*), redshank (*P. persicaria*), common chickweed (*Stellaria media*), thread-leaved water-crowfoot (*Ranunculus trichophyllus*), marsh foxtail (*Alopecurus geniculatus*) and the rare northern yellow-cress (*Rorippa islandica*). The northern side of the turlough contains a fringe of reed canary grass (*Phalaris arundinacea*), meadowsweet (*Filipendula ulmaria*), creeping cinquefoil (*Potentilla reptans*) and creeping-jenny (*Lysimachia nummularia*). Behind this fringe of vegetation are low spurs covered in ash (*Fraxinus excelsior*), hawthorn (*Crataegus monogyna*) and spindle (*Euonymous europaeus*). The presence of Whooper swan (*Cygnus cygnus*) adds significantly to the value of the site.

Turlough O'Gall (Site Code: 331)

Turlough O'Gall (M346509) is designated as a Special Area of Conservation (SAC) owing to its high habitat diversity and species richness. The presence of the largest stand of sedge heath and second largest stand of limestone grassland in any turlough, are particularly noteworthy. Overall, this site is relatively dry, although the presence of some ponds and rocky outcrops increases the habitat diversity.

The turlough covers an area of 50.9ha and is located approximately 3km west of the town of Belclare, between the towns of Shrule and Tuam. The complex local hydrology is the topic of some debate. There are a number of other important turloughs in the surrounding area, including Turlough Monaghan, Belclare Turlough and Kllower Turlough. While Turlough O'Gall has not been subject to any obvious

on-site drainage modifications, Coxon (1986) considers that arterial drainage of the Clare River has curtailed flooding. Goodwillie (1992), however, suggests that the turlough lies in the Black River catchment, rather than the Clare River, receiving some of its water from the hills to the south. He considers the catchment area to cover approximately 240ha.

The vegetation is dryish in character, reducing the potential of the site for breeding waders and waterfowl. The dominant species in the limestone grassland found in the southern half of the site, include creeping fescue (Festuca rubra), purple moor-grass (Molinia caerulea), lady's bedstraw (Galium verum), daisy (Bellis perennis), yarrow (Achillea millefolium) and glaucous sedge (Carex flacca). Where the soil is slightly leached mat grass (Nardus stricta) invades. The wet areas are dominated by broad-leaved pondweed (Potamogeton natans), curled pondweed (P. crispus), bogbean (Menyanthes trifolitata), common water-plantain (Alisma plantago-aquatica) and horned pondweed (Zannichellia palustris), fringed by vegetation dominated by amphibious bistort (Polygonum amphibium). Areas of hawthorn-dominated scrub, with scattered creeping willow (Salix repens) and buckthorn (Rhamnus catharticus are limited.

The surrounding countryside is very flat but the turlough can be viewed from the Knockmaa ridge to the south. The floor of the basin is uneven because of the bedrock, especially in the eastern half. To the west, there is a large expanse of level ground based on flat limestone which occasionally outcrops. The flat areas around the central lakes seem to have been partly dug out, perhaps as marl pits. Quite deep marl deposits occur in the basin (90-150cm) and they are normally covered by 10cm of peaty soil.

Turloughs are of high conservation value for botanical, zoological and ornithological reasons. They are listed as a priority habitat type under Annex I of the EU Habitats Directive (1992).

Knockmaa Hill (Site Code: 1288)

Knockmaa Hill is a proposed Natural Heritage Area (NHA), owing to its botanical value as a good example of native broadleaf woodland on thin limestone soil. This type of habitat is considerably rare in this part of the country. The area is of archaeological importance. Knockmaa (552ft), which dominates the local countryside, is named after Queen Meadhbh. Close to the summit is a cairn, while the ruins of a Knight's tower and Finbarra's Castle, an $18^{th}/19^{th}$ century folly, are located nearby. The area of scientific interest lies in the afforested northern and northwestern slopes of Knockmaa Hill, a limestone knoll, located approximately 10km west of the town of Tuam. This woodland is locally known as Horse Shoe Wood. The dominant native species are ash (*Fraxinus excelsior*) and oak (*Quercus* spp.), with alder (*Alnus glutinosa*) occurring in the wetter seepage areas. The ground flora is species-rich and is highly representative of ash/oak woodland. A variety of exotic trees such as beech (*Fagus sylvatica*), sycamore (*Acer pseudoplatanus*), cherry laurel (*Prunus laurocerasus*), larch (*Larix* spp.) and pine (*Pinus* spp.) also occur within the woodland. There is evidence that there is

some natural regeneration of beech and sycamore. The ecological value of the site is further enhanced by the occurrence of species-rich limestone pavement vegetation at the summit. This vegetation is typical of lime-rich soils. Locally, small areas of acidic heath vegetation have established where the weathering of impurities (chert) in the limestone can produce a clay-like soil, on which peaty conditions may develop.

Rahasane Turlough (Site Code: 322)

Rahasane Turlough (W847531) is designated as a Special Area of Conservation (SAC) owing to its botanical and ornithological importance. It is considered to be the most important turlough for birdlife in the country. It contains high habitat diversity and supports two rare plant species listed in the Irish Red Data Book. Atlantic salmon (*Salma salar*), a priority species on Annex II of the EU Habitats Directive (1992), travel through the river when it is flowing overground. The rare fairy shrimp, *Tanymastix stagnalis*, thrives in the isolated southern basin. Overall, it is one of the country's finest examples of a naturally functioning turlough.

Rahasane Turlough is located approximately 2km west of the town of Craughwell, County Galway. It was formerly the natural sink of the River Dunkellin, but an artificially created channel now takes some of the water further downstream. The turlough consists of two basins, the larger northern one taking the Dunkellin River westwards. Active swallow holes are present throughout the area. The substrate is predominantly silty clay with shell fragments, with some evidence of marl in the main basin. There is a complete absence of peat. The large catchment area results in a naturally eutrophic and productive system. For the most-part, the turlough is open, flat and grassy, with occasional depressions and dry channels. The edges of the turlough rise gradually into the gently undulating surrounding land, except in the southern basin, where high rocks mark a more sudden transition.

Distinct wet and dry communities are displayed within the turlough basin, the wet communities being closely associated with the river channel and pools. The wettest areas contain fan-leaved water crowfoot (*Ranunculus circinatus*), fennel pondweed (*Potamogeton pectinatus*), lesser pondweed (*P. pusillus*), fat duckweed (*Lemna gibba*), whorled water-milfoil (*Myriophyllum verticillatum*) and needle spike-rush (*Eleocharis acicularis*). The fringes of these wet areas are colonized by lesser water-parsnip (*Berula erecta*), fool's water-cress (*Apium nodiflorum*), river water-dropwort (*Oenanthe fluviatilis*) and amphibious bistort (*Polygonum amphibium*), along with the rare northern yellow-cress (*Rorippa islandica*). Where there is regular flooding another rare species, the fen violet (*Viola persicifolia*), is found growing with common spike-rush (*Eleocharis palustris*). The areas less frequently immersed supports species such as creeping cinquefoil (*Potentilla reptans*), common sedge (*Carex nigra*), silverweed (*Potentilla anserina*) and creeping bent (*Agrostis stolonifera*). Where the underlying limestone outcrops, particularly in the southern basin, the vegetation is dominated by red fescue (*Festuca rubra*) and crested dog's tail (*Cynosurus cristatus*) among a calcicolous grassland community. The turlough is fringed along the southern and northwestern by scrub

vegetation dominated by buckthorn (*Rhamnus cathartica*), hazel (*Corylus avellana*) and ash (*Fraxinus excelsior*). The branches of these trees support a rich epiphytic community with *Leskea polycarpa, Amblystegium riparium, Isopterygium elegans, Isothecim myosuroides* and *Thuidium tamariscinum.* Cattle, sheep and horse grazing helps to maintain the habitat diversity and species richness.

The ornithological value of the site is based on the presence of internationally important populations of wigeon (*Anas Penelope*) and shoveler (*A. clypeata*). Other regularly occurring birds including golden plover (*Pluvialis apricaria*), Greenland white-fronted goose (*Anser albifrons flavirostris*), Bewick's swan (*Cygnus columbianus bewickii*) and whooper swan (*Cygnus cygnus*), are listed on Annex I of the Birds Directive. It is also the largest inland site for dunlin (*Calidris alpina*) in the British Isles.

Turloughs are of high conservation value for botanical, zoological and ornithological reasons. They are listed as a priority habitat type under Annex I of the EU Habitats Directive (1992). Rahasane Turlough's importance lies in the fact that it is one of only two large naturally functioning turloughs. Goodwillie's assessment of Irish turloughs in 1992 rated Rahasane turlough as the one of international importance, second only to Coole/Newtown turlough.

Route –

County -

Section code –

1:10,000 Map number –

Grid reference (beginning and end of section) –

Length of section –

Elevation of section (range) –

SAC/NHA along/within 1 km of, proposed route –

Dominant habitat –

Characteristic plant species -

Secondary habitat –

Characteristic plant species -

Composition of field boundaries –

Rare plant species present –

Condition of vegetation –

Conservation value of vegetation –

Other comments:

APPENDIX 10.1

DETAILED SITE DESCRIPTIONS OF WATERCOURSE CROSSINGS

Crossing 1 Unnamed Tributary of Carrowmore Lake

Townland: Muingingaun

Ir. Grid Ref: F 8703 3132

Channel dimensions: width: 3.5m; depth 13cm

Banks: RHS 1.0m, ~ vertical; LHS 1.2m ~ vertical

Bankside Composition: Peat soil over till and patches of bedding rock.

Substrate: scattered cobbles, small stones and gravel

Flow: moderate in glide/pools, moderate-swift and turbulent in riffles.

Channel Habitat: typical small-scale pool, pool/glide, riffle sequence.

In-Channel Vegetation: generally plant-free,

Bankside Vegetation:
Soft Rush (*Juncus effusus*), Yellow Flag (*Iris pseudacorus*), *Rhytidiadelphus* occurred on the banks which were backed by a narrow (20m) strip of sheep pasture backed by cutaway bog.

Macroinvertebrates / Water Quality: water appeared clean, clear and silt free.

Macroinvertebrates included *Isoperla, Chloroperla, Rhithrogena, Baetis* and *Elminthidae.* A salmonid fry was also taken in a kicksample. Q5

Fisheries Value: ideal salmonid nursery and spawning habitat. Locals reported salmon spawning along this stretch in December, presumably well strung out as the channel is narrow.

Site Descriptions Broadhaven - Galway

Crossing 2 Unnamed Tributary of Carrowmore Lake

Townland: Glenturk More

Ir. Grid Ref: F 8699 2955

Channel dimensions: width 0.75-1.5 m, depth 5-7cm

Banks: small gorge with LHS bank several metres high, RHS shallow and open by the channel and high set back.

Bankside Composition: dominated by sandy material with some till; eroding.

Substrate: large and small boulders with cobbles and large gravel.

Flow: low at the time, slow to moderate in pools and turbulent over small cascades; probably torrential after heavy rain and in the winter.

Channel Habitat: sinuous channel with mixture of pools and small cascades, steep gradient.

In-Channel Vegetation: trailing filamentous algae and much brown scum on stones.

Bankside Vegetation: both banks with close-cropped sheep grazing with scattered gorse and willow (mainly below the banks) forming small thickets in places. Marginal vegetation with *J. effusus*, *Trifolium repens*, *Holcus lanatus*, *Anthoxanthum odoratum, Bellis perennis*, *Lotus corniculatus*, and occasional *Iris pseudacorus* and with scattered *Pedicularis, Potentilla erecta,* and *Anagallis tenella* in marginal grazed areas. Dry, hummucky growth of *Sphagnum* mixed in with *Polytrichum* in places at the water's edge.

Macroinvertebrates / Water Quality: water coloured but non-turbid. Much evidence of peat siltation. Presence of trailing algae suggests enrichment. The very coarse nature of the substrate made macroinvertebrate sampling difficult. Dominated by *Baetis*, with a few *Leuctra* and chironomids. Q4 (Q3-4).

Fisheries Value: the low flows and turbulent and narrow channel over very coarse substrate probably limits the value of this habitat for fisheries.

Site Descriptions Broadhaven - Galway

Crossing 3 Unnamed Tributary of Carrowmore Lake

Townland: Glenturk Beg

Ir. Grid Ref: F 8841 2767

Channel dimensions: width 1.0-1.5m, depth 5-12cm.

Banks: LHS 4-5m high in places, otherwise low, RHS 1.2-1.8m.

Bankside Composition: sandy on till (gravel and cobbles).

Substrate: boulders, cobbles and small stones.

Flow: Moderate to slow in glide/pools, moderate and turbulent in small cascades.

Channel Habitat: sinuous channel a mixture small stretches of glide/pool and small cascades. Torrential and spatey in appearance with evidence of undercutting of banks in places.

In-Channel Vegetation: trailing filamentous algae with much peat silt, very scummed-up.

Bankside Vegetation: RHS with *Calluna* dominant backed by conifer plantation. Low section of LHS narrow flood plain dominated by *J. effusus* with *Gallium saxatile* and *Rumex acetosella* frequent. Bracken dominant in places, scattered *Digitalis.*

Macroinvertebrates / Water Quality: evidence of enrichment and peat siltation (macroinvertebrates not sampled).

Fisheries Value: suitable for salmonids. However, siltation and enrichment combined with torrential nature of this stretch may limit its value.

Crossing 4 Oweniny River (tributary of the Owenmore)

Townland: Upstream of Bellacorick Bridge

Ir. Grid Ref: F 9722 2039

Channel dimensions: width 18-23m, depth 10-30cm

Banks: RHS 1.2 – 1.5m, LHS 1.2-1.7m,

Bankside Composition: peat with sand on top with coarse organic sand below sitting on gravely till

Substrate: upstream glide with cobbles and small boulders, downstream boulder filed with large boulders with cobbles on fine gravel. Hard sandstone or igneous

Flow: moderate to slow in upstream glide moderate or moderate to swift in parts of boulder field.

Channel Habitat: long shallow glide followed by boulder field / riffle alternating with more glide.

In-Channel Vegetation: moss (*Rhynchostegium riparioides* and *Fontinalis antipyretica*) and liverwort common on boulders and large cobbles, *Lemanea* also present. Long trailing filamentous green algae very common in shallow slacker-flow areas of the boulder field.

Bankside Vegetation: RHS at crossing point dominated by improved grassland cut as hay, LHS with marshy grassland both grazed by cattle. RHS just below crossing point with Rush dominated grassland with frequent *Filipendula ulmaria*, *I. pseudacorus*, R. *repens*, and *R. acetosella*.

Macroinvertebrates / Water Quality: water clean and clear but with much evidence of moderate peat siltation in shallows, slack flow areas and glides. Macroinvertebrates present only in very low densities including *Hydropsyche*, *Rhyacophila dorsalis*, *Baetis* (dominant), *Ephemerella*, *Perla* and *Limnius volckmari*. Q 4

Fisheries Value: ideal salmonid nursery habitat, but evidence of enrichment and peat siltation worrying. Glide and boulder area probably unsuitable for spawning,

Site Descriptions Broadhaven - Galway

Crossing 5 River Muing (tributary of the Owenmore)

Townland: 1 km east of Bellacorick

Ir. Grid Ref: F 9805 1995

Channel dimensions: Width 4.5m, depth 30cm

Banks: RHS 0.7m at edge, rising to 2.5-3m behind; LHS 1-1.2m

Bankside Composition: peat sitting on gravel with large stones and cobbles. .

Substrate: peat silt over gravel.

Flow: dead slow.

Channel Habitat: straight, canal-like and fairly shallow.

In-Channel Vegetation: scattered marginal clumps of *Sparganium erectum* and *Equisetum fluviatile* marginally, occasional, *Lythrum salicaria* and *Valeriana officinalis*, otherwise plant-free.

Bankside Vegetation: damp grassland dominated by *Potentilla anserina*, *R. repens*, with *J. effusus, Centaurea nigra* and *Plantago lanceolata* backed by coniferous plantation.

Macroinvertebrates / Water Quality: water was cloudy and mud-coloured, no samples taken due to peat silt nature of substratum and lack of structural diversity. System probably low diversity and dystrophic.

Fisheries Value: probably little or none in this stretch.

Site Descriptions Broadhaven - Galway

Crossing 6 Shanvolahan River (tributary of the Deel)

Townland: Just downstream of bridge on N59 (Coolturk)

Ir. Grid Ref: G0617 1801

Channel dimensions: Width 5m, depth <15cm

Banks: 0.5-1.0m (both)

Bankside Composition: obscured by vegetation, probably peat over gravely till.

Substrate: small stones and gravel emerging as banks and islets in places.

Flow: slow in glides and moderate in riffle/glides

Channel Habitat: shallow glides and riffle/glides, localised siltation

In-Channel Vegetation: abundant *Potamogeton* sp. (*P. natans* or *P. polygonifolius*) and *Myriophyllum* cf. *alterniflorum.*

Bankside Vegetation: herbaceous vegetation with *F. ulmaria, P. anserina, L. salicaria, Mentha aquatica, E. fluviatile, H. lanatus, Centaurea nigra, R. acetosella, Caltha palustris* etc.

In-channel gravel islets with *Carex rostrata, Scrophularia aquatica, Gallium palustre, C. palustris, M. aquatica,* and *Juncus cf. articulatus*

Macroinvertebrates / Water Quality: water discoloured and cloudy. Macroinvertebrates with Heptageniidae, *Ephemerella, Gammarus,* Chironomidae, and *Baetis* all in fair numbers and *R. dorsalis* in small numbers. Q 4-5 (Q4)

Fisheries Value: suitable for salmonids but probably too shallow, open and slow in this stretch to be particularly valuable.

Site Descriptions Broadhaven - Galway

Crossing 7 River Deel – main channel (to Lough Conn)

Townland: Knockbrack/Carrowgarve South

Ir. Grid Ref: G 0756 1490

Channel dimensions: width 18m, depth 50-60cm.

Banks: not measured (estimate 1.2-1.5m).

Bankside Composition: brown peaty sand.

Substrate: scattered boulders and cobbles on fine gravel.

Flow: dead slow to moderate to slow in glide, moderate in boulder field just upstream if crossing point.

Channel Habitat: mainly long moderately deep glide at and below the crossing punt, short boulder riffle immediately upstream before bend.

In-Channel Vegetation: much moss and some liverwort on boulders in glide, same in boulder area upstream but also with abundant *Potamogeton* sp. (*P. natans* / *P. polygonifolius*) and *Myriophyllum* cf. *alterniflorum*. Scattered stands *of S. erectum* marginally (LHS).

Bankside Vegetation: LHS bank J. effusus with occasional small willow, scattered Senecio jacobaea, R. acetosella, Centaurea nigra, Cirsium palustre, P. lanceolata, R. repens, R. acris, V. officinalis and Anthriscus sylvestris etc. backed by improved grassland. RHS bank heavily timbered and overhanging immediately upstream of the crossing point with Sycamore, Hazel, Ash, Hawthorn and possibly Mountain Ash. Crossing point with scattered willow and conifers (low density).

Macroinvertebrates / Water Quality: Mayflies (*Ecdyonurus*, *Ephemerella* (common), *Baetis rhodani* and *Baetis muticus*), *Stoneflies* (*Leuctra*), Caddis Flies (*Lepidostoma hirta* and *Agapetus*), Water Beetles (*Elmis, Limnius* and *Esolus*), True Flies (Chironomidae), Crustaceans (*Gammarus* and *Austropotamobius* pallipes – one only), clear and slightly coloured water. Q4

Fisheries Value: ideal salmonid habitat. Holding and feeding. Spawning unlikely in this stretch due to depth and slow flow.

Site Descriptions Broadhaven - Galway

Crossing 8 Castlehill River (to Lough Conn)

Townland: ENE of Lahardaun Village

Ir. Grid Ref: G 1142 1095

Channel dimensions: width 4-5m, depth 5-12cm

Banks: RHS 1.5m, LHS 1.5-1.7m

Bankside Composition: RHS with spoil heap of cobbles, boulders and gravel (dredged for local flood relief in the past). Otherwise open.

Substrate: cobbles and small stones on gravel.

Flow: moderate – swift and turbulent.

Channel Habitat: uniform shallow riffle, probably very spatey.

In-Channel Vegetation: plant-free.

Bankside Vegetation: disturbed, LHS with Bramble, *Heracleum sphondylium*, Digitalis *purpurea*, *Valeriana officials*, *Scrophularia aquatica* and *Holcus lanatus*. LHS dominated by Gorse, and Bramble. Both banks backed by improved grassland, damp on the LHS.

Macroinvertebrates / Water Quality: water clear with a slight colour. Macroinvertebrates typical of unpolluted conditions and including Mayflies *Ecdyonurus* and *Heptagenia, Leuctra, Isoperla, Ephemerella, Rhyacophila, Elmis, Gammarus,* Simuliidae, and Chironomidae. Q4-5 (Q5)

Fisheries Value: Ideal salmonid habitat; landowner reported seeing many trout spawning in this stretch in November and salmon spawning in there during December.

Site Descriptions Broadhaven - Galway

Crossing 9 Lecarrow River (to Lough Conn)

Townland: Ballymacredmond (nr. Laharadaun)

Ir. Grid Ref: G 1254 0995

Channel dimensions: width 2m, depth 10-24cm

Banks: RHS 0.5-0.8m, LHS 1m

Bankside Composition: organic sandy soil on coarse till.

Substrate: wide mix with scattered boulders, cobbles, small stones and coarse and fine gravel.

Flow: turbulent, moderate – swift; probably torrential after rain.

Channel Habitat: typical riffle/pool succession with small natural weirs.

In-Channel Vegetation: mainly plant free with scattered moss on boulders.

Bankside Vegetation: RHS Bramble backed by improved grassland with some Juncus. LHS dominated by Alder, and Holly with scattered Gorse and an understorey of Bramble and Ivy. Backed by improved hay meadow.

Macroinvertebrates / Water Quality: Clear slightly coloured water. Macroinvertebrates included *Rhithrogena, Baetis, Ephemerella, Rhyacophila, Gammarus, Limnephilidae* Q4-5 (Q5).

Fisheries Value: Small but ideal salmonid habitat, probably suitable both for spawning and nursery. A salmonid parr was taken in kick-sample.

Site Descriptions Broadhaven - Galway

Crossing 10 Addergoole River (to Lough Conn)

Townland: Cuilkillew/Tonacrock

Ir. Grid Ref: G 1492 0920

Channel dimensions: estimate 6-7m (too deep to cross), depth >1m

Banks: RHS 1.5-2m, RHS 2m

Bankside Composition: adhesive mineral peaty soil

Substrate: peaty mud

Flow: slow

Channel Habitat: deep pool/glide

In-Channel Vegetation: very sparse, occasional marginal submerged clumps of *Callitriche* sp. (LHS), very scattered *P. natans* centrally.

Bankside Vegetation: LHS dominated by medium sized Alder and Willow with intervening Bramble, all overhanging. RHS dominated by *J. effusus*, with scattered *F. ulmaria, S. jacobaea, S. aquaticum, R. acetosa, R. obtusifolius, C. palustre, Agrostis stolonifera, Lotus pedunculatus, L. salicaria* and *V. officinalis* and occasional gorse bushes. Backed by marshy grassland dominated by *Juncus*.

Macroinvertebrates / Water Quality: water appeared clean but was too deep and unsafe to sample.

Fisheries Value: possibly, good holding area for salmonids, particularly during spates. No spawning in the stretch.

Site Descriptions Broadhaven - Galway

Crossing 11 Clydagh River (to Lough Cullin)

Townland: Meelick / Rockfield

Ir. Grid Ref: M 1820 9404

Channel dimensions: width 11m, depth 30-50cm

Banks: LHS bank with high spoil heap now heavily vegetated (possibly 3m+ high), LHS 2-2.5m high, heavily timbered.

Bankside Composition: brown sandy silt

Substrate: coarse gravel and coarse sand forming shallow submerged banks in places.

Flow: moderate-slow, moderate

Channel Habitat: glide and pool

In-Channel Vegetation: abundant long trailing *Myriophyllum* cf. *alterniflorum.* Marginal emergents virtually absent, except for occasional *Oenanthe crocata*, and locally frequent *Mentha aquatica*, *Veronica beccabunga* and *Impatiens glandulifera.*

Bankside Vegetation: LHS dominated by large overhanging trees including Alder and Ash with some Willow and Hawthorn and an understorey of woodland/hedgebank herbs. Same species composition on RHS but not as large and dense.

Macroinvertebrates / Water Quality: water was clear and peaty coloured with a clean-water macroinvertebrate mix which included *Ecdyonurus*, *Ephemerella*, *Leuctra*, *Rhyacophila*, *Sericostoma personatum*, *Arthripsodes* spp., Elmidae, *Gammarus* and oligochaets. Q 4 (Q4-5)

Fisheries Value: suitable salmonid habitat, probably mainly holding and feeding. Fish were seen rising during the survey.

Site Descriptions Broadhaven - Galway

Crossing 12 Castlebar River (tributary of Clydagh River)

Townland: Leckeen

Ir. Grid Ref: M 1903 9278

Channel dimensions: width estimate 8m, depth 55cm

Banks: LHS 1.5-2m, RHS 1-1.5m

Bankside Composition: clay/marl topped with brown organic soil

Substrate: angular cobbles and small stones

Flow: moderate

Channel Habitat: glide

In-Channel Vegetation: Some trailing *Potamogeton natans* but nothing else obvious

Bankside Vegetation: Immediate bankside with *Phalaris arundinacea/Urtica dioica, Filipendula ulmaria*, and *Iris pseudacorus* mix with backed by improved damp grassland. There are some medium-sized Hawthorn scattered along both banks.

Macroinvertebrates / Water Quality: water clear but macroinvertebrates dominated by species indicative of slight to moderate pollution. *Gammarus* and *Asellus* were common (particularly the latter species) with Glossosomatidae, Oligochaeta and Chironomidae. Q 3

Fisheries Value: Probably suitable for large brown trout

Site Descriptions Broadhaven - Galway

Crossing 13 Manulla River

Townland: Kilknock

Ir. Grid Ref: M 2089 8831

Channel dimensions: width estimate 12-15m (too deep to cross), D >1m

Banks: vertical, greater than 1m

Bankside Composition: Clay

Substrate: organic mud/clay ?

Flow: dead slow

Channel Habitat: deep glide / pool

In-Channel Vegetation: Little in-channel vegetation apart from some Berula erecta submerged at the margin.

Bankside Vegetation: Not very extensive; dominated by *Phalaris* with some *Filipendula*. Marginal vegetation backed by improved grassland (right bank) and by plantation coniferous forestry on the left bank (north). Banks open.

Macroinvertebrates / Water Quality: Conditions at the site weere not suitable for obraing macroinvertebrate kick samples

Fisheries Value: The site may hold large trout but it would be more suitable for a mixed coarse fishery and my have some pike in areas of good cover.

Site Descriptions Broadhaven - Galway

Crossing 14 Unnamed Tributary of Needhams Lough

Townland: Smuttanagh

Ir. Grid Ref: M 2342 8413

Channel dimensions: width 3.5m, depth 40cm

Banks: 2.5-3m high, steep.

Bankside Composition: coarse limestone till with silty sand

Substrate: in areas with weak current: cobbles, small stones and coarse sand on sandy silt.

Flow: dead slow in plant-choked areas to moderate to slow in shallow riffle/glide.

Channel Habitat: mixture of canal-like glide and shallow riffle/glide.

In-Channel Vegetation: *S. erectum* co-dominant with *S. emersum*. *M. aquatica* and *Lemna* sp. locally common with occasional *Nuphar lutea*, and *Alisma plantago-aquatica; Lemna triscula, L. minor, Potamogeton crispus* (rare). *O. aquatica/O. fluviatilis*, marginal and occasional.

Bankside Vegetation: slopes dominated by *Phalaris* and Bramble backed on the RHS by marshy grassland with *J. effusus, Cirsium palustre, C. vulgare,* C. *arvense, Senecio aquaticus, R. acris, T. repens, H. lanatus* and *Cynosurus cristatus*. The LHS side with good growth of Willow, Alder, Elder and Hawthorn backed by a hay meadow (improved).

Macroinvertebrates / Water Quality: macroinvertebrates included *Ecdyonurus, Ephemerella, Heptagenia sulphurea, Baetis muticus, Rhyacophila dorsalis, Hydropsyche, Polycentropus, Lepidostoma hirtum, Sericostoma personatum, Agapetus, Elmis aenea*, Chironomidae, Simuliidae, *Gammarus, Bithynia tentaculata, Sphaerium, Glossiphonia complanata*, Oligochaeta. Q 4-5

Fisheries Value: probably contains trout but unlikely by virtue of its size and sluggish nature to be of much fisheries importance.

Site Descriptions Broadhaven - Galway

Crossing 15 River Robe

Townland: Pollrady

Ir. Grid Ref: M 2905 7136

Channel dimensions: width 9m, depth 30-60cm

Banks: 2.5m high, both

Bankside Composition: ?

Substrate: boulders over fine gravel and coarse sand.

Flow: moderate to swift

Channel Habitat: glide with a little riffle/glide with a large pool area immediately downstream of the crossing point just beyond the small drain joining from the LHS bank.

In-Channel Vegetation: dominated by long trailing *Cladophora* with moss (*Fissidens* sp.) common on boulders. Marginal vegetation sparse with *Phalaris* and *Agrostis stolonifera* dominant, with occasional stands *S. erectum.*

Bankside Vegetation: sloping banks grassy with *H. lanatus*, *Dactylis glomerata*, *Luzula campestris*, *R. acris*, *R. repens*, *Centaurea nigra*, *Carex nigra* group, *Trifolium repens*, *Rumex crispus*, *Cirsium arvense*, *C. vulgare*, *Mentha aquatica* and *Equisetum arvense*.

Macroinvertebrates / Water Quality: the dominant feature of the macroinvertebrate community was large crayfish, which although not specifically identified, are believed to be the White-Clawed variety (*Austropotamobius pallipes*). These were clearly seen holding station on and between boulders and were present with many juveniles in kick-samples; the river would appear to hold a dense population. Other taxa present included *Baetis*, *Paraleptophlebia cincta*, *Hydropsyche* (numerous), Chironomidae (abundant), *Leuctra* (scarce), *Asellus* scarce. The presence of large amounts of filamentous algae and the absence of more sensitive species indicates that this stretch, despite the healthy crayfish population, is slightly polluted. Q3-4

Fisheries Value: the large macroinvertebrate biomass would probably favour a good brown trout stock and a large pool downstream of the crossing could be a good holding/angling area at times. The area is not likely to be suitable for spawning.

Site Descriptions Broadhaven - Galway

Crossing 16 Black River – upper reaches, u/s Ardour Bridge

Townland: Ardour

Ir. Grid Ref: M 3216 5893

Channel dimensions:

Banks: low open

Bankside Composition: Limestone till with silty sand

Substrate: mud

Flow: virtually dry

Channel Habitat:

In-Channel Vegetation: choked with *Apium nodiflorum* and *Nasturtium aquaticum*-agg.

Bankside Vegetation: improved pasture

Macroinvertebrates / Water Quality: n/a

Fisheries Value: n/a

Site Descriptions Broadhaven - Galway

Crossing 17 Kilshanvey River

Townland: Ardour / Kilshanvey

Ir. Grid Ref: M 3217 5800

Channel dimensions: width 4-5m, depth ~ 60cm

Banks: 1.5m high on both sides with a 1m high spoil heap set back a few metres from the RHS bank.

Bankside Composition: ?

Substrate: soft, organic with scattered maerl covered boulders.

Flow: still-dead slow

Channel Habitat: plant-choked and canal-like

In-Channel Vegetation: dominated by *Potamogeton natans* with dense stands of *S. erectum* common; *S. emersum* also locally frequent. Marginally, *Apium nodiflorum* abundant *with Nasturtium aquaticum* agg. also common; *Hippuris vulgaris, Caltha palustris* and *Glyceria fluitans* frequent. *Batrachospermum* and jelly-like algal globules on boulders (*Chaetophora*).

Bankside Vegetation: semi-improved grassland, damp in places, with *Cynosurus cristatus, Brezia media, Gallium verum, Daucus carota, Lotus corniculatus, Trifolium repens, T. arvense, Plantago lanceolata, Cirsium arvense, Iris pseudacorus, Prunella vulgaris.*

Macroinvertebrates / Water Quality: macroinvertebrates were dominated by *Gammarus*, which were very abundant along with Chironomidae and *Lymnea peregra.* Also present were *Ephemerella ignita*, *Lepidostoma hirtum, Limnephilus lunatus*, *Helophorus* beetles and the flat worm *Polycelis* sp. (cf. *P. felina*). Q 3-4

Fisheries Value: this section of the river probably not of any significance from the salmonid fisheries standpoint; three-spined stickleback common

Site Descriptions Broadhaven - Galway

Crossing 18 Togher River

Townland: Cloonbar

Ir. Grid Ref: M 3283 5430

Channel dimensions: width 3.5-4m depth 10-30cm

Banks: both ~ 3m with spoil heay set back a few metres from the LHS bank

Bankside Composition: peaty soil on clay

Substrate: peaty organic bottom with angular cobbles, small stones and gravel in areas of moderate to slow flow, otherwise just organic silt.

Flow: mainly dead slow

Channel Habitat: canal-like and heavily vegetated for the most part

In-Channel Vegetation: dense stands of *S. erectum* marginally *with S. emersum, Lemna triscula, P. natans, M. aquatica, Hippuris vulgaris and Caltha palustris*, locally frequent. Further downstream, *Phragmites, Typha, Alisma plantago aquatica, Apium nodiflorum, Myosotis scorpioides, Senecio aquaticus* and *Ranunculus flammula* also in evidence. The green alga *Batrachospermum* was present on on cobbles.

Bankside Vegetation: RHS bank dominated by mainly by Gorse, with small alder and willow also present. LHS bank with small alder and willow, scattered. RHS backed by hay meadow, LHS with closely grazed improved to semi-improved grass with a mix of species including *H. lanatus. Prunella vulgaris, Hypochaeris radicata, Ranunculus acris, Cirsium arvense, Trifolium repens, Bellis perennis, Rhinanthus minor* (v. occ.)

Macroinvertebrates / Water Quality: macroinvertebrates collected in a small area of coarse substrate with a weak current included *Ephemerella, Baetis, Cloeon simile, Leuctra, Sericostoma personatum, Arthripsodes atterimus, Arthripsodes cinereus*, Elmidae (*Elmis, Oulimnius*), *Helophorus*, Water-boatmen (*Sigara dorsalis & S. fossarum*), *Gammarus, Asellus, Glossiphonia complanata, Bithynia tentaculata, Valvata psicinalis*, Oligocaheta Q 4.

Fisheries Value: too shallow and plant choked to be of any fisheries value in the study reach.

Site Descriptions Broadhaven - Galway

Crossing 19 River Clare

Townland: Cregmore

Ir. Grid Ref: 4166 3373

Channel dimensions: width 15m, 20-40cm in riffles, 40+ cm in glide / pool

Banks: RHS more vertical 2-3m, backed by dredge-spoil berm. LHS gradually sloping to edge backed by a step (1.5-2m) to field level. Large dredge-spoil berms with limestone boulders and cobbles set back 4-6m from the bank in places, although not immediately at the crossing point.

Bankside Composition: loose limestone till mixed with sandy silt.

Substrate: limestone cobbles and boulders; maerl coated; some limestone pavement at channel bed-level in places.

Flow: strong and swift and turbulent in riffles, moderate in glides.

Channel Habitat: mainly glide

In-Channel Vegetation: occasional *Potamogeton perfoliatus, P. x nitens*, and *Nuphar lutea* (submerged); *Batrachospermum* and moss (*Cinclidotus & Rhynchostegium*) common on boulders in riffle. Long trailing filamentous green algae common.

Bankside Vegetation: LHS marginal vegetation very sparse including *Phalaris* (with occasional *Filipendula*) and *Schoenoplectus lacustris. Potentilla anserina, P. reptans, Urtica dioica* and *Equisetum arvense*, with *Trifolium repens* all common backed by grassed areas (grazed by sheep) with *Cynosurus cristatus, Lolium perenne, Plantago lanceolata, Bellis perennis* etc. RHS with scattered Ash, Hawthorn, Gorse, Blackthorn, and Rubus sp. backed by large spoil heaps in places.

Macroinvertebrates / Water Quality: water coloured and slightly turbid; macroinvertebrates in riffle included *Gammarus, Hydropsyche, Rhyacophila, Ephemerella* (all common) with Philopomatidae, *Leuctra* and Leptoceridae. Q3-4 (Q4).

Fisheries Value: important salmon and trout angling area. Probably no spawning in this immediate stretch.

Crossing 20 Lavally River – Upper Tributary of Clarin River

Townland: Millpark

Ir. Grid Ref: M4703 2573

Channel dimensions: width 2.5-3m, 7-13cm in riffles

Banks: RHS more vertical 2-3m, backed by dredge-spoil berm. LHS gradually sloping to edge backed by a step (1.5-2m) to field level. Large dredge-spoil berms with limestone boulders and cobbles set back 4-6m from the bank in places, although not immediately at the crossing point.

Bankside Composition: brown mineral soil on cobble/boulder limestone till.

Substrate: boulders and cobbles on fine gravel and coarse sand

Flow: generally moderate to slow

Channel Habitat: mainly shallow glide and riffle/glide

In-Channel Vegetation: boulders were in luxuriant, long trailing *Cladophora,* which contained much trapped silt. Water crowfoot (submerged leaves only) was locally common in the centre of the channel and large boulders had a covering of *Fontinalis* moss. Marginally (RHS) *Cladophora* was also dominant with interspersed clumps of *Apium nodiflorum*, *Apium inundatum* (Lesser Marshwort) and *Mentha aquatica* with occasional small stands of *Sparganium erectum* also present.

Bankside Vegetation: RHS marginal vegetation was dominated by *Phalaris arundinacea* with *Epilobium hirsutum*, *Senecio aquaticus*, *Agrostis stolonifera*, occasional *Mentha aquatica* and *Plantago major* backed by improved grassland. The LHS bank was more heavily vegetated with a marginal herb layer dominated by Great Yellow-cress (*Nasturtium amphibia*), Bittersweet, and occasional backed by Blackthorn thicket and an Ash-dominated tree layer.

Macroinvertebrates / Water Quality: The snail *Lymnea peregra* was very abundant feeding on the in-channel *Cladophora*, where *Lymnea stagnalis* was also present. The dominant macroinvertebrates were Elmid beetles (*Elmis* and *Limnius*), the crustaceans *Gammarus* and *Asellus* with occasional *Leuctra*, *Rhyacophila dorsalis*, *Hydropsyche*, *Glossiphonia*, *Physa* and *Valvata. Q 3 (Q3-4).*

Fisheries Value: possibly a feeding/nursery area; spawning seems unlikely by virtue of the coarse substrate, and slow flows at the site.

Crossing 21 Escir River – Upper Tributary of Clarin River

Townland: Lecarrow

Ir. Grid Ref: M4825 2373

Channel dimensions: width 2.0-2.5m

General Description

This channel was dry and is therefore likely to be seasonal or temporary watercourse. The substrate comprised limestone boulders, cobbles and small stones. Under many stones small to medium-sized water beetles were sheltering in the damp soil, presumably awaiting water to again appear in the river. Some of the stones had a dried papery coating of algal scum and others dried coverings or *Fontinalis* moss in-channel and *Cinclidotus* higher up on marginal boulders. The banks were dominated by very large limestone boulders backed by Hawthorn, Blackthorn Ash and Bramble. Improved grassland was present beyond the banks.

Crossing 22 Dooyertha River – Dunkellin River Catchment

Townland: Garracloon South (NW Craughwell)

Ir. Grid Ref: M 5215 2156

Channel dimensions: width 4-8m

General Description

At the crossing the river comprises a short section of shallow riffle with much terrestrial/semi-aquatic vegetation invading the stream channel (mainly Rumex sp., possibly R. obtusifolius). The substrate here is of cobbles and small stones and the flow is shallow, moderate to swift and turbulent. The banks are steep and earthen in places and dominated by mature Hawthorn and Ash. Downstream of the crossing the water disappears entirely from the channel, which comprises moss-covered limestone boulders in the main. Other species, which occur at the margins of the channel or in the semi-dry areas, include *Potentilla anserina, Ranunculus ficaria, Phalaris, Ranunculus repens* and *Filipendula,* with occasional *Nodding Bur-Marigold (Bidens cernua).*

Immediately upstream of the crossing point the channel is broad and dammed back by a small loose stone weir to form a virtually stagnant glide/pool stretching upstream for more than 100m.

Macroinvertebrates & Water Quality

A kicksample collected in the narrow and shallow riffle at the site contained the following groups Simuliidae, *Baetis, Asellus, Isoperla, Limnephilus, Lymnea peregra.* (Q3-4). There was a single salmonid fry also taken at this site.

Fisheries Value

The fact that the river dries-up at least in places, probably during the summer/autumn period, suggests that the channel near the crossing point is of very limited fisheries value. However, a salmonid fry at the crossing point suggests that there must be some limited spawning in pockets possibly including at the site itself.

Appendix 13.1: National Freshwater Quality Database

NATIONAL FRESHWATER QUALITY DATABASE (SOURCE: EPA)

Units in mg/l (ppm)
Temperature in ^{0}C

Quality classification from 1 to 5
1 = Seriously polluted
2 = Moderately/ Seriously polluted
3 = Moderately polluted
4 = Slightly polluted
5 = Unpolluted

1.Muingnabo River

Sampling Point Information

Location	0.3 km u/s Annie Brady Bridge
Hydrometric Area	Blacksod-Broadhaven
River Name	MUINGNABO
Last Q Classification	4 (Unpolluted)

2.Glenamoy River

Sampling Point Information

Location	Glenamoy Bridge
Hydrometric Area	Blacksod-Broadhaven
River Name	GLENAMOY
Last Q Classification	3-4* (Slightly polluted

Biological Sampling Information

Location	Glenamoy Bridge
River Name	GLENAMOY
Hydrometric Area	Blacksod-Broadhaven
Quality 1994	3-4* (Slightly polluted)
Quality 1990	4-5 (Unpolluted)
Quality 1986	4-5 (Unpolluted)
Quality 1981	5 (Unpolluted)

Chemical Sampling Information

Parameter	Symbol	Maximum	Mean	Median	Minimum	No. of Samples
Ammonia	NH3	0.1	0.0326	0.02	0.005	23
BOD	O2	4.3	1.74	1.5	1	23
Chloride	Cl	50	27.82	27	16	22
Colour		250	135.28	138	40	18
Conductivity @ 25 °C		302	166.78	173	80	23
Dissolved Oxygen		106	96.5	97	80	23
Nitrate+Nitrite	N	0.18	0.062	0.054	0.011	22
Ortho-phosphate	PO4	0.057	0.0195	0.018	0.005	22
Ph		8.4	7.3	7.3	5.9	23
Temperature		19.5	11.21	10.9	4.8	23
Un-ionised Ammonia	NH3	0.0013	0.0002	-0.0001	-0.0001	23

3.River Muing
Sampling Point Information

Location	Just u/s Owenmore River
Hydrometric Area	Blacksod-Broadhaven
River Name	MUING
Last Q Classification	3-4 (Slightly polluted)

4. Altnabrocky River
Sampling Point Information

Location	Just u/s Owenmore River confl
Hydrometric Area	Blacksod-Broadhaven
River Name	ALTNABROCKY
Last Q Classification	4-5 (Unpolluted)

5. Shanvolahan River
Sampling Point Information

Location	Bridge S.W. of Coolturk
Hydrometric Area	Moy and Killala Bay
River Name	SHANVOLAHAN
Last Q Classification	3 (Moderately polluted)

6. Shanvolahan River
Sampling Point Information

Location	Just u/s Deel River confl
Hydrometric Area	Moy and Killala Bay
River Name	SHANVOLAHAN
Last Q Classification	4 (Unpolluted)

7. Castlehill River

Sampling Point Information

Location	Bridge S. of Castlehill
Hydrometric Area	Moy and Killala Bay
River Name	CASTLEHILL
Last Q Classification	5 (Unpolluted)

8. Addergoole River

Sampling Point Information

Location	Bridge u/s Lough Conn
Hydrometric Area	Moy and Killala Bay
River Name	ADDERGOOLE
Last Q Classification	4 (Unpolluted)

9. Clydagh (Castlebar)

Sampling Point Information

Location	Clydagh Bridge
Hydrometric Area	Moy and Killala Bay
River Name	CLYDAGH (CASTLEBAR)
Last Q	4 (Unpolluted)

Biological Sampling Information

Location	Clydagh Bridge
River Name	CLYDAGH (CASTLEBAR)
Hydrometric Area	Moy and Killala Bay
Quality 1993	4 (Unpolluted)
Quality 1989	5 (Unpolluted)
Quality 1986	4-5 (Unpolluted)
Quality 1981	5 (Unpolluted)

Chemical Sampling Information

Parameter	Symbol	Maximum	Mean	Median	Minimum	No. of Samples
Ammonia	NH3	0.12	0.0389	0.03	0.01	24
BOD	O2	3.7	1.61	1.4	0.5	25
Chloride	Cl	35	21.42	20	13	24
Colour		300	145.48	150	20	21
Conductivity @ 25 °C		506	160.96	153	82	25
Dissolved Oxygen		103	90.4	91	78	25
Nitrate+Nitrite	N	0.26	0.094	0.072	0.03	23
Ortho-phosphate	PO4	0.03	0.0133	0.011	0.001	24
pH		8.1	7.5	7.5	6.6	25
Temperature		17.5	9.7	11	0.3	25
Un-ionised Ammonia	NH3	0.0011	0.0003	-0.0001	-0.0001	24

10. Clydagh River (Castlebar)

Sampling Point Information

Location	Bridge E. of Ballyguin
Hydrometric Area	Moy and Killala Bay
River Name	CLYDAGH (CASTLEBAR)
Last Q Classification	5 (Unpolluted)

Biological Sampling Information

Location	Bridge E. of Ballyguin
River Name	CLYDAGH (CASTLEBAR)
Hydrometric Area	Moy and Killala Bay
Quality 1986	5 (Unpolluted)
Quality 1981	4-5 (Unpolluted)

11. Castlebar River

Sampling Point Information

Location	Br 2.5 km d/s Castlebar
Hydrometric Area	Moy and Killala Bay
River Name	CASTLEBAR
Last Q Classification	3 (Moderately polluted)

Biological Sampling Information

Location	Br 2.5 km d/s Castlebar
River Name	CASTLEBAR
Hydrometric Area	Moy and Killala Bay
Quality 1995	3 (Moderately polluted)
Quality 1993	3 (Moderately polluted)
Quality 1989	3 (Moderately polluted)
Quality 1986	3 (Moderately polluted)
Quality 1984	3 (Moderately polluted)
Quality 1983	3 (Moderately polluted)
Quality 1981	2-3 (Moderately polluted)
Quality 1980	1 (Seriously polluted)
Quality 1979	1 (Seriously polluted)
Quality 1977	1 (Seriously polluted)
Quality 1975	1 (Seriously polluted)
Quality 1973	1-2 (Seriously polluted)
Quality 1971	1 (Seriously polluted)

Chemical Sampling Information

Parameter	Symbol	Maximum	Mean	Median	Minimum	No. of Samples
Ammonia	NH3	0.33	0.0563	0.04	0.005	27
BOD	O2	5.2	2.22	2.1	0.9	27
Chloride	Cl	58	34.89	33	22	27
Colour		125	80.33	85	40	15
Conductivity @ 25 °C		477	396.15	391	333	27
Dissolved Oxygen		126	89.5	88	64	27
Nitrate+Nitrite	N	1.83	0.771	0.73	0.13	27
Ortho-phosphate	PO4	0.66	0.1174	0.04	0.005	27
Ph		8.2	7.7	7.7	7.2	27
Temperature		20	11.79	11.5	2.5	27
Un-ionised Ammonia	NH3	0.0044	0.0008	0.0005	-0.0001	27

12. Castlebar River

Sampling Point Information

Location	Br N. of Turlough Park
Hydrometric Area	Moy and Killala Bay
River Name	CASTLEBAR
Last Q Classification	3 (Moderately polluted)

Biological Sampling Information

Location	Br N. of Turlough Park
River Name	CASTLEBAR
Hydrometric Area	Moy and Killala Bay
Quality 1995	3 (Moderately polluted)
Quality 1993	3 (Moderately polluted)
Quality 1989	3 (Moderately polluted)
Quality 1984	3 (Moderately polluted)
Quality 1983	3 (Moderately polluted)
Quality 1981	3 (Moderately polluted)
Quality 1980	2 (Seriously polluted)
Quality 1979	2-3 (Moderately polluted)
Quality 1977	2-3 (Moderately polluted)
Quality 1975	1-2 (Seriously polluted)
Quality 1973	3 (Moderately polluted)
Quality 1971	3 (Moderately polluted)

Chemical Sampling Information

Parameter	Symbol	Maximum	Mean	Median	Minimum	No. of Samples
Ammonia	NH3	0.14	0.0431	0.04	0.005	27
BOD	O2	2.6	1.7	1.7	0.9	27
Chloride	Cl	57	33.81	31	20	27
Colour		125	78.67	85	40	15
Conductivity @ 25 °C		474	407.59	401	342	27
Dissolved Oxygen		128	93.6	90	80	27
Nitrate+Nitrite	N	2.13	0.809	0.67	0.12	27
Ortho-phosphate	PO4	0.46	0.1111	0.04	0.005	27
Ph		8.5	7.8	7.9	7.2	27
Temperature		19.5	11.63	11.5	3	27
Un-ionised Ammonia	NH3	0.0104	0.0011	0.0005	-0.0001	27

13. Manulla River

Sampling Point Information

Location	Ballinfad Bridge
Hydrometric Area	Moy and Killala Bay
River Name	MANULLA
Last Q Classification	4 (Unpolluted)

Biological Sampling Information

Location	Ballinfad Bridge
River Name	MANULLA
Hydrometric Area	Moy and Killala Bay
Quality 1995	4 (Unpolluted)
Quality 1993	4 (Unpolluted)
Quality 1989	4-5 (Unpolluted)
Quality 1984	4-5 (Unpolluted)
Quality 1980	5 (Unpolluted

Chemical Sampling Information

Parameter	Symbol	Maximum	Mean	Median	Minimum	No. of Samples
Ammonia	NH3	0.19	0.0607	0.05	0.01	27
BOD	O2	2.6	1.59	1.7	0.8	27
Chloride	Cl	48	26.74	25	14	27
Colour		150	77.33	70	30	15
Conductivity @ 25 °C		696	527.04	518	399	27
Dissolved Oxygen		108	81.3	81	65	27
Nitrate+Nitrite	N	2.41	1.179	1.095	0.51	26
Ortho-phosphate	PO4	0.04	0.0148	0.01	0.005	27
Ph		8.2	7.7	7.7	7.2	27
Temperature		19	11.5	11	3.5	27
Un-ionised Ammonia	NH3	0.0051	0.0009	0.0005	-0.0001	27

14. Robe River

Sampling Point Information

Location	Bridge near Tagheen
Hydrometric Area	Corrib
River Name	ROBE
Last Q Classification	3-4 (Slightly polluted)

Biological Sampling Information

Location	Bridge near Tagheen
River Name	ROBE
Hydrometric Area	Corrib
Quality 1989	3-4 (Slightly polluted)
Quality 1987	4 (Unpolluted)
Quality 1985	4 (Unpolluted)
Quality 1982	3-4 (Slightly polluted)
Quality 1980	4 (Unpolluted)

Chemical Sampling Information

Parameter	Symbol	Maximum	Mean	Median	Minimum	No. of Samples
Ammonia	NH3	0.198	0.0577	0.05	0.01	27
BOD	O2	3.5	1.79	1.8	0.7	28
Chloride	Cl	33	25.14	25	19	28
Colour		150	97.17	100	40	23
Conductivity @ 25 °C		648	565.25	578	398	28
Dissolved Oxygen		131	86.7	86	64	27
Hardness	CaCO3	416	0	0	416	1
Nitrate+Nitrite	N	2.15	1.087	0.991	0.365	27
Ortho-phosphate	PO4	0.113	0.0515	0.052	0.005	28
pH		8.5	7.9	7.9	7.3	28
Temperature		16.8	10.21	10.1	3	28
Un-ionised Ammonia	NH3	0.0023	0.0007	0.0007	0.0002	27

15. Black River (Shrule)

Sampling Point Information

Location	Bridge at Kilshanvy
Hydrometric Area	Corrib
River Name	BLACK (SHRULE)
Last Q Classification	3-4 (Slightly polluted)

Biological Sampling Information

Location	Bridge at Kilshanvy
River Name	BLACK (SHRULE)
Hydrometric Area	Corrib
Quality 1994	3-4 (Slightly polluted)
Quality 1989	3-4 (Slightly polluted)
Quality 1984	3-4 (Slightly polluted)
Quality 1980	3-4 (Slightly polluted)

Chemical Sampling Information

Parameter	Symbol	Maximum	Mean	Median	Minimum	No. of Samples
Ammonia	NH3	0.07	0.0291	0.03	0.005	35
BOD	O2	2.9	1.29	1.2	0.5	36
Chloride	Cl	34	25.66	26	16	35
Colour		125	48.08	40	5	26
Conductivity @ 25 °C		738	611	608	228	36
Dissolved Oxygen		106	71.6	69	44	36
Nitrate+Nitrite	N	3.4	1.409	1.39	0.134	35
Ortho-phosphate	PO4	0.055	0.0219	0.02	0.005	36
Ph		8	7.6	7.5	7.2	36
Temperature		15	9.06	8.9	2.5	36
Un-ionised Ammonia	NH3	0.0005	0.0002	-0.0001	-0.0001	35

16. River Clare (Galway)

Sampling Point Information

Location	Br S.W. of Turloughmore
Hydrometric Area	Corrib
River Name	CLARE (GALWAY)
Last Q Classification	4 (Unpolluted)

Biological Sampling Information

Location	Br S.W. of Turloughmore
River Name	CLARE (GALWAY)
Hydrometric Area	Corrib
Quality 1993	4 (Unpolluted)
Quality 1989	4 (Unpolluted)

Chemical Sampling Information

Parameter	Symbol	Maximum	Mean	Median	Minimum	No. of Samples
Ammonia	NH3	0.125	0.0439	0.04	0.005	50
BOD	O2	2.5	1.54	1.6	0.4	50
Chloride	Cl	40	24.02	24	14	49
Colour		150	77.63	78	15	40
Conductivity @ 25 °C		686	542.66	553	402	50
Dissolved Oxygen		137	91.7	90	71	50
Nitrate+Nitrite	N	2.88	1.394	1.312	0.51	49
Ortho-phosphate	PO4	0.114	0.0406	0.0375	0.005	50
pH		8.5	7.9	8	7.4	48
Temperature		17	10.32	10.4	3	50
Un-ionised Ammonia	NH3	0.002	0.0007	0.0007	-0.0001	48

17. River Clare (Galway)

Sampling Point Information

Location	Cregmore Bridge
Hydrometric Area	Corrib
River Name	CLARE (GALWAY)
Last Q Classification	3-4 (Slightly polluted)

Chemical Sampling Information

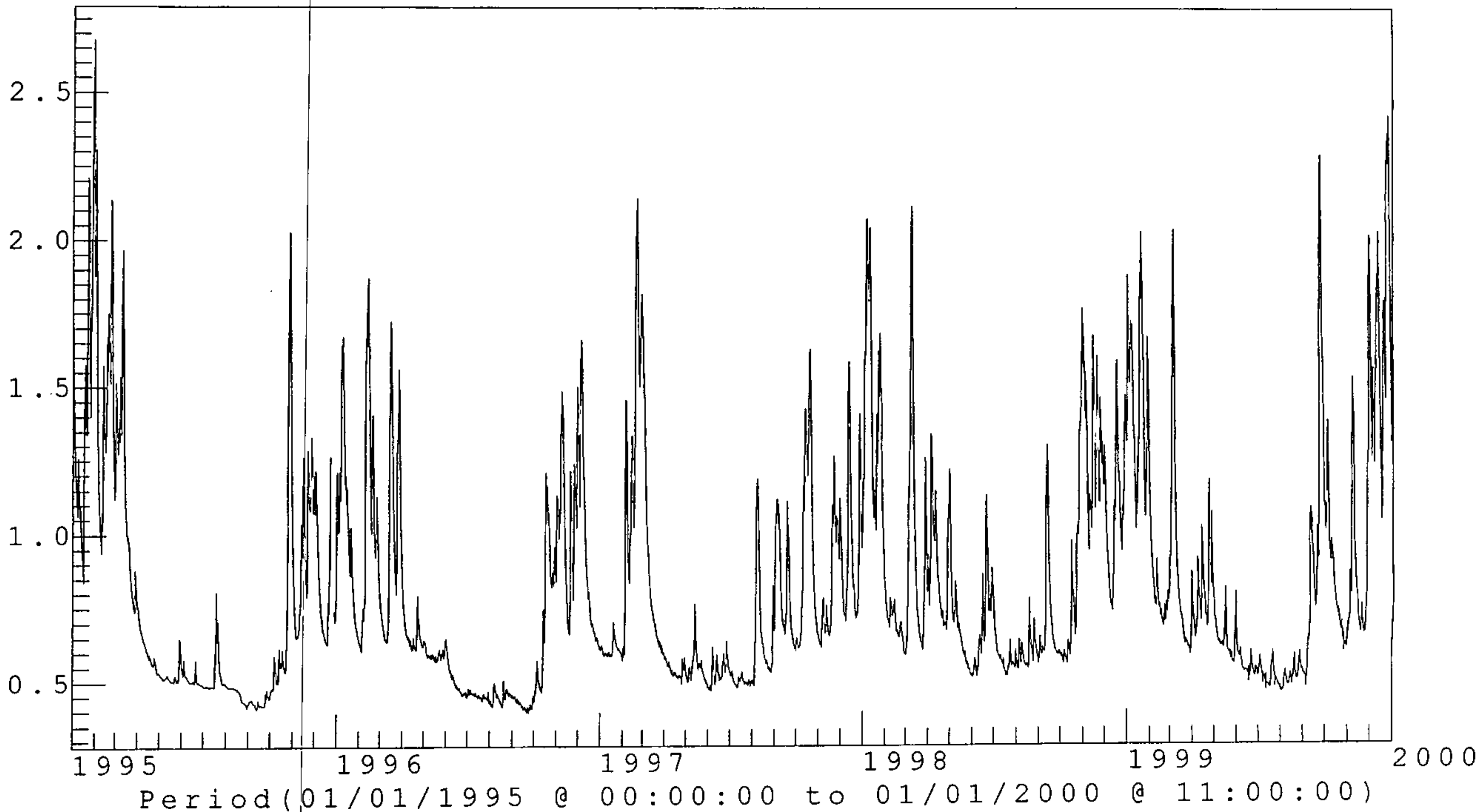
Parameter	Symbol	Maximum	Mean	Median	Minimum	No. of Samples
Ammonia	NH3	0.106	0.0349	0.03	0.009	51
BOD	O2	2.6	1.43	1.4	0.3	51
Chloride	Cl	38	23.98	23.5	16	50
Colour		150	73.9	70	15	41
Conductivity @ 25 °C		682	545.14	552	414	51
Dissolved Oxygen		137	93.3	91	75	51
Nitrate+Nitrite	N	2.65	1.414	1.386	0.39	50
Ortho-phosphate	PO4	0.121	0.0382	0.033	0.005	51
pH		8.6	8	8	7.4	51
Temperature		19.9	10.49	10.3	2.5	51
Un-ionised Ammonia	NH3	0.0033	0.0006	0.0004	-0.0001	51

Appendix 13.2: Hydrometric Data

Office of Public Works
Hydrometric Division

Time Series Plotting

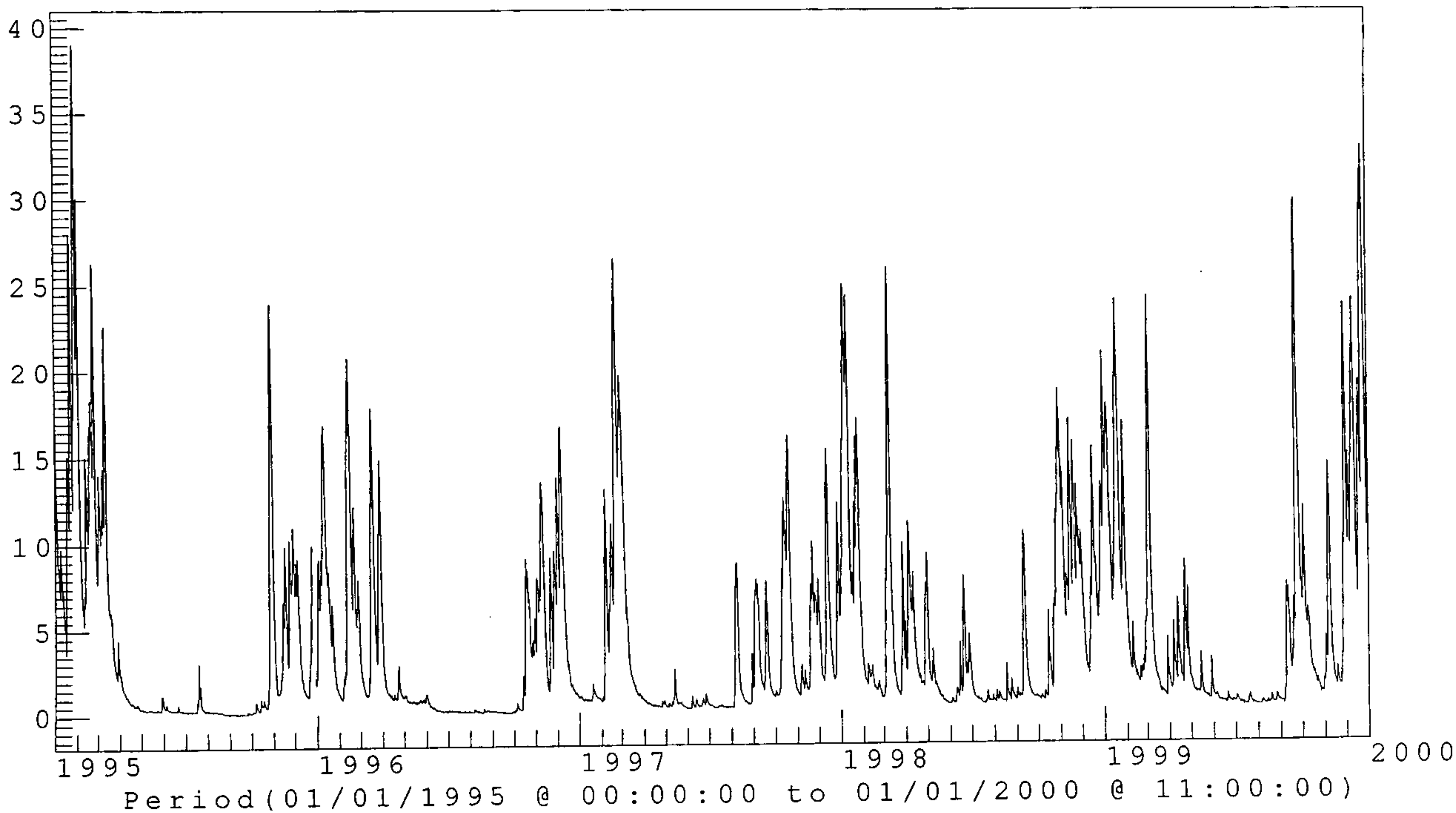
29007.1/100.00/1: Craughwell - Level (m)



Office of Public Works
Hydrometric Division

Time Series Plotting

29007.1/100.00/1: Craughwell (PTo(200.00,0)) - Flow Cmcs

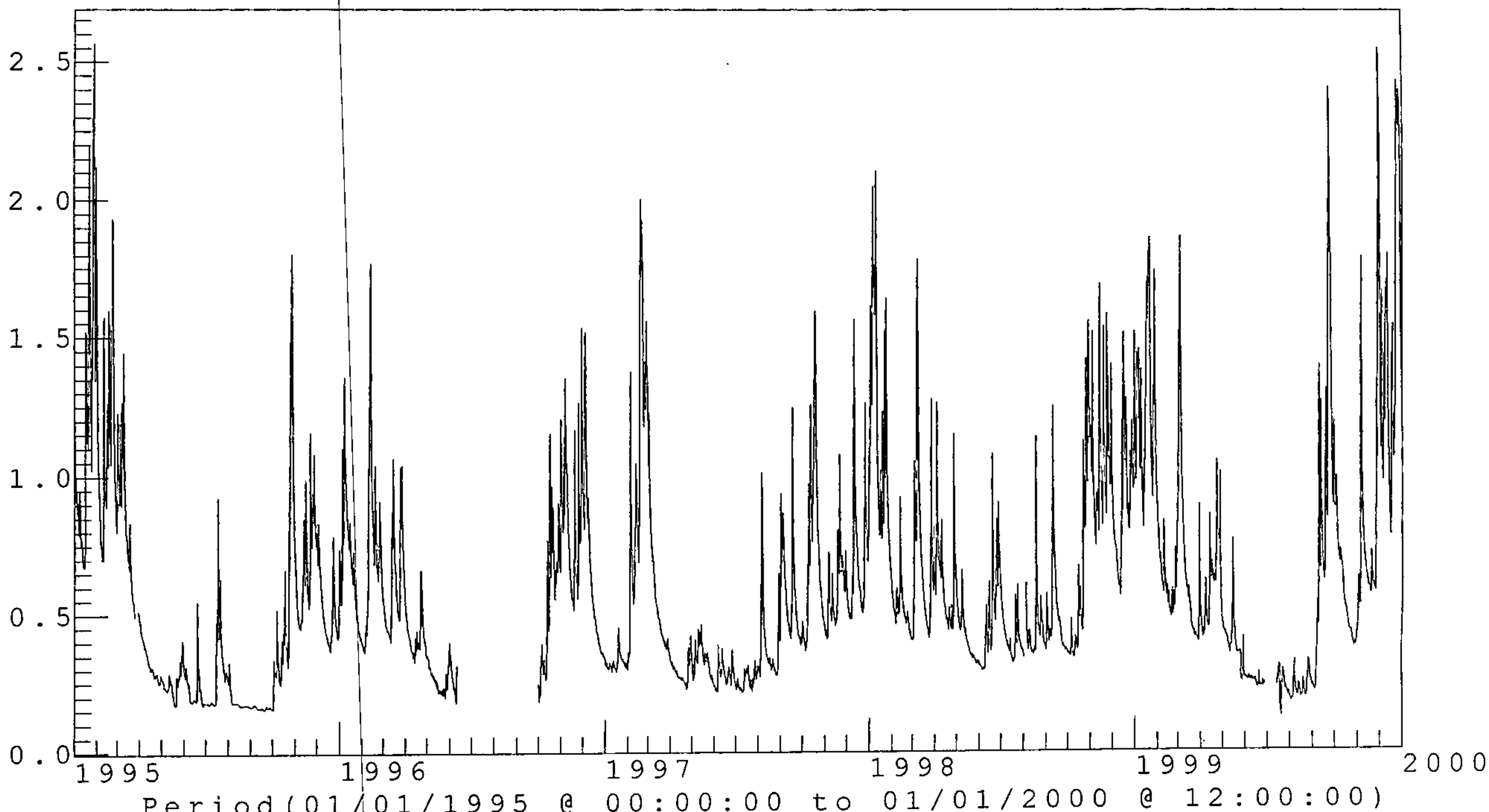


dhonac
/04/2001 @ 11:41
me Series Plotting 4

Office of Public Works
Hydrometric Division

Time Series Plotting

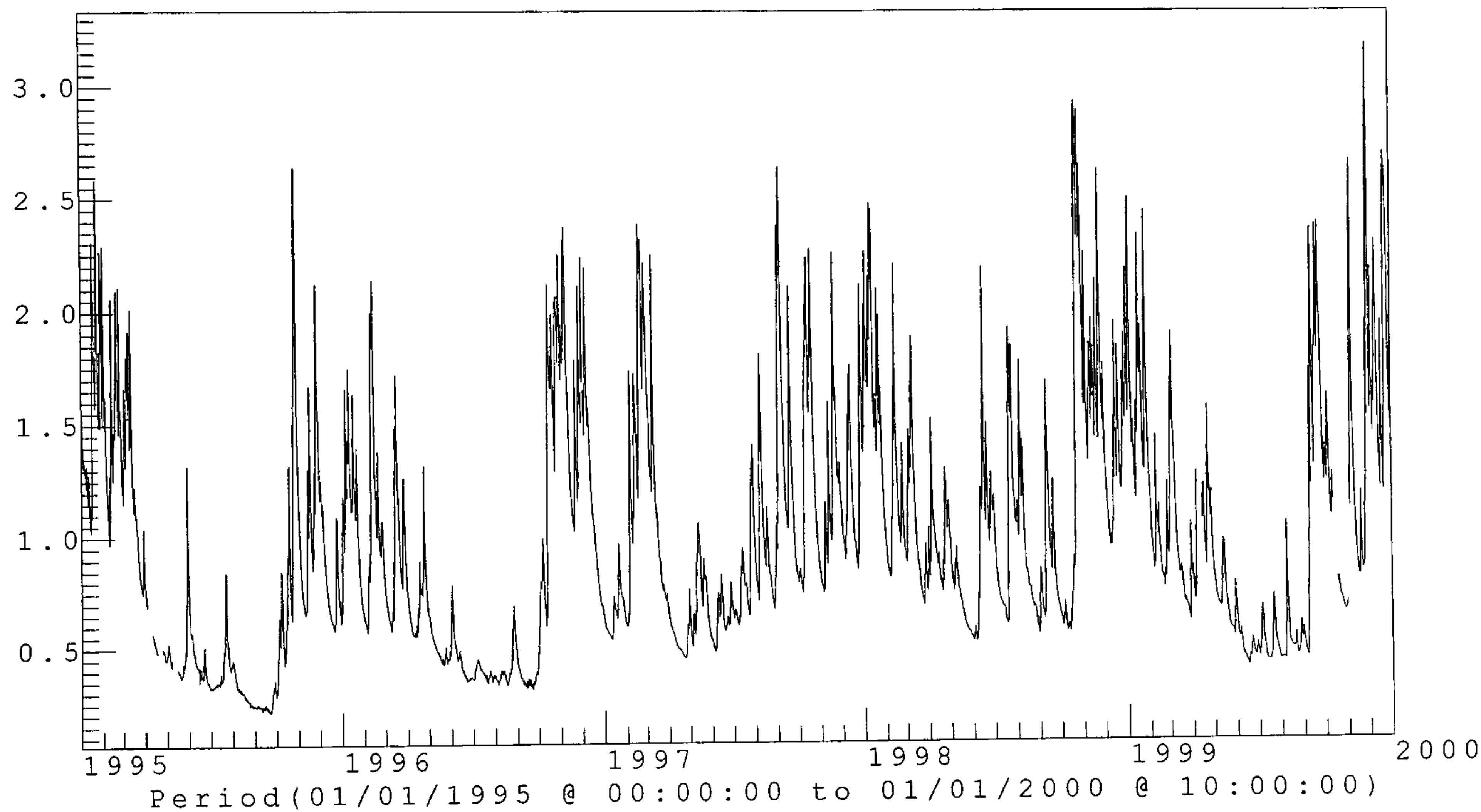
29014.1/100.00/1: Caherfinesker - Level (m)



Office of Public Works
Hydrometric Division

Time Series Plotting

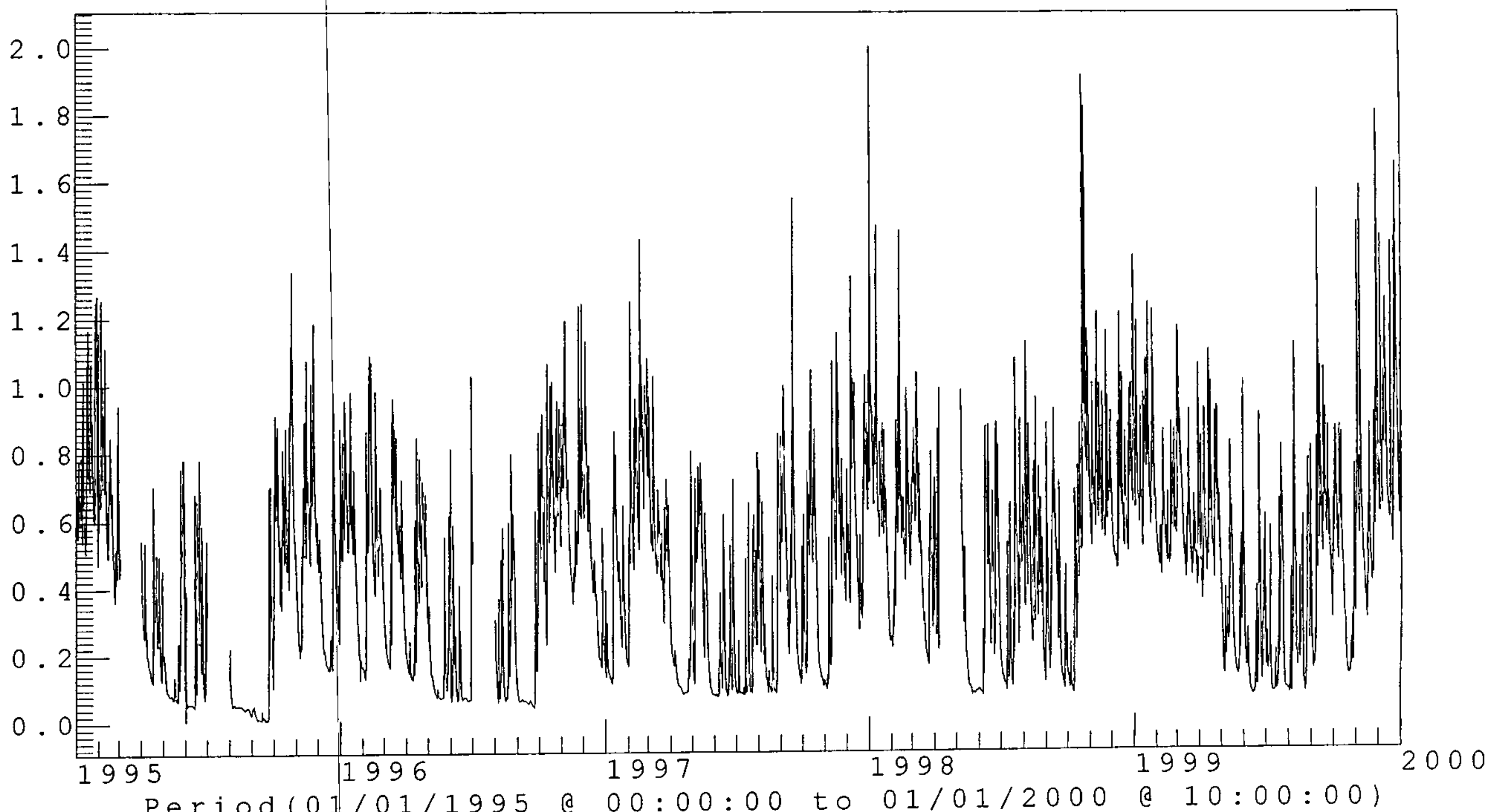
30037.1/100.00/1: Clooncormick - Level (m)



Office of Public Works
Hydrometric Division

Time Series Plotting

34007.1/100.00/1: Ballycarroon - Level (m)

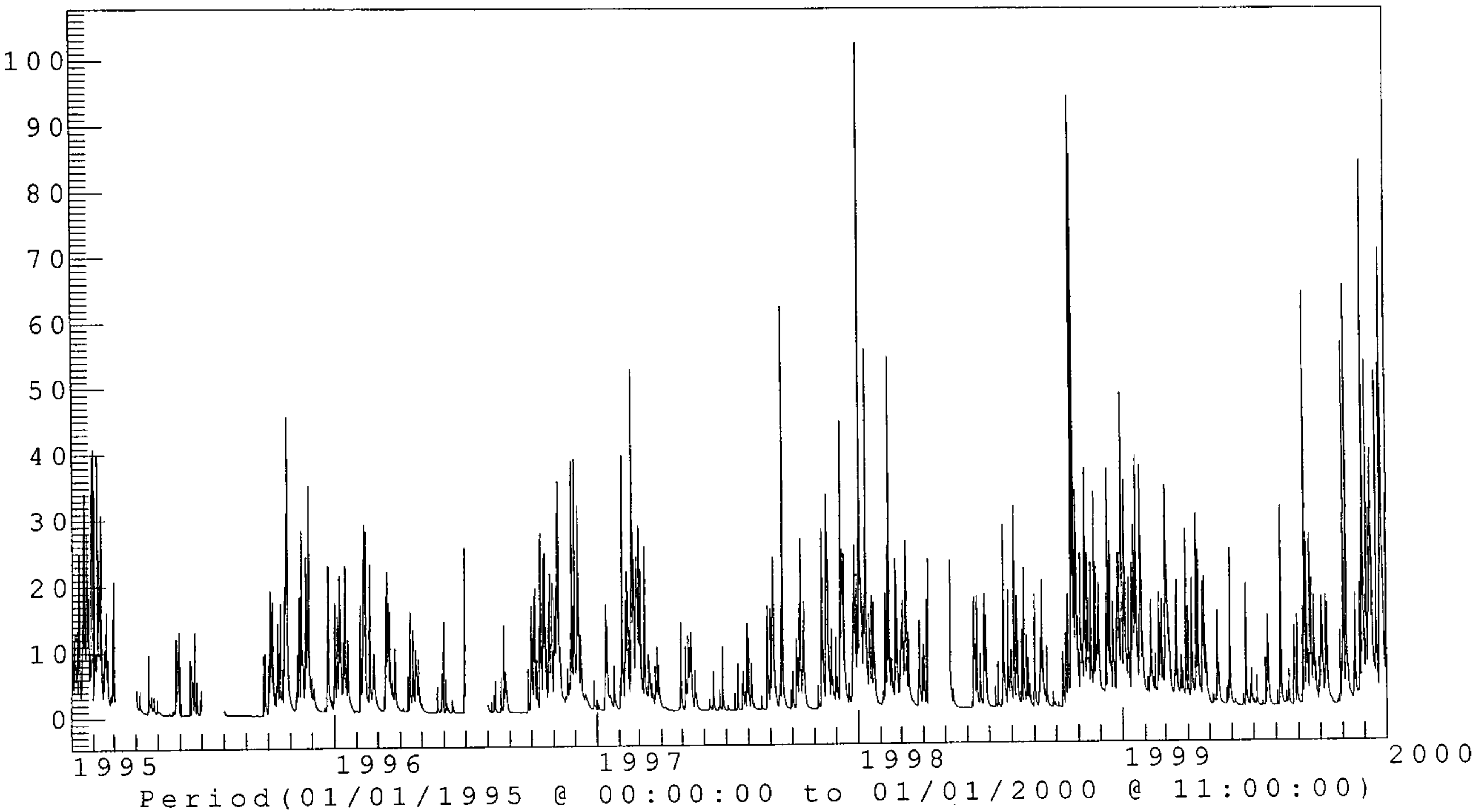


dhonac
:/04/2001 @ 10:15
me Series Plotting 1

Office of Public Works
Hydrometric Division

Time Series Plotting

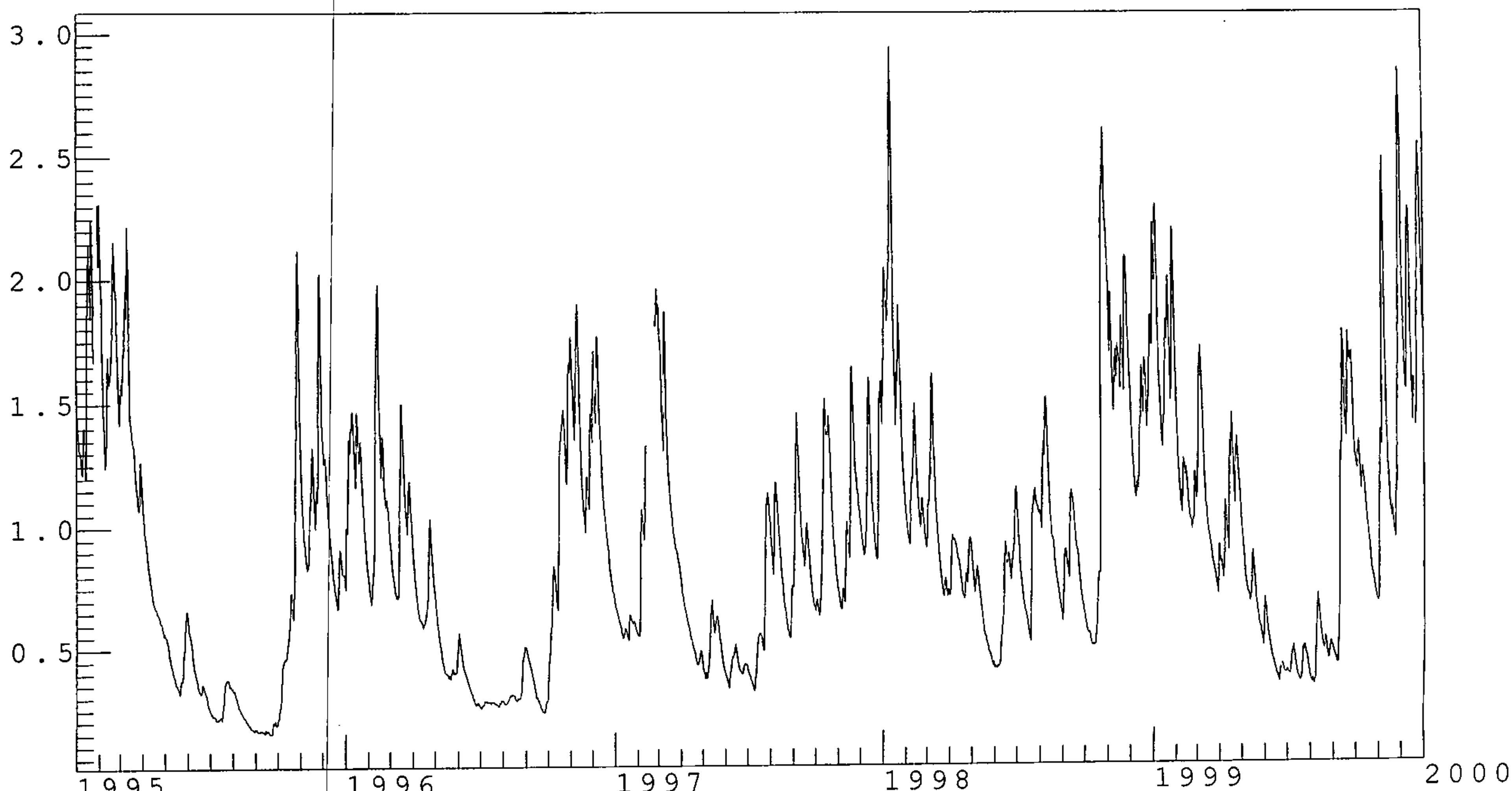
34007.1/100.00/1: Ballycarroon (PTo(200.00,0)) - Flow Cmcs



Office of Public Works
Hydrometric Division

Time Series Plotting

34011.1/100.00/1: Gneeve Bridge - Level (m)



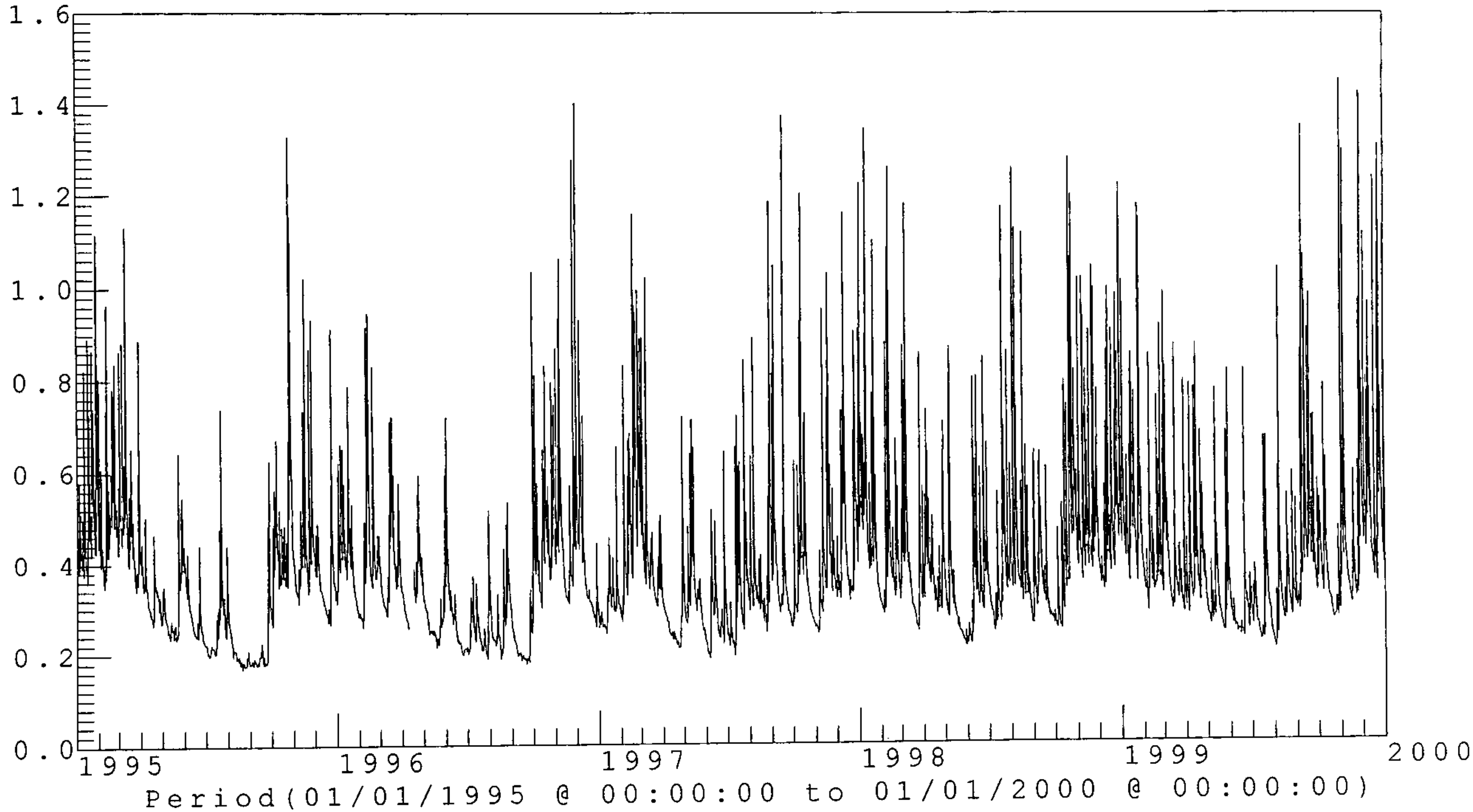
Period(01/01/1995 @ 00:00:00 to 01/01/2000 @ 10:00:00)

amsonm
/04/2001 @ 14:58
me Series Plotting 2

Office of Public Works
Hydrology and Hydrometric Section

Time Series Plotting

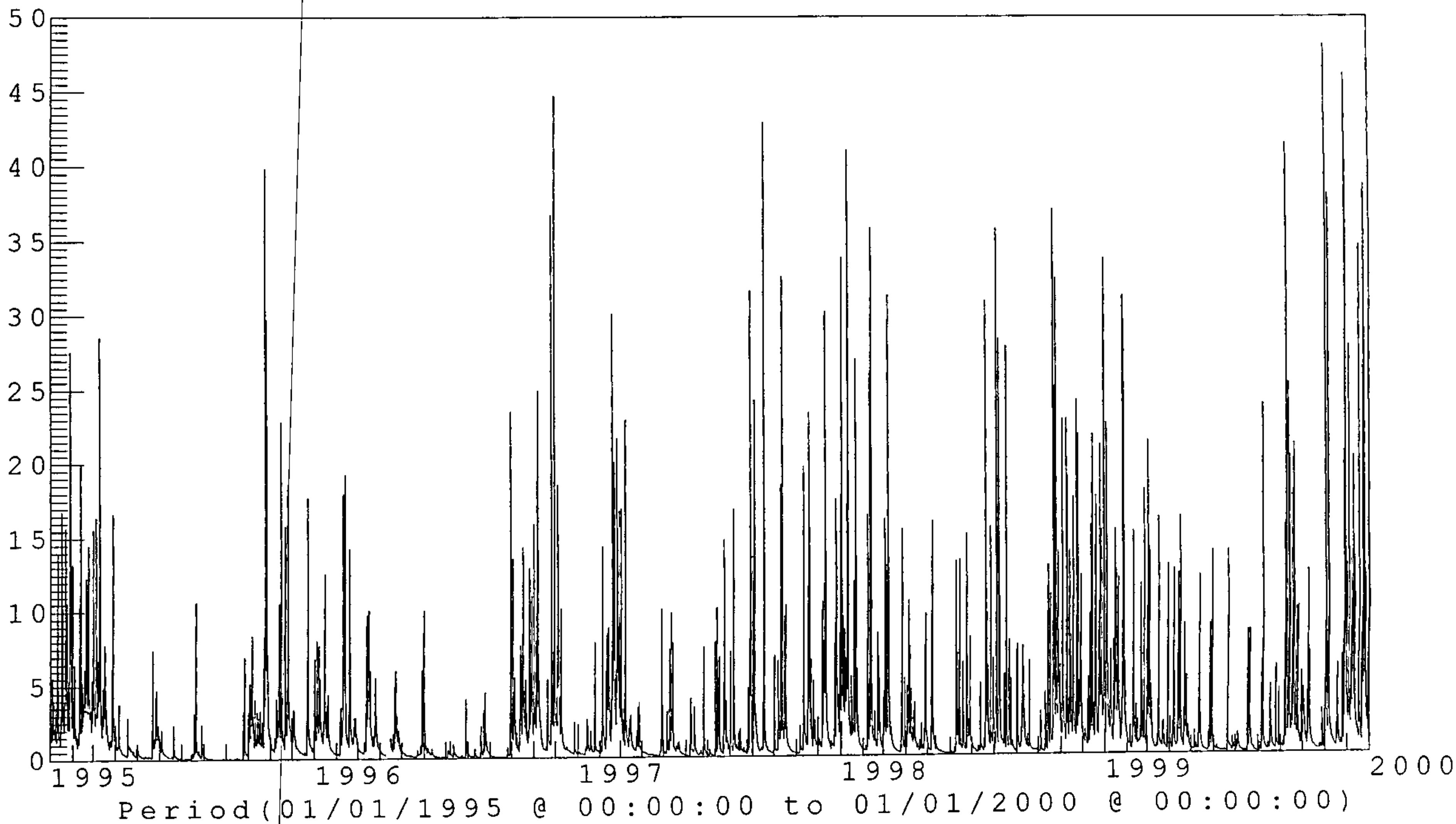
34014.1/100.00/1: Mill Bridge - Level (m)



Office of Public Works
Hydrology and Hydrometric Section

Time Series Plotting

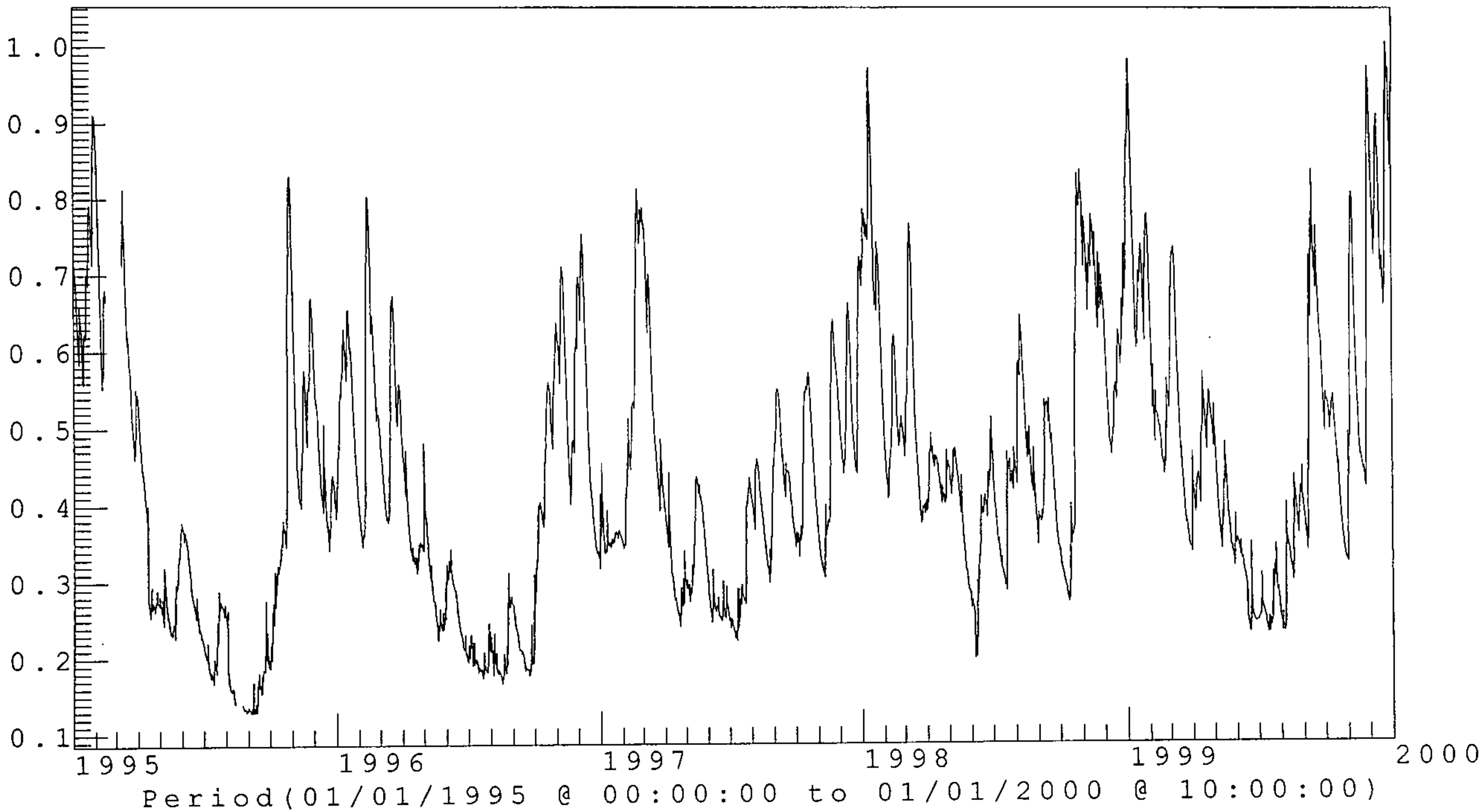
34014.1/100.00/1: Mill Bridge (PTo(200.00,0)) - Flow Cmcs



Office of Public Works
Hydrometric Division

Time Series Plotting

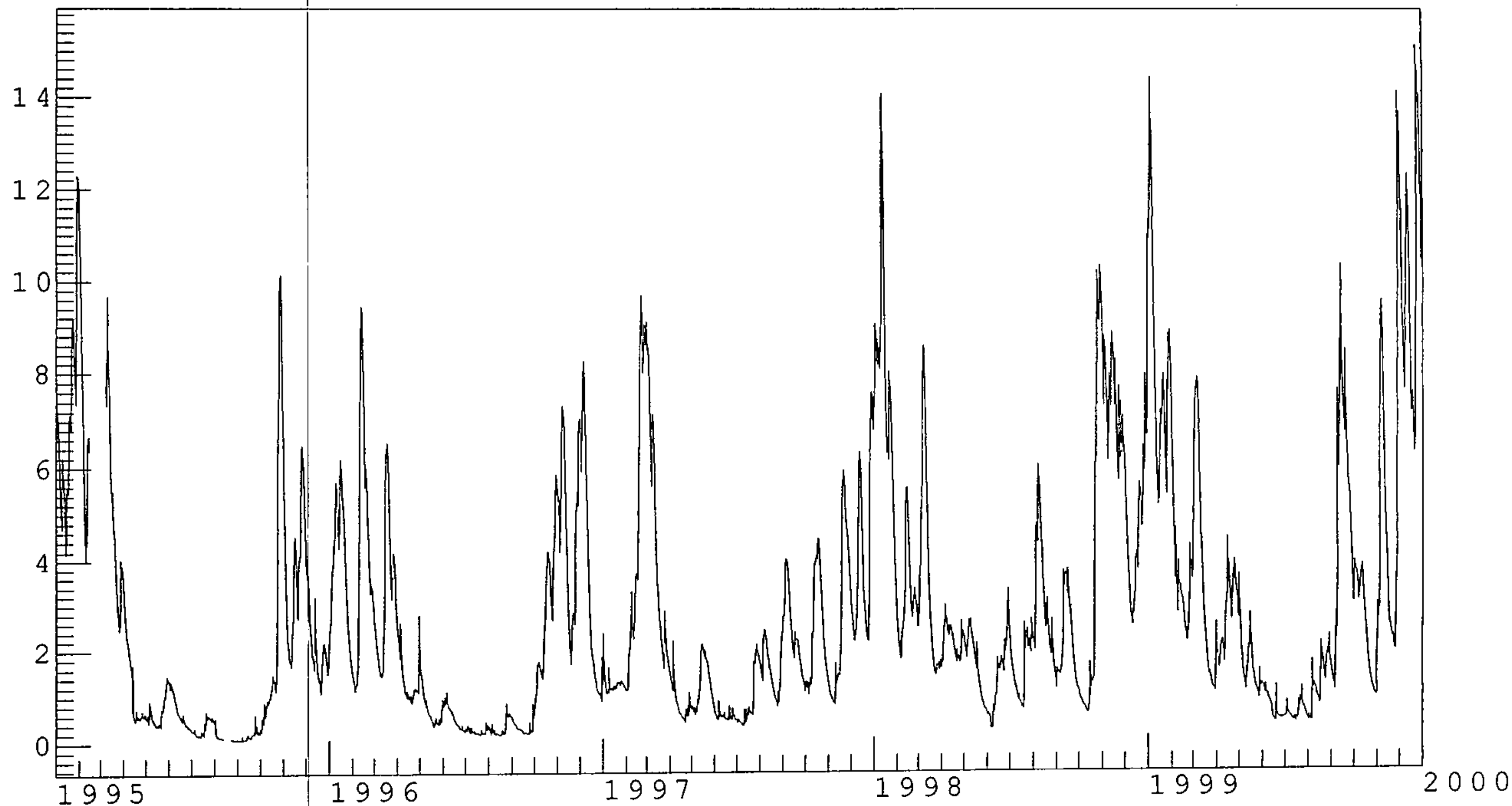
34018.1/100.00/1: Turlough - Level (m)



Office of Public Works
Hydrometric Division

Time Series Plotting

34018.1/100.00/1: Turlough (PTo(200.00,0)) - Flow Cmcs



Period(01/01/1995 @ 00:00:00 to 01/01/2000 @ 11:00:00)

Appendix 14.1: List of Known Archaeological Sites and Monuments Within 500m of Pipeline

LIST OF KNOWN ARCHAEOLOGICAL SITES AND MONUMENTS WITHIN 250M OF PIPELINE

The information presented below outlines the archaeological and historical potential of the area through which the proposed pipeline will pass. It is based on two main sources. The first source is the SMR manual and corresponding constraint maps at Dúchas. The second is the *Archaeological Inventory for County Galway*, Vol. II.

The sites are numbered according to the OS six-inch sheet on which they are located, so that Site No. 1 on OS six-inch sheet 45 is listed as 045:001. A county code—MA for Mayo and GA for Galway—is utilised.

All the sites listed below are within 250m of the proposed pipeline route and are shown on the accompanying SMR location map.

The national grid reference (NGR) is given for each site, as is the townland in which it is located. The NGR is presented as a ten-figure co-ordinate and indicates the position or siting of each monument.

Archaeological sites are generally classified for the purpose of impact assessment in such a way that their status in the archaeological record is suggested. The classification system is explained in Appendix D.

An area of interest is suggested for each site. This is a zone of archaeological potential around the known extant remains in which related archaeological features are likely to occur.

SMR Ref.	Townland	Monument Type	NGR	Sources	Classification	Area of Interest	Approx. Distance
MA 027:003	Tawnagh More	Cist	94970, 321720	NMI Topographical Files 1991 (co-ordinates may be inaccurate). NMI Finds Register 1991.	F, excavated	10–20m	250m
MA 028:004	Dooleg More	Standing stone	102360, 318750	Per comm. Margaret Keane 1991	D	10–20m	150m
MA 028:005	Dooleg More	Standing stone	102050, 318130	Per comm. Margaret Keane 1991	D	10–20m	150m
MA 028:006	Dooleg More	Stone Row	103260, 318800	Per comm. Margaret Keane 1991	D	10-20m	150m
MA 028:003	Eskeragh	Pre-bog walls, standing stone, court tomb, stone row, enclosure.	104960, 318820	Per comm. P. Walsh 1990 and Margaret Keane 1991	C	Unknown	150m
MA 037:003	Knockbrack	Enclosure	107710, 314860		D	20-30m	70m
MA 038:065	Killacorraun	Ringfort and Souterrain	108430, 313460	Per comm. Margaret Keane 1991	C	Unknown	70–100m
MA 038:151	Killacorraun	Mound	108470, 313100	Per comm. Margaret Keane 1991	D	20–30m	100m
MA 038:152	Killacorraun	Cashel	108780, 312960	Per comm. Margaret Keane 1991	C	20–30m	70m
MA 038:100	Srahyconigaun	Ringfort	108980, 312420	Per comm. Margaret Keane 1991	D	20–30m	170–200m
MA 038:108	Doonbreedia	Enclosure	109990, 311740		C	20–30m	100m
MA 038:109	Doonbreedia	Ringfort	110060, 311510	Per comm. Margaret Keane 1991	C	20–30m	50m

SMR Ref.	Townland	Monument Type	NGR	Sources	Classification	Area of Interest	Approx. Distance
MA 047:002	Ballymoyock	Ringfort and Children's Burial Ground	110790, 311140	Per comm. Margaret Keane 1991	C	20–30m	50m (located in an adjacent field to the monument)
MA 047:003	Ballymoyock	Ringfort	110980, 311300	Per comm. Margaret Keane 1991	D	20–30m	100m
MA 047:006	Ballymoyock	Enclosure	110980, 311230	Per comm. Margaret Keane 1991	Unknown	20–30m	100m
MA 047:005	Carrowkeel (ed Addergoole).	Ringfort	111560, 310720	Site levelled. Per comm. Margaret Keane 1991	G	20–30m	120m
MA 047:007	Carrowkeel (ed Addergoole).	Ringfort	111770,	Per comm. Margaret Keane 1991 R.B. Aldbridge (1986-87), *The Routes Described in the Story Called Táin Bo Flidhais* in the North Mayo Historical Journal, Vol. 1, No. 5 pp 60–66.	G	20–30m	160–200m
MA 047:012	Lahardaun	Enclosure	112720,		G	20–30m	200m
MA 047:024	Lahardaun	Enclosure	113320,		C	20–30m	150m

SMR REF.	TOWNLAND	MONUMENT TYPE	NGR	SOURCES	CLASSIFICATION	AREA OF INTEREST	APPROX. DISTANCE
MA 047:026	Knockfarnaght	Archaeological Complex	113700,	JRSAI Proceedings ('The Excursions') 1898 p.283; Knox 1918, pp 157 – 63De Valera and Ó Nualláin *Survey o the Megalithic Tombs of Ireland* 1964 p. 98 O' Donovan 1838, p. 185 Per comm. Christy Lawless, Turlough 1991, hut site Per comm. Margaret Keane - ring barrow with outer enclosure.	C	200x200m shown on the SMR map.	250–300m
MA 047:060	Lahardaun	Enclosure Possible ("Non Antiquity")	112870,	GSI G 243-2, Roll 221, Print 32	G, not archaeological	None	
MA 047:061	Lahardaun	Enclosure Possible, Field Walls	113190,	GSI G 242-3	F	Unknown	200–230m
MA 047:066	Lahardaun	Ringfort	113430,	Per comm. Margaret Keane 1991.	D	20–30m	30m

MA 059:009	Massbrook South	Enclosure (Non-antiquity)	116610,		G, possibly non-Archaeological	None	200m

SMR REF.	TOWNLAND	MONUMENT TYPE	NGR	SOURCES	CLASSIFICATION	AREA OF INTEREST	APPROX. DISTANCE
MA 060:051	Largan	Hut site	117850,	Site discovered by Mr. Christy Lawless, Turlough, Castlebar See master file.	UC	Unknown	200m
MA 070:172	Rockfield	Ringfort	118060,	Per comm. Mr. Christy Lawless, Turlough, Castlebar.	D	20–30m	200m
MA 070:180	Clogher	Enclosure	11933/29257		D	20–30m	150m
MA 070:181	Clogher	Enclosure	11928/29239		D	20–30m	150m
MA 079:003	Clougher (ED. Turlough)	Ringfort	118800,	OPW Topographical Files, 1959.	D	20–30m	200m
MA 079:011	Ballinvoash	Enclosure	119550,		D	20–30m	70–100m
MA 079:030	Ballinvoash	Enclosure	119320,		D	20–30m	200–240m

MA 079:031	Ballinvoash	Enclosure site	119540,		G	20–30m	50–70m
MA 079:038	Drumdoogh	Enclosure	120290,		D	20–30m	170–180m
MA 079:039	Drumdoogh	Enclosure	120510,		D	20–30m	250m
MA 079:058	Skiddernagh	Enclosure/rath	Not available		D	20–30m	c. 80m
MA 079:082	Creaghanboy	Ecclesiastical Remains - Possible	122440,	O' Donovan Aldridge, JRSAI, Vol. 99, 1969	G, site	Unknown	100–130m
MA 079:083	Lisnolan	Enclosure	122610,		D	20–30m	190–200m

MA 079:031	Ballinvoash	Enclosure site	119540,		G	20-30m	50-70m
MA 079:038	Drumdoogh	Enclosure	120290,		D	20-30m	170-180m
MA 079:039	Drumdoogh	Enclosure	120510,		D	20-30m	250m
MA 079:058	Skiddernagh	Enclosure/rath	Not available		D	20-30m	*c.* 80m
MA 079:082	Creaghanboy	Ecclesiastical Remains - Possible	122440,	O' Donovan Aldridge, JRSAI, Vol. 99, 1969	G, site	Unknown	100-130m
MA 079:083	Lisnolan	Enclosure	122610,		D	20-30m	190-200m

MA 079:084	Lisnolan	Enclosure	122980,		F-G	20–30m	150–200m
MA 090:046	Tullymore	Crannóg	123870,		UC	20–30m	230m
MA 090:048	Brownwall	Enclosure	123680,		UC	20–30m	150m
MA 090:070	Ballymackeogh	Enclosure and Souterrain	124840,		UC	20–30m	100–120m
MA 101:031	Polldrian	Enclosure	129040,		UC	20–30m	200m

SMR Ref.	**Townland**	**Monument Type**	**NGR**	**Sources**	**Classification**	**Area of Interest**	**Approx. Distance**
MA 101:046	Polldrian	Enclosure	128820,		UC	20–30m	150m
MA 101:048	Carrowmore	Enclosure	128950,		UC	20–30m	70m
MA 111:007/01	Tagheen East	Ecclesiastical remains	128840,		UC	50–100m	100–120m
MA 111:023	Garreens	Enclosure	128890,		UC	20–30m	150m
MA 111:025	Garreens	Enclosure	129300,		UC	20–30m	250m

MA 111:039	Clooneen	Enclosure	128880,		UC	20–30m	200m
MA 111:050	Lissatava	Enclosure	129010,		UC	20–30m	180m
MA 111:051	Lissatava	Enclosure	129480,		UC	20–30m	200m
MA 111:054	Bushfield	Enclosure	12914/22634		UC	20–30m	220m
MA 119:026	Annefield	Enclosure (non-antiquity)	129800,		G	20m	75m
MA 119:025	Annefield / Davros	Earthwork	129860,		G	approx.	Pipeline to avoid area
MA 119:027	Davros	Enclosure	130320,		D	20–30m	100–150m

MA 119:044	Davros	Enclosure / Ringfort	130480,		D	20–30m	80–100m
MA 119 (Discovered 2000)	Davros	Enclosure (possible)	Not available		D	20–30m	80–100m
MA 119:059	Oultauns	Ringfort and Children's Ground	132010,		D	20–30m	150m
GA 015:002	Ardour	Named Well	13213, 25904		D	10–20m	80m
SMR Ref.	**Townland**	**Monument Type**	**NGR**	**Sources**	**Classification**	**Area of Interest**	**Approx. Distance**
GA	Kilshanvy	Conjoined Ringfort	13174, 25830		D, extensive site	20–30m	250m
GA	Kilshanvy	Souterrain	13174, 25829		As above	20–30m	250m

GA 028:001	Ardour /	Bivallate Ringfort	13205, 25807		C	20–30m	40m
GA 028:035	Kilshanvy	Univallate Ringfort	13230, 25751		C	20–30m	150m
GA	Kilshanvy	Univallate Ringfort	13233, 25754		C	20–30m	120m
GA	Kilshanvy	Souterrain Probable	13233, 25754		F, part of a site	20–30m	120m
GA 028:034	Kilshanvy	Bivallate Ringfort	13215, 25737		D	20–30m	250m
GA 028:009	Cloonsheen	Univallate Ringfort	13225, 25615		D	20–30m	130m

SMR REF.	TOWNLAND	MONUMENT TYPE	NGR	SOURCES	CLASSIFICATION	AREA OF INTEREST	APPROX. DISTANCE
GA 042:025	Beagh Beg	Ecclesiastical Remains	13226, 25144		F- G	50–100m	200m
GA 042:029	Biggera Beg	Univallate Ringfort	13559, 24607		D	20–30m	50m
GA 042:074A/B	Carheenard	Enclosure and Field	13306,25084 and 13303,		F	250x250m	100m at its closest point
GA 042:065	Caltragh	Circular Enclosure	13470, 24844		D	20–30m	100m
GA 042:066	Caltragh	Circular Enclosure	13489, 24825		D	20–30m	170m
GA 042:067	Caltragh	Unclassified Earthwork	13488, 24814		G	20–30m	100m
GA 042:068	Caltragh	Unclassified Earthwork	13487, 24812		G	20–30m	50m
GA 042:070	Caltragh	Polygonal Cist	13457, 24868		F- G	10–20m	60–90m
GA 042:071	Carheenard	Enclosure	13347,25036		G	Unknown Area of Interest	200m
GA 42:95	Cave	Unclassified earthwork	13400,24907		D	20–30m	200m
GA 056:088	Laurclavagh	Circular Enclosure	13616, 24408		G	20–30m	60–80m
GA 057:064	Bunoghanaun	Univallate Ringfort	13090, 24957 (incorrect; verified as 137009,		D	20–30m	60–80m

GA 057:142	Slievefin	Enclosure	13883, 23900		G	20-30m	130-150m
GA 070:096	Racoona	Enclosure	13905, 23854		G	20-30m	80-50m
GA 070:105	Knockdoebeg West	Ringfort	13994, 23723		D	20-30m	30-40m
GA 070:104	Knockdoebeg West	Ringfort	13979, 23706		D	20-30m	150-180m
GA 070:080	Knockdoebeg West	Battlefield	14047, 23682		Extensive site no apparent remains	150m by 250m	100m
GA 070:6:6	Knockdoemore	Ringfort	14027, 23630		D	20-30m	130m
GA 070:057	Cregmore	Univallate Ringfort	14194, 23376		D	20-30m	230m
GA 083:044	Knocknacreeva	Enclosure	145010,		D	20-30m	100m
GA 083:045	Knocknacreeva	Earthwork	144890,		G	20-30m	50m
GA 084:122	Rathmorrisey	Ringfort / Rath / Cashel	147370,		UC	20-30m	<50m

GA	Cloran	Cashel	147800,		D	20–30m	150m
GA	Cloran	Souterrain	147800,		F (part of the site)	20–30m	150m
GA 096:061	Cloran	Ringfort	147650,		C-D	20–30m	150m
GA 096:051	Castleturvin	Ecclesiastical remains	148420,		C-D	50–100m	120m
GA 096:029	Cahercrin	Childrens Burial Ground,	14891, 22401		D	30m	*c.* 250m

		Ringfort					
GA 096:031	Cahercrin	House	14900, 22397		UC	20m	250–300m
GA 096:030	Cahercrin	Ringfort, Souterrain	14910, 22360		C-D	20–30m	150m
GA 096:165	Templemartin	Church and Graveyard	15067, 22213		C-D	50m	approx. 60–
GA 096:012	Ballywinna	Enclosure	151710,		UC	Unknown	200–250m
GA 096:010	Ballywinna	Ringfort; Children's Burial Ground	152130,		UC	Unknown	200m
SMR REF.	**TOWNLAND**	**MONUMENT TYPE**	**NGR**	**SOURCES**	**CLASSIFICATION**	**AREA OF INTEREST**	**APPROX. DISTANCE**
GA 096:099	Garracloon South	Enclosure	152200,		UC	Unknown	50–100m
GA 096:098	Garracloon South	Ringfort, Childrens Burial Ground	15240, 22139		UC	Unknown	30–50m
GA 096:092	Ganty	Souterrain	152830,		F	20–30m	50–100m

Appendix 14.2: List Of Stray Finds

GA 096:094	Ganty	House	152800,		UC	Unknown	100-200m
GA 096:006	Ballyageeragh,	Earthwork	15303, 22099		UC	Unknown	180m

The information presented below is based on the National Museum of Ireland Topographical Files. These files record stray finds reported to or held by the National Museum. The following list provides the registration number of the find, the townland in which it was found and, where available, the context of the find.

County Mayo

Townland	Reg No.	Find	Context
Bellacorick	IA/43/80	Wooden V-shaped object	Found in bog
Bellacorick	1944:218	Wooden vessel	Found in bog
Davros	1971:955	Bronze spearhead	
Dooncarton (Glengad)	1961:138	Human skull fragments and teeth	
Dooleeg More	M1950:8	Cylindrical wooden vessel	
Dooleeg More	1948:8	Wooden deer trap (in four parts)	
Dooleeg More	M1950:16	Wooden vessel fragments	
Inver	1955:37; 38	Polished bone objects	
Lisnolan	1934:5945	Bronze spearhead	Found in bog
Massbrook Lower	1959:26	Stone axehead (riverstone type)	
Rosdoagh	1957:256	Polished stone axehead	
Rosdoagh	P1953:23	Flint arrowhead, barbed and tanged	
Rosdoagh	1968:440a, 440b	Stave-built wooden vessel with bog butter fragments	
Smuttanagh	81.2625	Bronze dish	Loona Bog
Tawnagh	1968-78, 79	Rough-outs for wooden bowls	
Tawnaghmore	1971:1042	Human bones	Cist grave
Tawnaghmore	1960:620	Decorated wooden vessel	
Tawnaghmore	1960:610	Lid for 1960:620	

County Galway

Townland	Reg No.	Find	Context
Beagh More	1950:19	Leather shoe and bog butter container	Bog at Ummoon
Beagh More	E185:21	Flat copper axe	
Beagh More	1949:14	Bronze pin	
Caltragh	1958:2-5, 5a	Cinerary urn, sherd of enlarged food vessel, flint slug knife, bone pin and cremated human bones	
Castlehackett	1932:6524	Food vessel	Cairn at Knockura
Kilshanvy	1932:6413-6418	Bronze pins, bracelets and ear rings	
Kilshanvy/ Nettlehill	1932:6363	Stone axehead (broken)	

Appendix 14.3: National Monuments Legislation

National Monuments Legislation

All archaeological sites have the full protection of the national monuments legislation (Principal Act 1930; Amendments 1954, 1987 and 1994).

In the 1987 Amendment of Section 2 of the Principal Act (1930), the definition of a national monument is specified as:

> any artificial or partly artificial building, structure or erection or group of such buildings, structures or erections,
>
> any artificial cave, stone or natural product, whether forming part of the ground, that has been artificially carved, sculptured or worked upon or which (where it does not form part of the place where it is) appears to have been purposely put or arranged in position,
>
> any, or any part of any, prehistoric or ancient
>
> (i) tomb, grave or burial deposit, or
>
> (ii) ritual, industrial or habitation site,
>
> and
>
> any place comprising the remains or traces of any such building, structure or erection, any cave, stone or natural product or any such tomb, grave, burial deposit or ritual, industrial or habitation site.

Under Section 14 of the Principal Act (1930):

> It shall be unlawful..
>
> to demolish or remove wholly or in part or to disfigure, deface, alter, or in any manner injure or interfere with any such national monument without or otherwise than in accordance with the consent hereinafter mentioned (a licence issued by the Office of Public Works National Monuments Branch),
>
> or
>
> to excavate, dig, plough or otherwise disturb the ground within, around, or in the proximity to any such national monument without or otherwise than in accordance..

Under Amendment to Section 23 of the Principal Act (1930),

> A person who finds an archaeological object shall, within four days after the finding, make a report of it to a member of the Garda Siochana..or the Director of the National Museum..

The latter is of relevance to any finds made during a watching brief.

In the 1994 Amendment of Section 12 of the Principal Act (1930), all the sites and 'places' recorded by the Sites and Monuments Record of the Office of Public Works are provided with a new status in law. This new status provides a level of protection to the listed sites that is equivalent to that accorded to 'registered' sites (Section 8(1), National Monuments Amendment Act 1954) as follows:

> The Commissioners shall establish and maintain a record of monuments and places where they believe there are monuments and the record shall be comprised of a list of monuments and such places and a map or maps

Appendix 14.4: Classification Table for EIS

showing each monument and such place in respect of each county in the State.

The Commissioners shall cause to be exhibited in a prescribed manner in each county the list and map or maps of the county drawn up and publish in a prescribed manner information about when and where the lists and maps may be consulted.

In addition, when the owner or occupier (not being the Commissioners) of a monument or place which has been recorded, or any person proposes to carry out, or to cause or permit the carrying out of, any work at or in relation to such monument or place, he shall give notice in writing of his proposal to carry out the work to the Commissioners and shall not, except in the case of urgent necessity and with the consent of the Commissioners, commence the work for a period of two months after having given the notice.

Appendix 14.5: Archaeological Site Investigation Sheet

Classification Table for EIS

EPA Impacts	Impact Level	Criteria for EIS	Category	Status	Implications
Profound or significant, (negative effect only)	Severe	Reserved for adverse effects only. Applies where mitigation would be unlikely to remove such effects. The effects are generally but not exclusively associated with sites and features of international or national importance	A	National Monument	Sites must be avoided
Significant impact, (positive or negative)	Major	Important considerations at a national to regional level. If adverse, they have the capacity to become key components in the structuring of the project. Mitigation measures are unlikely to remove all effects upon the affected communities or interests	B	Nationally important site/ or very rare in the archaeological record	Sites must be avoided
	Moderate	Represents issues where mitigation measures and detailed design work may ameliorate/enhance some of the consequences upon affected interests. If adverse, they are important but not likely to be key decision makers on the EIS. The effects can be mitigated.	C	Extensive, well-preserved sites (ringforts, castles, churches, graveyards, burial mounds) not necessarily rare in the archaeological record	Sites should be avoided, if possible. All archaeological investigation work should take place pre-development well in advance of construction
			D	Sites similar to those in category C, but not as well preserved or extensive	Avoidance is recommended. If not an option, full archaeological excavation ensuring preservation by record would be required. Archaeological work should be conducted at the pre-development stage
			E	Historical Building Sites, post 1700AD and industrial buildings and/or structures.	Archaeological/architectural building survey. Sites are assessed by survey and photographic and historic record. To take place at the pre-construction and/or construction phase
			F	Low visibility sites/features, i.e., fulachta fiadh, souterrains/ lithic scatters	Archaeological investigation/excavation prior to the construction phase. If archaeological material is found, full excavation or avoidance can then be cited
	Minor	Not significant in the decision making process. Can be of relevance to the subsequent design of the project	G	Sites of sites, destroyed or delisted, marked on the OS, or known from documentary sources	Area needs to be archaeologically assessed in the field. Sometimes monitoring is required during the construction phase
	Unknown		UC	Sites of possible archaeological potential but of unquantified extent and significance	Trial excavations for a detailed assessment would be required and a full excavation may be recommended. To take place pre-construction
Neutral or slight Impact	Not significant	The forecasting framework cannot envisage any effect on the environment	N/A	N/A	An area of archaeological potential must be observed around all sites

Archaeological Site Investigation Sheet

ENTERPRISE OIL - CORRIB PIPELINE **Site Investigation**		
Trial Pit No. ***TP -***	***Townland Name***	***OS 6" Sheet No.*** ***Mayo:***
General Topography		
Dimensions of Trial Pit	***General Information***	
Width:	***Photo:***	
Length:	***Sketch:***	
Depth:	***Initials & Date:***	
Details of Stratigraphy:		
Proximity to Archaeological Monuments:		
Additional Information:		
Access:		
Photo:		
Description:		
Roll No:	***Neg No:***	
Sketch:		

AGRICULTURAL LIAISON OFFICER	A BGÉ employee who provides a communication link between landowner/occupiers and Bord Gáis Éireann
ALLUVIUM	Detrital material, commonly composed of sands and gravels, transported and deposited by a river
ALO	Agricultural Liaison Officer
ANTICLINE	Fold or fold system in the form of an arch
AOD	Ordnance Datum
AQUIFER	A water bearing bed of strata, either by virtue of its porosity or because it is pervious
AUGER	A tool for boring holes
BAR	A unit of pressure
Barg	bars above atmospheric pressure
BAT	Best Available Technology
BATNEEC	Best Available Technology Not Entailing Excessive Costs
BEDDING	Layers within sedimentary rocks characterised by differences in composition, texture or structure
BGÉ	Bord Gáis Éireann
BH	Borehole
BIOCIDES	Chemicals which destroy living organisms within the pipeline during hydrotesting
BOD	Biological Oxygen Demand
BP	Before Present
BPEO	Best Practicable Environmental Option
BRONZE AGE	*c.* 2300 BC–500 BC
BUND	An earth embankment
CAIRN	Burial mound composed of stones, sometimes with internal structures
CHILDREN'S BURIAL GROUND	A burial ground used for unbaptised children, and others who could not be buried on consecrated ground. Graves are sometimes marked with simple stones, and burials are occasionally set within earlier enclosures, or outside church sites.
CIST	Box-like structure of stone, set into the ground or into a burial monument, used to contain the burial.
COD	Chemical Oxygen Demand
COURT TOMB	Megalithic tomb dating to the Early Neolithic, so called because of a its large open court feature with a gallery leading into a long trapezoidal cairn
DAFOR	Ecological abundance classification D: Dominant A: Abundant F: Frequent O: Occasional R: Rare
DEEP-TINE CULTIVATION	Blades pulling behind a tracked vehicle used to loosen compacted soils
DIP	The angle in degrees between a horizontal plane and an inclined feature such as rock strata

DRIFT	A general name for the superficial as distinct from the solid formation of the earth's crust or material deposited by a glacier
EARTHWORK	Any monument made entirely or largely of earth.
EASEMENT	Permanent wayleave negotiated with the landowner
EC	European Commission
EIA	Environmental Impact Assessment
ENCLOSURE	Any monument consisting of an enclosing feature, such as a bank or a ditch, usually earthen, such as barrows or ringforts.
ENVIRONMENTAL IMPACT ASSESSMENT	A systematic study which identifies and predicts the effects on the bio-geophysical, social and economic environment of a project
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EQS	Environmental Quality Standard
EU	European Union
EVAPO-TRANSPIRATION	Combined water loss through evaporation and transpiration by plants
EXCAVATABILITY	Related to the ease with which the trench can be dug
FIELD SYSTEM	Pattern of fields, now no longer in use, usually visible as low earthworks, often associated with medieval or earlier settlements
FOSSE	Ditch associated with a ringfort.
FULACHT FIADH	Bronze Age cooking sites
FPO	Floral Protection Order
GEOTEXTILE SHEET	A permeable synthetic membrane specifically designed to be used as a construction material
GLEY SOILS	Waterlogged soils that develop where the drainage is poor or the water table high
GPR	Ground Penetrating Radar
HDD	Horizontal Directional Drilling
HOLY WELL	A natural spring or well with an association with a saint, or a tradition of cures. Often found near ecclesiastical or monastic sites.
HORIZONTAL DIRECTIONAL DRILLING	A method of drilling and installing pipelines under large features, such as rivers, with minimal ecological and environmental impact.
HP	High Pressure
HUT SITE	Small ring of stones representing the foundation of a hut. Can be of any date, usually found in upland or marginal land
IFA	Irish Farmers Association
INTELLIGENT PIG/ PIG	A device used for the measurement of several parameters which operates inside a pipe
Iron Age	c. 500 BC – AD 500
L_{eq}	The equivalent continuous sound level (Leq) that is the notional steady noise level which, over a given period, would deliver the same amount of sound energy as the actual fluctuating level

LINEAR EARTHWORK	A long bank or ditch, often a territorial boundary such as the Pale. Can be of any date
MEGALITHIC TOMB	Literally 'large stone' Neolithic tomb
MESOLITHIC	Middle Stone Age (*c.* 10,000 BC–4000 BC)
NATURAL GAS	Gaseous forms of petroleum consisting of a mixture of hydrocarbon gases, the most important of which is methane
NEOLITHIC	New Stone Age (*c.*4000 BC–2300 BC)
NHA	Natural Heritage Area
NMI	National Museum of Ireland
OPEN-CUT CROSSING	A method of pipeline crossing whereby an open trench is dug
OS(I)	Ordnance Survey (Ireland)
PEDOLOGICAL	The scientific study of soils, including their origins, characteristics, and uses
PIG	Pipeline Integrity Gauge: cylinders fitted with rubber or neoprene cups which conform and fit the internal bore of the pipe allowing them to be propelled at a controlled speed through the pipe
PIG TRAP	Equipment for launching and receiving pigs through a pipeline
pNHA	Proposed Natural Heritage Area
PORTAL TOMB	Megalithic tomb dating to the Early Neolithic, so called because of its large door feature, on which a large capstone is balanced. Known also as dolmens or cromlechs. Usually situated near streams and rivers
RUDERAL	Plants which colonise open ground
SAC	Special Area of Conservation
SEMI-NATURAL HABITAT	Habitat modified by human activity from its original state but with a vegetation composed of native species similar in structure to natural types and with native animal communities
SHEET PILING	Vertical supports for trench excavations i.e. wall support.
SI	Statutory Instrument
SMR	Sites and Monuments Record
SPA	Special Protection Area
STONE CIRCLE	Ceremonial ring of stones dated to the Bronze Age, occasionally associated with burials
(PIPE) STRINGS	Assembled lengths of pipe
SUBSOIL	The layer of soil between the topsoil and bedrock
SWARD	Mixture of grasses forming a turf
SYNCLINE	A basin shaped fold or fold system
TILL/BOULDER CLAY	A poorly sorted mixture of sands, clays and boulders produced by the erosion of rocks by moving ice
TOGHER	Literally a causeway, usually used to mean a wooden trackway across a bog
TOPOGRAPHY	The physical features or configuration of a land

	surface
TP	Trial Pit
TRENCH STABILITY	Ease of producing trenches (without collapse)
TURLOUGH	Formed when solution cavities within the limestone collapse to form surface depressions.
VENTING	Release of high pressure gas to atmosphere
WAYLEAVE	Permission or consent to build and maintain the pipeline
WEDGE TOMB	Megalithic tomb dating to the Late Neolithic and Early Bronze Age; so called because of a wide high front, sloping and narrowing towards the back.
(WELL-POINT) DEWATERING	A method used for artificially lowering groundwater levels via pump extraction.
WORKING WIDTH	The area within which the pipeline construction takes place

References

Aalen, F.H.A., Whelan, K. & Stout, M. (1997) *Atlas of the Irish rural landscape.* Cork University Press.

Alcock, O., de hÓra, K., and Gosling, P. (1999) *Archaeological inventory of County Galway,* vol. II, *north Galway.* Stationary Office, Dublin.

An Foras Taluntais 1980 *General Soil Map of Ireland 1: 575,000.* National Soil Survey, An Foras Taluntais.

Anon (1999) *Water quality in Ireland 1995-1997 – Statistical Compendium of River Quality Data Version 2.* Environmental Protection Agency, Dublin.

Caulfield, S., O'Donnell, R. G., and Mitchell, P. I. (1998) 'Radiocarbon dating of a Neolithic field system at Céide Fields, County Mayo, Ireland,' *Radiocarbon* 40, 629–40.

Central Statistics Office, Census of Population (1996)

Collins, J.F. & Cummins, T. (eds.) 1996 *Agroclimatic atlas of Ireland.* Asmet, Dublin.

Colhoun, Kendrew. February 2000. I-WEBS Report 1997-98; Results of the fourth winter of the Irish Wetland Bird Survey. Publ. by Birdwatch Ireland.

Collins, J.F., Walsh, M. & Guinan, L. (2000) *Quantification and monitoring landforms and vegetation changes arising from the development of Barnesmore Wind Energy Generating Station, Co. Donegal.* Forest Enterprises Ltd. for EU INTERRG - II/Dept. Public Enterprise/Scottish Power Plc.

Conaghan, J.P. (1995). *The Ecology of* Eriophorum gracile *and* Eriophorum latifolium *in Ireland.* Ph. D. Thesis, National University of Ireland.

Cooney, G. (1999a) *Landscapes of Neolithic Ireland.* Routledge, New York.

Cooney, G. (1999b) 'Editorial,' *Archaeology Ireland,* winter.

Countryside Bird Survey. Survey data from BirdWatch Ireland for various 1km square survey areas in Cos. Mayo and Galway. Summarised data from 1999 or 2000 presented in this report. Acknowledgements to Dick Coombes

Coxon, C.E. (1986). *A study of the hydrology and geomorphology of turloughs.* Unpublished Ph.D. Thesis, Trinity College, Dublin.

Crushell, P. (2000). *Irish Fen Inventory: Review of the Status of Fens in Ireland.* IPCC, Dublin.

Cuppage, J. (1986) *Archaeological survey of the Dingle Peninsula,* Ballyferriter, Oidreacht Chorca Dhuibhne.

Curtis, T.G.F. & McGough, H.N. (1988). *The Irish Red Data Book. 1: Vascular Plants.* The Stationery Office, Dublin.

De Buitleir, M. (1998) 'A neglected aspect of Irish Archaeology,' *Archaeology*

Ireland, spring.

Department of the Environment 'Sustainable Development – A Strategy for Ireland' (1997)

Department of Public Enterprise - *Green Paper on Sustainable Energy* (1999)

Douglas, C., Garvey, L., Kelly, L. and O' Sullivan, A. (1989). *A survey to locate blanket bogs of scientific interest in County Mayo.* A report commissioned by The Wildlife Service, Office of Public Works, Dublin.

Douglas, C. & Grogan, M. (1986). *Survey to locate raised bogs of scientific interest in Counties Longford, Westmeath and Mayo.* Internal report for the Forest and Wildlife Service, Dublin.

Douglas, C., Garvey, L., Kelly, L. & O'Sullivan, A. (1989). *A survey to locate blanket bogs of scientific interest in County Kerry and County Sligo.* Unpublished report for the Wildlife Service, Dublin.

Duignan, M. V., and Lord Killanin (1995) *The Shell guide to Ireland.* Dublin.

E.C. (1992). Council Directive 92/43/EEC of 21 May 1992 *on the conservation of natural habitats and of wild fauna and flora.* Official Journal no. L 206, 22/07/92.

English Heritage (1995) *Geophysical survey in archaeological field evaluation. Research & professional services guideline no. 1,* compiled by Andrew David, Ancient Monuments Laboratory, English Heritage Society.

Fitzpatrick & Associates et al, Border, Midlands and Western Region - Development Strategy 2000-2006

Foss, P.J. and McGee, E. (1987). *A survey to locate blanket bogs of scientific interest in County Mayo.* A report commissioned by The Wildlife Service, Office of Public Works, Dublin.

Fossitt, J.A. (2000). *A guide to habitats in Ireland.* The Heritage Council.

Galway County Council, Galway County Development Plan (1997-2002) 'A Western Development Commission - Development Plan for the West – Blueprint for Success'

Goodwillie, R. (1992). *Turloughs over 10ha: Vegetation Survey and Evaluation.* Unpublished report for the National Parks and Wildlife Service, Office of Public Works, Dublin.

Gosling, P. (1993) *Archaeological inventory of County Galway,* Volume I, west *Galway,* Stationery Office, Dublin.

Gowen, M. (1988) *Three Irish gas pipelines: new archaeological evidence in Munster.* Wordwell, Dublin.

Hulme, P.D. (2000) *Ecologically Sensitive Approach to the Extension of Corrie Windfarm, County Leitrim.* A Report for Gaoithe Saor Teo.

JNCC. 1990 *Handbook for Phase I habitat survey - a technique for environmental audit.* Nature Conservancy Council, UK.

Keane, M. (1989) 'An archaeological survey of the basin of the River Deel, Co. Mayo, Volume 1.' Submitted as part of a Master's thesis. Unpublished.

Kelly, L., Doak, M. & Dromey, M. (1995). *Raised Bog Restoration Project: An investigation into the conservation and restoration of selected raised bog sites in Ireland.* Internal report to the National Parks and Wildlife, Dublin.

Kurz I. and Costello M. J. (1998) *An outline of the biology, distribution and conservation of lampreys in Ireland* – Irish Wildlife Manual No. 5. Dúchas, Dublin.

Lacy, B. (1983) *Archaeological survey of County Donegal,* Donegal County Council, Lifford.

Lewis, S (1837) *A topographical dictionary of Ireland,* 2 vols., Dublin.

Lockhart, N. D. (1987). The occurrence of *Homalothecium nitens* (Hedw.) Robins. in Ireland. *Journal of Bryology,* 14, 511-517.

Lockhart, N. D. (1991). *Phytosociological and Ecological Studies of Lowland Blanket Flushes in West Galway and North Mayo.* Unpublished PhD thesis, University College Galway.

Mayo County Council, Mayo County Development Plan (1992)

McKee, A.M. (1999). *A survey of the rare and protected flora of County Mayo.* A report to the National Parks and Wildlife Service, Dublin.

Molloy, K., and O'Connell, M. (1995) 'Palaeoecological investigations towards the reconstruction of environment and land-use changes during prehistory at Céide Fields, western Ireland,' Probleme der Küstenforschung im südlichen Nordseegebiet 23, 187–225.

Mór Ó Mongáin, S. (1996) 'Iorras Domhnann,' Living Heritage, *summer.*
Mitchell, F. (1990) *The way that I followed: a naturalist's journey around Ireland,* Dublin, 112-114

Ní Lamhna, E. 1979 *Provisional distribution atlas of amphibians, reptiles and mammals in Ireland.* An Foras Forbartha.

Onshore Pipeline Logistics, Constructability and Cost Study prepared by McAlpine-PPS Pipeline Systems Joint Venture (dated August 2000);

Onshore Gas Pipeline Constructability Study prepared by PML (dated September 2000) [Section 9: Traffic/Transport Plan only];

Ordnance Survey 1985 *Geological Map of Ireland 1: 750,000,* 3rd edition.

Ordnance Survey, Dublin.

O'Sullivan, P. 1994 *Bats in Ireland.* Irish Naturalists' Journal, special supplement.

O'Sullivan, A., and Sheehan J. (1996) *The Iveragh Peninsula—an archaeological survey of South Kerry*, Cork University Press.

Rogers, K. and de Barra, R. (2000) *An environmental appraisal and review of the main factors contributing to the decline of the River Robe as a salmonid fishery.* Occasional Report Series 2000/1. Western Regional Fisheries Board, Earl's Island, Galway.

Scannell, M.J.P. and Synnott, D.M. (1987). *Census Catalogue of the Flora of Ireland.* (2nd edition). Stationery Office, Dublin.

Sites and Monuments Record, files held at Dúchas. Unpublished.

Smal, C.M. 1988 *The American mink in Ireland.* Mammal Rev. **18**(4): 201-208.

Smal, C.M. 1995 *The badger and habitat survey of Ireland.* The Stationery Office, Dawson St., Dublin 2.

Smal, C.M. 1995 *Ecological monitoring in Ireland: a preliminary land classification of Ireland based on cartographic data and remotely sensed imagery.* Unpublished report for National Parks & Wildlife Service.

Synnott, D.M. (1986). *An outline of the flora of Mayo.* Glasra, **9**, 13-117.

The Economic and Social Research Institute, National Investment Priorities for the period 2000-2006 (1999)

The National Development Plan, 2000-2006

Topographical files held at the National Museum of Ireland. Unpublished.

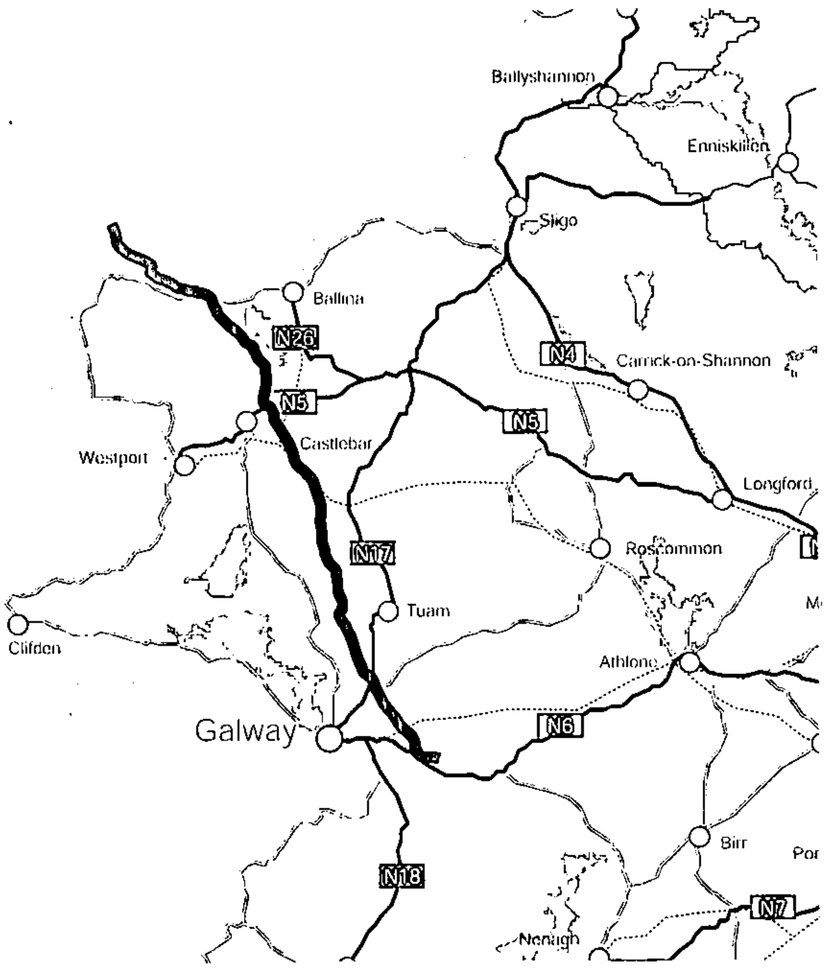
Western Development Commission - 'Developmeny Plan for the West - Blueprint for Success'

White,J. & Doyle, G. (1982) *The vegetation of Ireland a catalogue raisonne.* J.Life Sci.R.Dubl.Soc. 3 No.2 289-368.

BORD GÁIS
TRANSMISSION BUSINESS UNIT

MAYO-GALWAY GAS PIPE LINE

EIS No 1633
PART 2 of 3



ENVIRONMENTAL IMPACT STATEMENT

Addendum Report

SEPTEMBER 2001

ARUP

Report Mayo to Galway Gas Pipeline EIS

Additional Information

4 September 2001

C689/10

Report Mayo to Galway Gas Pipeline EIS

Additional Information

Prepared By: Ria Lyden
Signed: Ria Lyden

Date: 4 September 2001

Checked By: Ria Lyden
Signed: Ria Lyden

Date: 4 September 2001

Passed By: Eoghan Lynch pp
Signed:

Date: 4 September 2001

Revision Record

Issue No.	Date	Status	Prepared	Checked	Passed
1	02/07/01	Draft Report	RL	RL	EJL
2	04/09/01	Issue 1	RL	RL	EJL

ARUP
Consulting Engineers

Table of Contents

1 Introduction

The Mayo to Galway gas pipeline project comprises the construction of a circa 150km, 660mm (26inch) diameter, high pressure gas transmission pipeline from the Corrib Bellanaboy Bridge terminal in Co. Mayo to Craughwell, Co. Galway. Enterprise Energy Ireland Ltd., who initiated the project, signed a contract in late 2000 with Bord Gáis Éireann (BGE) whereby BGE would undertake detailed design and construction of the pipeline. Enterprise Energy Ireland Ltd. had commissioned an Environmental Impact Assessment and the preparation of an Environmental Impact Statement (EIS). When BGE took over the project Arup Consulting Engineers assumed responsibility for completion of the EIS.

The EIS was submitted to the Department of Public Enterprise in May 2001. The Department appointed consultants to review the EIS. This document is a response to queries raised by the consultants.

2 Safety and Risk Management

2.1 Non Routine Events

Chapter 22 of the EIS contains a summary of the environmental impacts of the Mayo to Galway gas pipeline. Section 22.4, 'Non Routine Events', describes the environmental risk assessment process and provides a risk assessment of potential hazards. For eight events the nature of the event, the control measures to prevent its occurrence and the likely environmental consequences are tabulated.

2.2 Risk Assessment

The event which would pose a risk to nearby residents from a gas pipeline or an associated above ground installation (AGI) is an escape of gas which subsequently ignites, causing a fire or explosion. For this to happen there must be both a gas leak and a source of ignition. A leak of gas on its own will not pose a risk as the gas, which is lighter than air, will dissipate into the atmosphere very quickly.

Natural gas is an asphyxiant. This can pose a risk to personnel and must be considered in the design of certain types of gas installation. A gas transmission pipeline does not pose a risk of asphyxiation to nearby residents. (Note: The Concise Oxford Dictionary defines asphyxia as 'defective aeration of blood through impaired respiration; suffocation'. An asphyxiant is a substance which causes this effect.)

2.3 Gas Leak Prevention

To prevent a gas leak, the pipeline has been designed and will be constructed, operated and maintained in accordance with IS328 Code of Practice for Design and Installation of Gas Transmission Pipelines, 1989. The pipe size, grade of steel, wall thickness and corrosion protection systems have been specified to ensure the pipeline is suitable for its purpose and to ensure that its integrity is maintained during its design life.

To be included in the pipeline construction tender list, contractors will have to pre-qualify, by demonstrating their competence and previous experience in pipeline construction. Construction method statements must be provided for each element of the work. The method statements will be scrutinised and only a contractor of proven competence will be appointed. The pipeline will be constructed to the highest standards. Material and workmanship will be inspected and tested and the entire pipeline will be pressure tested prior to commissioning.

BGE has developed a comprehensive set of procedures for pipeline operation and maintenance. These are contained in BGE's Field Operations and Maintenance - Works Instruction Manual. The manual specifies maintenance and inspection routines designed to ensure that the integrity of the pipeline is not compromised.

2.4 Prevention of an Ignition Source

Possible ignition sources are sparks arising from impact damage to the pipeline during operations or a spark from an electrical source at an AGI. The pipeline will be given a minimum of 1.2m of soil cover to prevent damage from routine events. The cover will be increased under the bed of rivers and streams. The most likely cause of damage to the pipeline would be excavations close to the pipeline. The pipeline wayleave will be monitored regularly to ensure that no unsupervised excavation occurs. If there is some requirement to excavate close to the pipeline, the method of working will be specified and BGE personnel will supervised the work. At the AGIs, any electrical equipment, which could come in contact with gas, will be specified to have the appropriate rating for use in a potentially explosive environment.

2.5 Gas Pipelines Safety Performance

BGE has operated high-pressure gas transmission pipelines in Ireland for more than 20 years. In this time no catastrophic failure has occurred which has resulted in the release of gas to the atmosphere. A report, published recently by European Gas Pipeline Incident Data Group (EGIG), presented data on pipeline safety performance of high pressure (>15bar) gas transmission pipelines. This group comprises nine operators in Denmark, Spain, France, Holland, Germany, Belgium, Italy, Switzerland and UK. The main results of analysing the safety performances of their pipeline systems are:

- Over the period 1970 to 1998 there has been no fatal accident involving inhabitants.
- The overall incident frequency with an unintentional gas release over the period 1970 to 1998 is 0.480 incidents per year per 1000km pipeline. However, the figure over the period 1993 to 1998 is significantly lower: 0.211 incidents per year per 1000km pipeline.
- External interference is the main cause of gas pipeline incidents involving gas leakage; an average of 0.239 incidents per year per 1000km pipeline for the period 1970 to 1998. However, an improvement in the incident frequency occurred over the period 1993 to 1998 where this statistic reduced to 0.087 incidents per year per 1000km pipeline.

These figures show an increase in the safety performance. It is considered that this is primarily due to an increasing integration of safety items during the phases of design, manufacturing, construction, maintenance and operation of pipelines.

The above data are based on failure incidents in pipelines outside of AGIs. The EGIG has also assessed the contribution to the above statistics of failure incidents within all elements of transmission pipeline systems including AGIs and concluded that the external safety for the "public at large" will only be affected by the cross country high pressure pipelines. The contribution of all the other elements such as block valves, pressure reducing stations, pigging stations etc. was found to be negligible. Therefore, to demonstrate the safety of high pressure gas transmission system it is sufficient to concentrate just on the pipelines.

2.6 Liaison and Emergency Procedures

BGE's existing liaison and emergency procedures will cover the Mayo to Galway pipeline. Central to BGE's procedures is the preparation of an emergency plan. This will contain a minimum of the requirements of IS328. As part of a Quality Management System, BGE has developed a *Control of Emergencies – Works Instruction Manual*. This manual sets out the action to be implemented by the Transmission Operational Response Team in the management of a crisis on the BGE Transmission Grid and details Emergency Procedures for the overall transmission network. It sets out procedures to be followed for the receipt, location, classification and control of emergencies. Emergencies are classified in the following categories:

- Line break (Major Leakage) Bord Gáis National Transmission System (NTS).
- Line damaged (sustainable level of gas leakage) Bord Gáis NTS.
- Line damaged (no gas leakage).
- Loss of gas supplies.
- Major emergency as declared by Local/Regional Authorities.

The manual sets out response procedures for each of these classes of emergency. It also provides contact details and details of the organisational structure that will be in place during an emergency. Central to this structure is the supply of information to the public through the Communications Team.

Major emergencies as defined by the BGE emergency procedures are 'any emergency which will require the implementation of the Regional Major Accident/National Emergency Plan and will normally involve a number of seriously injured casualties'. Emergencies can be classified as major if there are a number of human casualties involved, if the evacuation of a populated area is necessary or if there is a possibility that the emergency will escalate. Regional Emergency Plans and BGE emergency procedures identify the role of BGE as part of the Regional/National Emergency Plan. This role is generally to deal with and make safe any gas involvement and to liaise with Gardaí and other authorities in the overall operation as appropriate. In this regard, the BGE emergency procedures are integrated with the Regional/National Emergency Plans.

2.7 Air Emissions During Maintenance and Unforeseen Events

Any emissions to atmosphere during maintenance of the pipeline would be of natural gas. None of the routine maintenance activities will cause the release of a significant quantity of gas. An unforeseen event, which caused a rupture of the pipeline, would result in a leak of gas. It is difficult to quantify such a release. However BGE will operate a computerised leak detection system, continuously monitoring the pipeline. The leak detection system is described in Section 7.3.1 of the EIS. If a leak is detected the system will shut the block valves which are provided to allow each length of pipeline to be isolated. This will minimise the quantity of gas which is released.

If the leaking gas ignited, the emission to atmosphere would comprise the products of combustion of the gas such as carbon dioxide, water and nitrous oxides.

2.8 Outlet Valve from the Corrib Terminal at Bellanaboy Bridge

The operators of the Corrib Terminal at Bellanaboy Bridge will be able to shut the outlet valve from the terminal to the pipeline in the event of an emergency arising. The emergency could be a leak in the pipeline or an unforeseen situation in the terminal. An EIS has been submitted to Mayo County Council with the planning application for the Corrib terminal. Reference should be made to the EIS for the terminal for details of the terminal operations.

3 Difficulties Encountered in the Study.

3.1 Additional Studies

The scope and methodology of the ecological surveys to be undertaken during the Environmental Impact Assessment was agreed in advance with Dúchas and the Regional Fisheries Boards. All of this work was completed, and all of the areas, which required field inspections, were inspected. Completion of the EIS was delayed to allow this fieldwork to be undertaken when the Foot and Mouth Disease restrictions had been relaxed to allow visits to farmland. The field studies, which were undertaken, provided sufficient information to describe the receiving environment and assess the impacts of the pipeline, as required by Article 25, Second Schedule, of the Environmental Impact Assessment Regulations 1989 and subsequent amendments.

Following completion of the field studies, Dúchas was informed of the findings. Dúchas requested that some more detailed studies be undertaken in specific areas, prior to the commencement of construction. Dúchas did not require these additional studies to form part of the EIS.

Seven of the additional studies relate to vegetation. The purpose of six of these vegetation studies is to form a detailed baseline, in specific areas, in order to record the changes and monitor the recovery of the vegetation during and following construction of the pipeline. The baselines will also be used to monitor the impact of different construction techniques in bog areas.

The seventh vegetation study requires the recording of the dominant species composition in well developed hedgerows, in order to facilitate the reinstatement of the hedgerows on completion of construction.

Additional field surveys of badgers, otters and bats were also requested by Dúchas.

The badger survey will be undertaken to identify badger activity close to the pipeline route. If a badger sett is identified which will be affected by the pipeline construction, and it is not practicable to adjust the route of the pipeline to avoid the sett, Dúchas will be informed. The appropriate mitigation measures, which may include relocating the badgers, will be taken by suitably qualified persons in consultation with Dúchas.

Otter surveys will be undertaken at the river crossing points. If otter activity is identified, precautions will be taken to ensure that otter movement along the river banks is not hindered temporarily by construction of the river crossing.

In the limestone areas to the west of Caltragh and Knockdoe a survey will be undertaken to identify bat roosts close to the pipeline. This is a precautionary measure, requested by Dúchas. For geotechnical reasons the pipeline route has been chosen specifically to avoid areas of limestone cave formation, which might be suitable as bat roosts. The geophysical surveys, which were undertaken as part of the geotechnical site investigation, would have identified any unknown areas of this type. Nevertheless, the survey will be undertaken and if bat roosts are identified, Dúchas will be informed and the appropriate mitigation measures, which may involve adjusting the route of the pipeline, will be taken.

Dúchas requested additional hydrogeological studies in the sensitive wetland areas. The objective of the hydrogeological studies is to form a baseline against which to monitor the groundwater levels and groundwater movement during and after construction of the pipeline. The baselines will also facilitate monitoring of the impact of different construction techniques in bog areas.

The field surveys undertaken and reported in the EIS were very comprehensive. Given the scope of the additional surveys, detailed above, it is extremely unlikely that these surveys will uncover any matters which will have serious consequences for the potential environmental impact and eventual mitigation measures of the pipeline.

If completed as originally planned, these more detailed surveys would have been included in the EIS. However the EIS has sufficient detail to more than fulfil the statutory requirements in the descriptions of the existing habitats and the assessment of the impacts of the pipeline project. It is not intended to the delay the EIS process until the surveys have been completed.

The reports of the surveys will be submitted to Dúchas and copies will be made available to interested parties on request.

3.2 Fieldwork in Re-route Areas

Before the Foot and Mouth crises occurred, when a change to a section of pipeline route was proposed a desk study was undertaken by the ecologists, archaeologists and engineering geologists and the re-routed section was inspected on the ground. During the period in which the Foot and Mouth protocols were in place, the desk studies of proposed re-routes were undertaken and the need for a site visit assessed. In most cases the re-routes were quite minor and covered by existing fieldwork and it was concluded that a site visit was not essential. However there were some instances where a site visit was regarded as essential for the completion of the EIS.

In the initial phase of the Foot and Mouth protocols access to land was forbidden. This delayed completion of the EIS. The protocols were then relaxed to allow access to land under a strict regime of disinfectant use etc. BGE's policy was to enter onto land only where this was unavoidable. In compliance with the policy, only the areas, to which the EIS team considered that a site visit was essential, were inspected and the EIS was completed.

When all protocols have been relaxed, and there is no risk posed by moving from one land holding to another, the other re-route areas will be visited. With the continuing incidents of Foot and Mouth disease in the United Kingdom it may be several months before this may be possible. As visits to these areas are not regarded as essential, it is not intended to delay the EIS process until the visits take place.

4 Climate

4.1 General

The EIS addresses topics where there is the potential for a significance impact. The net effect of the project on the climate will be insignificant.

4.2 Construction Impact on Climate

Construction of the pipeline will require construction plant and vehicles, fuelled by hydrocarbons, the combustion of which will cause emissions of greenhouse gases. The quantity will not be significant in relation to the total amount of greenhouse gas emissions due to plant and vehicle traffic in Ireland. Commissioning of the pipeline will involve minor emissions of natural gas which is regarded as a greenhouse gas. The pipeline is routed through areas of forestry, and some trees will have to be felled. Trees cannot be replanted in the 14m width of the pipeline way-leave. Consequently the total amount of forestry will be marginally reduced. Forests are regarded as carbon sinks acting to reduce the amount of carbon dioxide, a greenhouse gas, in the atmosphere. The reduction in the total amount of forestry in Ireland, and the consequent reduction in the carbon sink capacity of Ireland, due to the construction of the pipeline will be insignificant. Thus the construction of the pipeline will have an insignificant direct negative impact on the climate.

4.3 Pipeline Operations Impact on Climate

Operation of the pipeline will have no significant direct impact on climate. Any release of natural gas during operations and maintenance will be negligible.

There will be indirect impacts on the climate due to operation of the pipeline. The pipeline will facilitate the construction of a gas distribution system in the areas of Counties Galway and Mayo, to the north of Galway City, which would not otherwise get it. The relative convenience and lower cost of natural gas will encourage households and businesses to switch from coal and oil for space heating. The climate change emissions from natural gas are far less than coal or oil and the switch will have a beneficial effect on the climate. However these areas of Mayo and Galway have a relatively low population density and any reduction in greenhouse gas emissions will not be significant in the context of Ireland as a whole.

There is the potential to develop a natural gas fired power station along the route of the Mayo to Galway gas pipeline. Generation of electricity from natural gas will result in reduced greenhouse gas emissions, if there is a resulting reduction in the use of coal or oil to generate electricity. However, with the construction of the second gas inter-connector to the UK gas transmission grid, there will be the possibility of siting a gas fired power station at many locations on the BGE grid. Siting one on the Mayo to Galway pipeline would just displace it from another location. A new gas-fired power station is not dependent on the Mayo - Galway gas pipeline being constructed.

Thus operation of the pipeline will have an insignificant beneficial effect on the climate.

5 Human Beings

Section 21.2.1 of the EIS lists the sections in which the impact of the project on Human Beings is addressed, as follows:

'Human Beings are addressed throughout the EIS, but not specifically in one section. The economic and social considerations are detailed in Section 19, Land Use issues are addressed in Section 5 and 12, and Health and Safety issues have been considered in Section 6 and 21. The effects of the development on human beings with regard to Landscape and Visual (Section 15), Traffic (Section 16), Noise (Section 17) and Environmental Emissions (Section 18) are also addressed.'

The impact on Human Beings can be summarised as follows: there will be localised impact on Human Beings along the pipeline route due to the activities undertaken during the course of the construction stage of the project. These will include disruption to traffic, loss of farming activities in the area fenced for construction, some noise and visual impact. On completion of the construction there will be no significant negative impacts and some positive economic impacts on Human Beings.

6 Waste

Chapter 18 of the EIS describes emissions from the construction and operation of the pipeline. Section 18.5 includes a table which describes the wastes arising from 15 construction activities, and the recommended disposal route. Sections 18.6.6 and 18.7.6 describe wastes arising from pipeline testing and commissioning and from pipeline operations.

The management of wastes generated during the construction of the pipeline will be the responsibility of the contractors. Management of wastes will be controlled under the Waste Management Act 1996 and the subsequent amendment. Each contractor will be required to prepare a waste management plan. The plans will have to adhere to the waste hierarchy, giving priority to waste prevention and minimisation, followed by reuse, recycling and recovery, with disposal as the least desirable option.

The EIS team is not aware of any studies which have been undertaken to record the waste generated by the construction of a natural gas pipeline in Ireland. The amount of waste, which will be generated by the construction of a natural gas pipeline, is difficult to quantify as it is dependent on a number of variables.

For example:

- The duration of the construction phase, and consequently the quantities of incidental waste such as office and canteen waste and sewage and also of stone for temporary roads, will be very dependent on weather conditions in the spring and summer of 2002 and 2003. With a long spell of dry weather, construction might proceed much more rapidly than currently expected and the quantities of these wastes would be reduced.

- The quantities of waste will also be very dependent on the construction methods and the effectiveness of waste minimisation programmes of the pipeline contractors.

- The quantity of crushed stone waste from temporary roads will be very dependent on whether the contractor opts to construct stone roads in soft ground areas or to used bog mats, which can be reused many times.

- Quantities of water pumped from excavations will be very dependent of weather conditions, amount of rainfall and height of the water table in the construction seasons.

- The construction methods used in peat areas will determine the quantity of water, if any, to be pumped from trench excavation in peat.

- Some contractors may opt to crush rock and boulders on site and reuse the material in the excavations. This would greatly reduce the volume of surplus spoil and rock to be removed from site.

- Some contractors may opt for trenchless crossings of some of the main roads, other contractors may do all road crossings as open cut.

- The quantity of office waste would be reduced if the contractor operates an effective paper and cardboard waste minimisation and recycling system.

In order to give an indication of the waste quantities to be expected, a preliminary estimate has been made. The estimate is based on pipeline construction experience and a two-season construction schedule. Refer to table 6.1 below.

Table 6.1: Potential Wastes Generated by the Construction of the Pipeline.

Activity	Waste Generation	Disposal Recommendation	Quantity
Pipeline Construction Base			
Site preparation	Likely to be negligible	-	
Operation	Office rubbish, paper, packaging, canteen refuse etc. Rubbish from yard and site. Scrap metal. Sewage.	Recycle or send to licensed waste disposal site. Collect in covered skips or tipper trucks and send to a licensed waste disposal site. Sell as scrap. Cesspit emptied regularly.	50 tonnes 50 tonnes 25 tonnes $3500m^3$
Site reinstatement	Workshop waste, e.g. paints, oil etc. Concrete foundations etc.	Collect in covered skips or tipper trucks and send to a licensed waste disposal site. Send to a licensed waste disposal site.	10 tonnes 100 tonnes
Pipeline Construction			
Working width preparation	Hedges, timber, brash, fence posts, wire etc.	In accordance with landowners requirements.	200 tonnes (note 1)
Pipe-stringing and bending	Pipe-bands, off cuts and end caps.	Collect in covered skips or tipper trucks and send for recycling or to licensed waste disposal site.	500 tonnes
Welding, testing and coating	Spent welding rods, grinding wheels, visors, and shot-blast.	Collect in covered skips or tipper trucks and send to licensed waste disposal site.	20 tonnes
Trenching, lowering and laying	Pumping discharge.	Pump into adjacent ditch using suitable filtration/ settlement techniques.	$100m^3$ (note 1)
Backfilling and grading	Surplus spoil and rock.	Subject to landowner/ occupier's agreement, take to licensed waste disposal site.	1000 tonnes (note 1)
Reinstatement	Temporary stone roads. Temporary fencing, gates, troughs etc.	Subject to agreement with the relevant County Council. Re-use elsewhere within land holding.	5,000 to 30,000 tonnes (note 1)
Construction through areas of peat	Pumping discharge.	Pump into adjacent ditch / field using suitable filtration/ settlement techniques.	$100m^3$ (note 1)

Activity	Waste Generation	Disposal Recommendation	Quantity
Microtunnelling	Slurry/Spoil.	Passed through de-sander, slurry recycled and ultimately disposed of using road truck tankers to licensed waste disposal site.	0 to 20 tonnes (note 1)
Auger-boring and pipe jacking	Spoil and rock cuttings.	Disposed of using road truck tankers to licensed waste disposal site.	0 to 20 tonnes (note 1)
Drill and Grout	Spoil grout and flush water.	Spoil disposal to licensed waste disposal site. Water used for flushing disposed of in accordance with the relevant County Council requirements either by filtration to land or off-site, if contaminated.	10 tonnes (note 1) $50m^3$ (note 1)
Mess huts, misc., etc.	Canteen refuse, safety equipment etc.	Collect in covered skips and send to licensed waste disposal site.	100 tonnes (note 1)
Mobile site toilets	Sewage.	Disposal by appointed waste management contractor.	$1000m^3$

Note 1: depends on construction method.

7 Consultations

The EIS team consulted with a very wide range of organisation and individuals in the course of the Environmental Assessment. The organisations and individuals consulted are listed in Section 2.4 of the EIS. The EIS team is satisfied that the full statutory requirements have been complied with, in terms both of the requirement for consultation and the information to be contained in the EIS.

8 Alternatives Considered and Routing of the Pipeline

8.1 Existing Planning and Licences

The route was chosen to avoid existing houses and gardens. Searches were undertaken of the Mayo and Galway County Council Planning Registers to identify sites for which planning permission had been obtained. The pipeline route was chosen to avoid these sites.

8.2 Concerns of Nearby Residents

All landowners along the route were consulted and their requests for changes of the route were considered in detail. The ecologists, archaeologists, pipeline design engineers and engineering geologists commented on each proposed route change. The change was implement if it did not conflict with environmental, archaeological or engineering constraints.

9 Other Remarks

9.1 Impacts due to Pipeline Construction

Section 6 describes the construction methods of the pipeline. The likely environmental impacts, mitigation measures and residual impacts from pipeline construction are comprehensively described in the EIS, in Section 9.5 for terrestrial habitats, and Sections 10.2 and 10.3 for aquatic habitats. Section 18 details emissions during construction and mitigation measures. Section 22.3 provides a summary of construction impacts, mitigation measures and residual impacts.

There are a number of construction methods and types of equipment which can be used to construct a gas pipeline at special locations such as through peat or at river crossings. The contractor will specify the construction methods. This will allow the contractor to utilise methods and equipment in which he has particular expertise and experience. Prior to commencement of construction the contractor must submit detailed method statements for construction of the pipeline in the ecologically sensitive areas, which are identified on the pipeline tender drawings. The tender documents give the required scope of the method statement for each type of special location, to ensure that the key issues are addressed by the contractor. These methods statements will be agreed with Dúchas, or the Regional Fisheries Board in the case of the river crossings, prior to construction commencing. This procedure will ensure that the mitigation measures listed in the EIS are implemented.

An extract from the pipeline tender documents giving the scope of the method statements is appended to this document, in Appendix 1.

9.2 Rahasane Turlough

Indirect impacts on the Rahasane Turlough SAC from the construction of the crossing of the River Dooyertha include possible changes to the hydrogeology of the area if a non-open cut crossing method was chosen or if extensive rock blasting were required for trench excavation. Diversion of the River to allow a dry crossing might also have an indirect impact on the Turlough, which is downstream. These possible indirect impacts will be avoided by ensuring that the contractor's proposed method for constructing this crossing is will avoid these construction techniques.

9.3 Mitigation Measures to Prevent Impact on Watercourses

Mitigation measures to prevent impact on watercourses are addressed in Section 10.2.

9.4 Terrestrial Habitats - Residual Impacts

The extent and nature of the residual impacts are described under the habitat types Dry Habitats, Wetlands and Fauna, in the subsections following the heading '9.5.10 Residual Impacts'. The subsections are incorrectly numbered.

9.5 Pipe Storage/Construction Facilities

The pipe storage and construction facilities are dealt with in a general way in the EIS. Each compound will be the subject of an application for planning permission to Mayo or Galway County Council. Drainage drawings will be submitted with the planning applications.

9.6 Noise

In Section 17 of the EIS, Table 17.2 gives typical noise levels for various construction activities. These noise levels are based on typical plant being operated during the activity. Thus where the use of compressors are a normal part of the activity, the noise for the compressor is included.

Currently BGE carry out helicopter monitoring of their entire transmission pipelines on a fortnightly basis, and have done so for many years. No difficulties have been experienced with noise impact on livestock.

It is not intended to carry out noise monitoring unless there is a specific complaint from a landowner.

9.7 Inert Plugs

The term 'inert plug' is used in Section 9.5.6.2 in the context of the need to ensure that the pipeline trench, when backfilled with the pipe in place, does not act as a longitudinal drain, changing the ground water flow regime. In this context an inert plug is a barrier of chemically inert material which will act as a dam to prevent movement of water.

9.8 Programme for River Crossings

On the pipeline route there are 22 significant river crossings, none of which are major rivers and most are less than 10m in width. A few small streams, which are tributaries of the streams feeding Carrowmore Lake and are ecologically sensitive, will also be crossed. It is planned to construct the Mayo to Galway gas pipeline over two seasons, 2002 and 2003. Two seasons will give 10 months to construct these crossings. This should be sufficient time.

9.9 Archaeological and Cultural Heritage - Unknown Sites

Any unknown archaeological sites will be uncovered in the topsoil stripping operation. As stated in the EIS, topsoil stripping along the pipeline route will be monitored by a licensed archaeologist. If a site is uncovered, the contractor will be instructed to stop work and move to a different part of the pipeline. Dúchas will be consulted and it will determine if the site should be archaeologically resolved or remain untouched. If the site cannot be archaeologically resolved the pipeline will be rerouted.

9.10 Storage of Construction Materials

Construction materials and chemicals, which could cause environmental damage if accidentally released, will be stored in the most appropriate manner. Liquid chemicals will be treated in a similar manner to oils.

9.11 Preliminary Design Aspects

The natural gas will comprise methane and a low concentration of an odourant (Butyl Mercaptan 80% and di-Methyl Sulphide 20%) added to the gas. BGE's quality specification for the gas sets upper limits to impurities. Refer to Table 1.

Table 1

Material	**Concentration**
Hydrogen Sulphide	5.6 mg/m^3
Total Sulphur Content	50 mg/m^3
Oxygen Content	0.5%
Non Combustibles Content	
(1) Carbon Dioxide	4%
(2) Nitrogen	6%
Water Content	112 mg/m^3
Mist, Dust, Liquid	Technically free

The design life of the pipeline will be 40 years.

APPENDIX 1

Extract from Pipeline Construction Tender Documents

Method Statements for Pipeline Construction in Environmentally Sensitive Areas

6.0 METHOD STATEMENTS FOR PIPELINE CONSTRUCTION IN ENVIRONMENTALLY SENSITIVE AREAS

6.1 Introduction

The pipeline route passes through some areas of major ecologically importance. The pipeline would not have been routed through these areas if there had been a feasible alternative. These sensitive areas are highlighted in Section 7.0 of the Special Locations Report. A more complete description of these areas is also included in the Environmental Impact Study report.

The Contractor is required to prepare a method statement for construction in these sensitive locations. The scope of the method statement required for each type of area is outline below.

6.2 Scope of Method Statement for Areas of Peat

6.2.1 *Characteristics of Peat*

There are a number of key features of peat and bog areas underlain by peat, which the construction method statement must address.

- The top layer of peat, which contains the growing vegetation (hereinafter referred to as Layer 1), is very susceptible to mechanical damage, by shear and compaction, which can destroy the vegetation and adversely change the water storage and transmission properties. Layer 1 may generally be taken to be 0.5m or less in thickness, depending on the depth of living root penetration. The peat below the top layer (hereinafer referred to as Layer 2) has an even more delicate soil structure and is very liable to erosion by rain, surface water flow, and foot and vehicle traffic. The thickness of this layer varies considerably and may be up to 5m or more locally.

- Layer 2 peat can consist of up to 98% by weight of water. Handling tends to break down its physical structure and alter the chemical properties, and can turn the material into a soupy liquid.

- Storage of materials on the surface of Layer 1 (i.e. the natural bog surface) for any length of time, besides causing compaction of the underlying peat, can reduce or eliminate the light and oxygen reaching the vegetation cover and damage it or cause it to die.

- The movement of water across the bog surface and within Layer 1, and the storage and retention of water in the lower layers of peat are very important features in the development and preservation of the body of peat.

- Digging a trench in peat may cause drainage and lowering of the moisture content causing the peat to shrink and crack, and thus leading to chemical changes in the peat. This in turn can lead to non-bog plant species spreading onto the peat.

- In areas of sloping ground underlain by peat, digging a trench can alter the surface water run-off pattern. The result can be erosion where the run off increases and drying out of the peat where the run-off is reduced or removed.

6.2.2 *Scope of Method Statement for Working in Areas of Peat Bog*

Items to be included in the method statement for each length of peat bog include:

1. Construction schedule including start date, finish date, allowance for inclement weather

2. Provision for liaison with Dúchas throughout the works

3. Type of inclement weather which, if it occurs, will cause work to be halted

4. Construction method and sequence including:

- working area width required
- method of setting out the working width and the centreline of the pipeline
- type of fencing to be used and method of fence installation, including types of vehicles to be used
- number of months fencing is to be left in place
- Width and depth of each of the soil layers to be removed and temporarily stockpiled
- method of removing the top layer of peat, containing living vegetation (Layer 1)
- method of storing Layer 1 material, to include means for keeping it separate from the underlying surface and preventing cross-contamination by extraneous soil and vegetation; location for storage, and means for protection from drying out.
- location and method of storing Layer 2 peat material, to include means for keeping it separate from the underlying surface and preventing cross-contamination by extraneous soil and vegetation; height and width of the stockpile, protection from drying out.
- location and method of storing subsoil (i.e. mineral soil) encountered beneath the peat, to include means for keeping it separate from the underlying surface, height and width of stockpile.
- method of creating the vehicle access road along the working width, including road width, materials for construction and method of removal of the road when construction is completed
- method and types of plant to be used for transporting pipe along the spread, stringing the pipe, forming the trench and supporting the sides, lowering in the pipe and back-filling the trench
- types of vehicles to be used to transport personnel along the wayleave
- method of de-watering the trench, including treatment and disposal of the water
- method to prevent the trench acting as a short term or long term drainage path
- method to ensure existing watercourses continue to function when temporary access roads are constructed and the trench is open, and in the long term, following completion of works
- method for back-filling the trench, including ensuring that the materials are replaced in the reverse sequence to which they were excavated, i.e. the material from the deepest parts of the trench being back-filled first,

- method of reinstating the surface layer of peat, including ensuring that there is not a long term hollow along the pipeline trench as the back-fill materials settles
- method for removing excess material from the wayleave and disposal location
- method to prevent liquid or solid contaminants (diesel, hydraulic oil, cement, etc.) from coming in contact with the in situ or stockpiled peat, or with surface water or ground water
- construction management plan to minimise traffic on the working width
- traffic management plan and haul routes on the surrounding road network
- proposal for the supervision by peatland ecologists of all construction and restoration work in peat areas and monitoring following completion, including name and CV of staff to be employed.

6.3 Scope of Method Statement for River Crossings

6.3.1 Rivers Crossings General

For each river crossing the special locations report identifies the features which require protection because of the importance or sensitivity of the habitat. These features include the use of the river for fish spawning or fish feeding, the presence of fauna such as salmonid species, freshwater crayfish or lampreys, and the importance of the river for angling.

To minimise the impact of the pipeline construction it will be important to reinstate the river bed and banks as closely as possible to their original condition including restoring the bed and bank material, gradient and vegetation. It will also be very important to prevent contaminants entering the river.

Notwithstanding the above, careful consideration must also be given to the possibility of erosion of the river bed and banks at times of flood. Where an armour layer of stones is present on the river bed or vegetation serves to protect the banks from erosion, the same conditions (or an acceptable environmental equivalent in terms of erosion protection) must be included as part of the reinstatement.

6.3 2 *Scope of method statement for river crossings*

Items to be included in the method statement for each river crossing include:

1. Construction schedule including start date, finish date, allowance for inclement weather

2. Provision for liaison with the relevant regional fisheries board and Dúchas on the work

3. Type of inclement weather which, if it occurs, will cause work to be halted

4. Construction method and sequence including:

- identify the working area required on either side of the crossing
- method of forming a temporary bridge
- identification and method of protecting trees and hedgerows on the two river banks
- method of removing and storing the bank-side vegetation and topsoil, including the height of the stockpile.

- location and method of recording, removing and storing the river bottom material include the height of the stockpile.
- location and method of storing subsoil
- method and types of plant to be used for stringing the pipe, forming the trench and supporting the sides, and lowering in the pipe
- method to minimise silt entering the river
- precautions to protect existing fish and other species if blasting is to be used
- method for back-filling the trench, including ensuring that the river bottom material is replaced so as to replicate the original river bottom material and lateral and longitudinal profile
- method of reinstating the river banks to the original profile and so as to prevent erosion
- method for ensuring long term stability of the river bed and banks
- method for removing excess material from the site and the disposal location
- method to prevent oil or other materials spilling or leaking from plant and contaminating the river, soil or ground water
- maintenance of access for anglers to and along the river bank
- traffic management plan and haul routes on the surrounding road network

6.4 Scope of Method Statement for Hazel scrub

6.4.1 *Hazel Scrub General*

The route passes through areas of hazel scrub which represent a semi-natural habitat of importance. To minimise impact it will be important to reduce the working width to a minimum, to fell the minimum quantity of trees, protect the remaining trees from damage and to reinstate the scrub after construction.

6.4.2 *Scope of Method Statement*

Items to be included in the method statement for where the route crosses hazel scrub include:

1. Construction schedule including start date, finish date, allowance for inclement weather

2. Provision for liaison with the Dúchas on the work

3. Type of inclement weather which, if it occurs, will cause work to be halted

4. Construction method and sequence including:

- Method for identifying hazel scrub
- Protection of topsoil to the extent of the edge of the tree canopy
- Method for identifying and marking trees for removal
- Reducing working width where possible
- Protection to be provided for branches of trees in working width
- Method for protection of thin soil cover from erosion
- Name, CV and outline of relevant experience of staff or sub-contractors to be employed to fell trees
- Method to reinstate the scrub including species to be used

- Aftercare method for scrub reinstatement – including provision for replacement of any dead stock for a minimum period of two years after planting and protection from rabbits and grazing animals

6.5 Scope of Method Statement for Areas of Karst, Turloughs, Vulnerable Hydrology

6.5.1 *General*

The route crosses extensive areas underlain by Pure Limestone Formation bedrock, which tends to be particularly prone to solution weathering, known as karst. Karst is associated with the occurrence of springs, underground water channels, caverns and swallow holes. Of these, swallow holes are the most widespread and obvious manifestation of karst. Sink holes may become enlarged to form turloughs, which are either shallow karst lake features or areas prone to seasonal flooding by high groundwater. Turlough may or may not be associated with surface stream drainage.

Due to their unique characteristics some of the karst areas on the route have ecologically important flora. These are identified in the Special Locations report. In addition many karst areas along the route are Regionally Important Aquifers, and where the overburden in thin, these can be very vulnerable to pollution. These are identified in the Special Locations report.

In karst areas it is essential to avoid unnecessary disturbance of the underlying soils or rock which might alter or interrupt the groundwater movement. It is also important to avoid changes to the surface and near surface drainage.

It is also imperative that usage and storage of potential contaminants be avoided or strictly controlled in karst/Regionally Important Aquifer areas because of the rapidity with which contaminant materials can enter the ground and be transported by groundwater.

6.5.2 *Scope of Method Statement for Working in Karst Areas*

Items to be included in the method statement for working in each length of karst:

1. Construction schedule including start date, finish date, allowance for inclement weather

2. Provision for liaison with Dúchas throughout the works

3. Type of inclement weather which, if it occurs, will cause work to be halted

4. Construction method and sequence including:

- working area width required
- method and types of plant to be used for forming any trench in rock
- if blasting is to be employed, name, CV and outline of relevant experience of staff or sub-contractors to carry out the blasting
- method of monitoring vibrations creating during trench excavation
- method of monitoring the trench and surrounding area to detect instability or settlement
- method of de-watering the trench, including disposal of the water
- method to prevent the trench acting as a short term or long term drainage path

- method to ensure existing watercourses continue to function when temporary access roads are constructed and the trench is open, and in the long term, following completion of works
- method for back-filling the trench, including ensuring that the materials are replaced in the reverse sequence to which they were excavated
- method of reinstating the topsoil, including ensuring that there is not a long term hollow along the pipeline trench if the back-fill materials settles
- method for removing excess material from the site and disposal location
- method to prevent oil or other materials spilling or leaking and contaminating the soil or rock, surface water or ground water
- method for full containment storage of oil, diesel, and other liquid/solid contaminants
- construction management plan
- traffic management plan and haul routes on the surrounding road network

v

Mayo - Galway Gas Pipeline

Environmental Impact Statement
Volume 11 - Figures

May2001

Job No. C689/10

Mayo - Galway
Gas Pipeline

Environmental
Impact Statement
Volume 11 - Figures

Prepared By: Daniel Garvey
Signed: Dan Garvey
Date: 11 05 01

Checked By: Ria Lyden
Signed: Ria Lyden
Date: 11-05-01

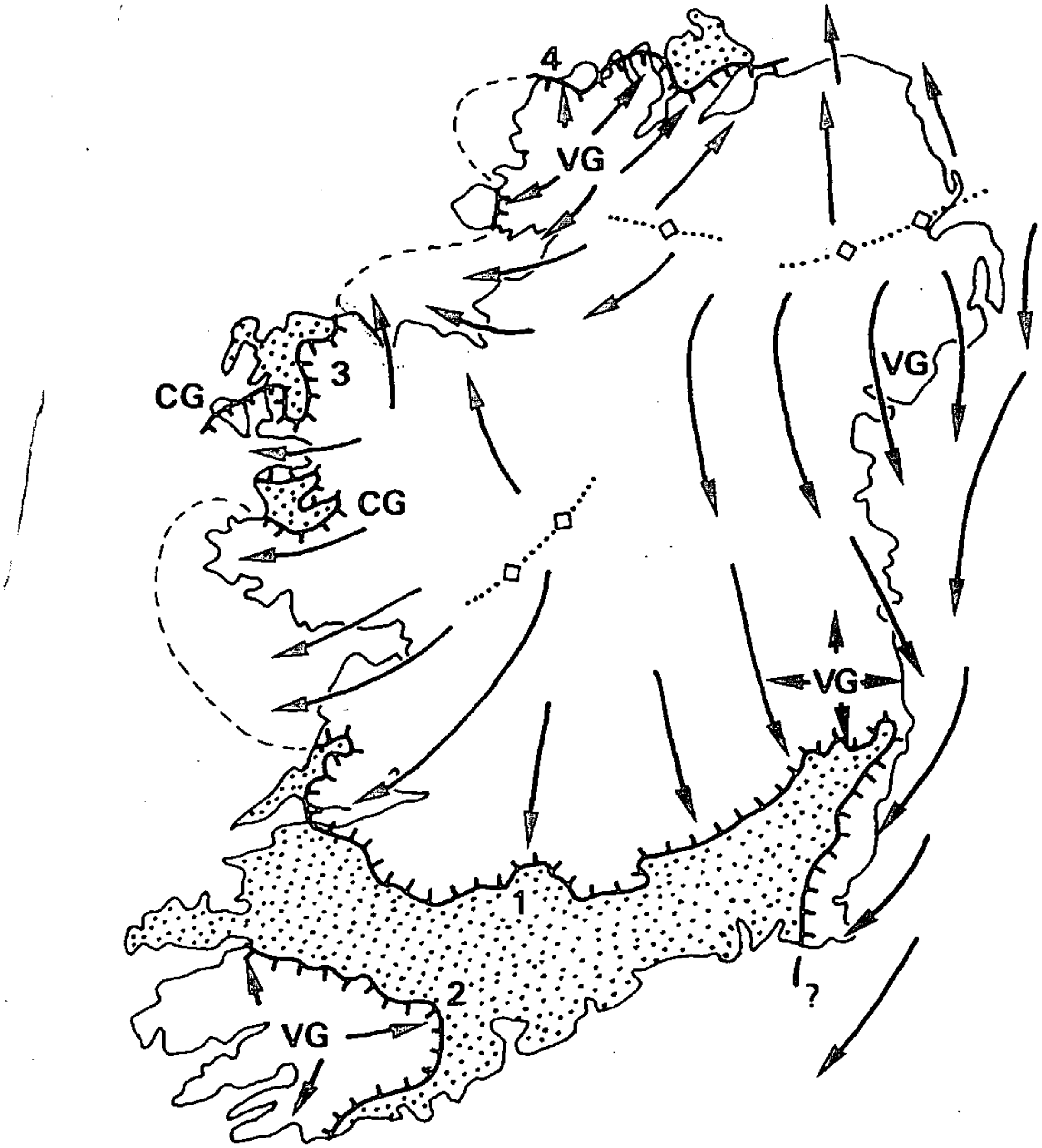
Passed By: Eoghan Lynch
Signed: Eoghan Lynch
Date: 11 May 2001

Revision Record

Issue No.	Date	Status	Prepared	Checked	Passed
1	**1 May 2001**	**Draft**	**DG**	**RL**	**EJL**
2	**11 May 2001**	**Final Issue**	**DG** DG	**RL**	**EJL** EJL

ARUP
Consulting Engineers

LIST OF FIGURES (VOLUME II)



Ice axes or domes	VG Valley glaciers & mountain ice caps	**GENERALIZED ICE LIMITS**
Irish inland ice	CG Corrie glaciers	1. Southern Irish End-Moraine
Irish Sea and North Channel Ice	Largely unglaciated during the Midlandian Cold	2. Killumney moraine
		3. Ballycastle-Mulrany moraine
		4. Bloody Foreland moraine

Taken from Edwards (1985)

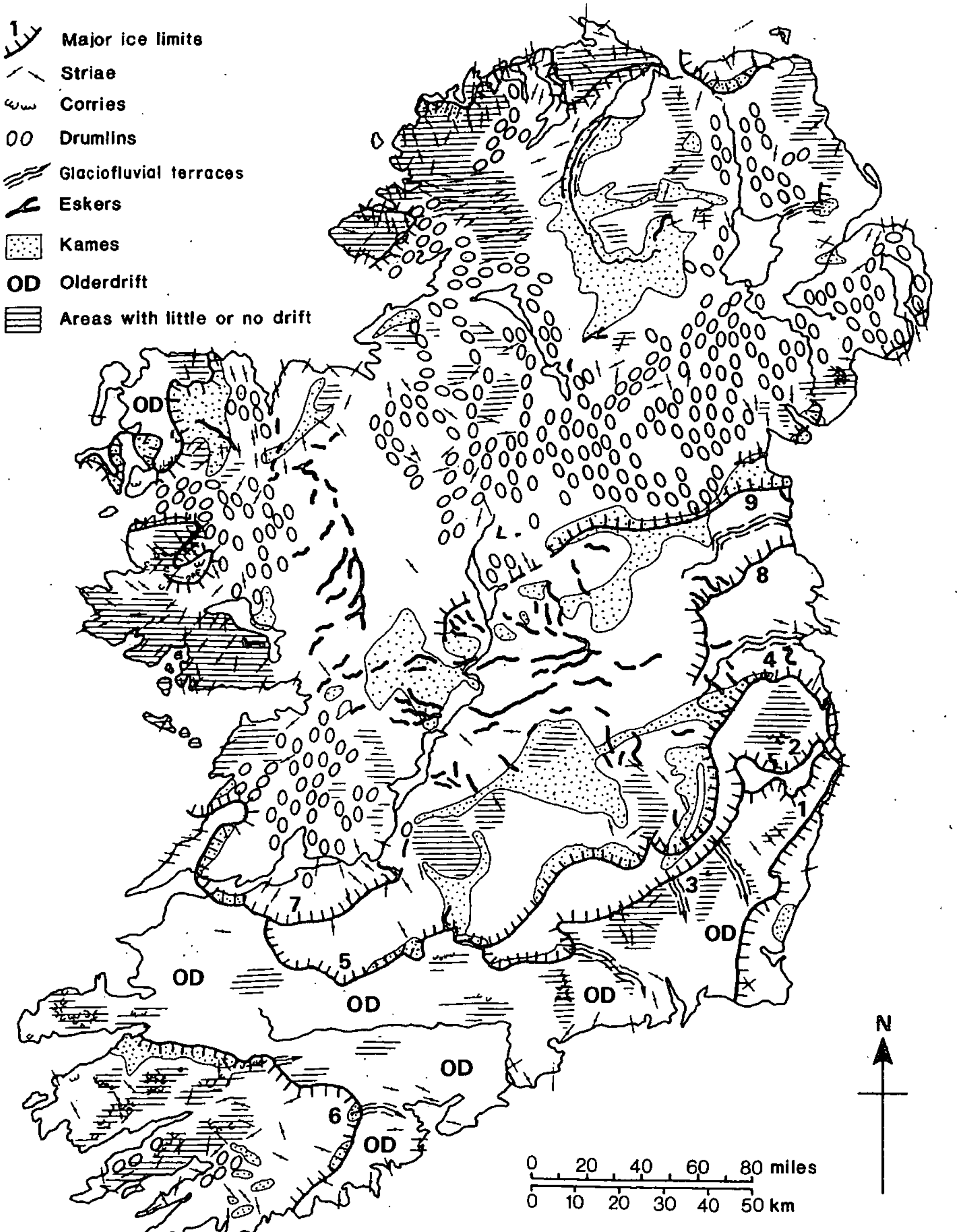
BORD GÁIS

ARUP

MAYO TO GALWAY PIPELINE

Title: ICE LIMITS & GENERAL DIRECTIONS OF ICE MOVEMENT DURING THE LATE MIDLANDIAN COLD STAGE

Scale: N.T.S.	Date: 25.04.01	Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Drg. No.: Figure 11.1	Rev. A

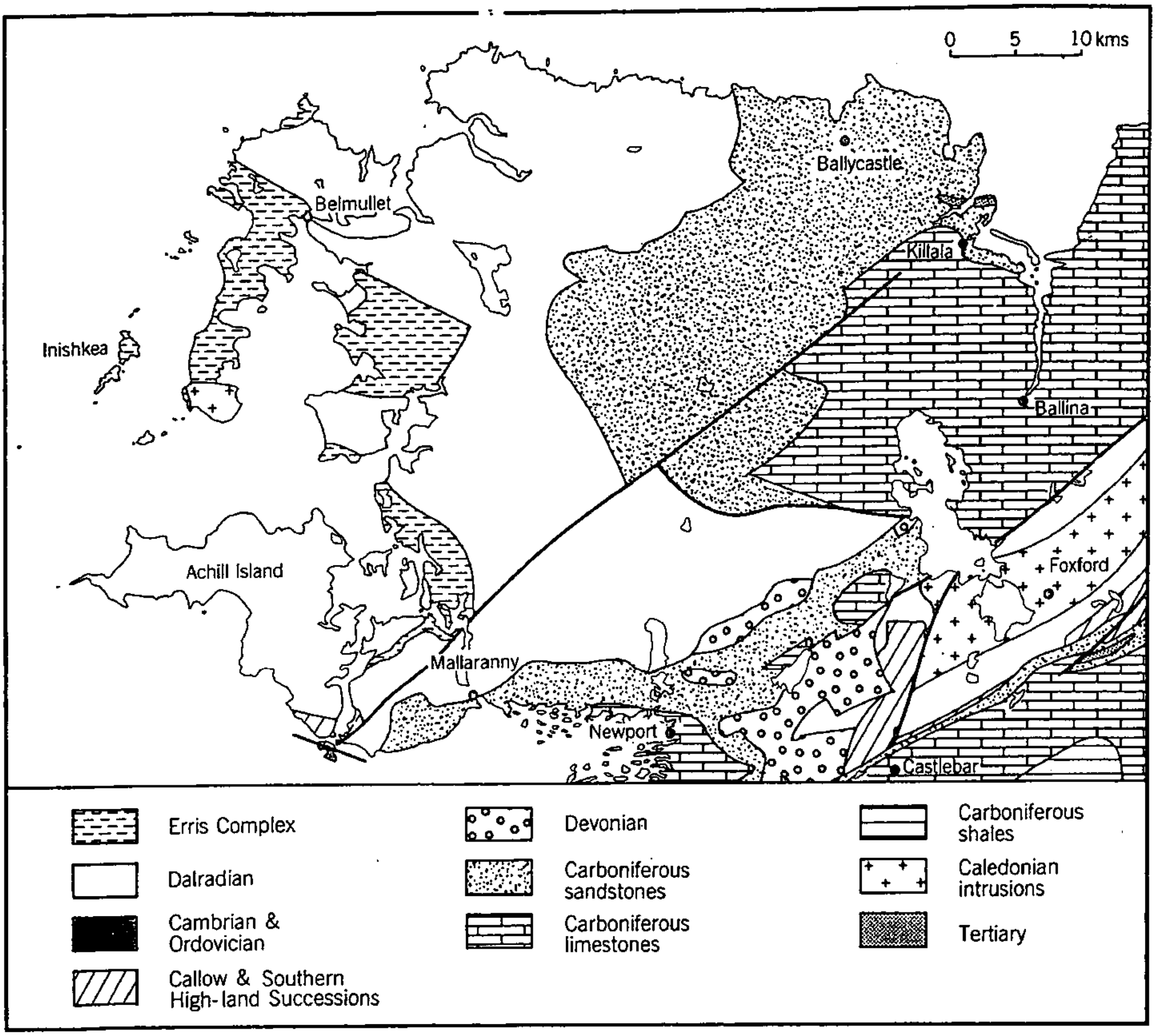


Taken from Edwards (1985)

BORD GÁIS

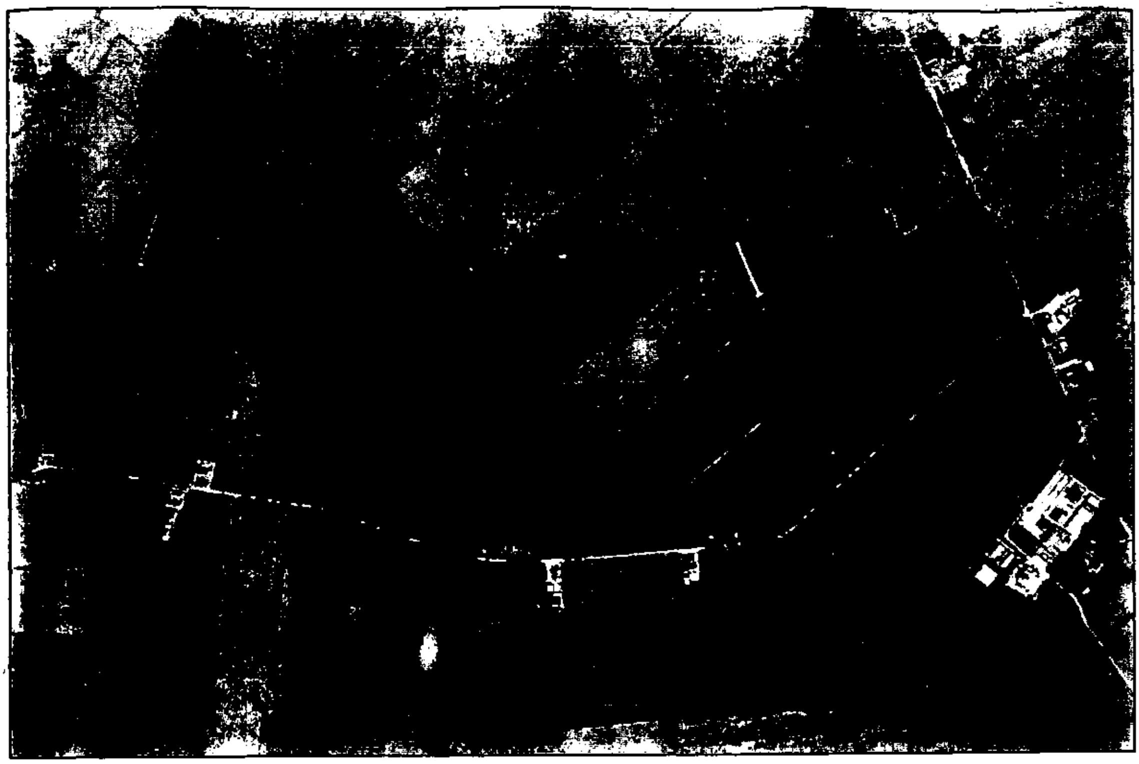
ARUP

MAYO TO GALWAY PIPELINE		
Title: GLACIAL GEOMORPHOLOGICAL FEATURES		
Scale: N.T.S.	Date: 25.04.01	Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Drg. No.: Figure 11.2	Rev. A

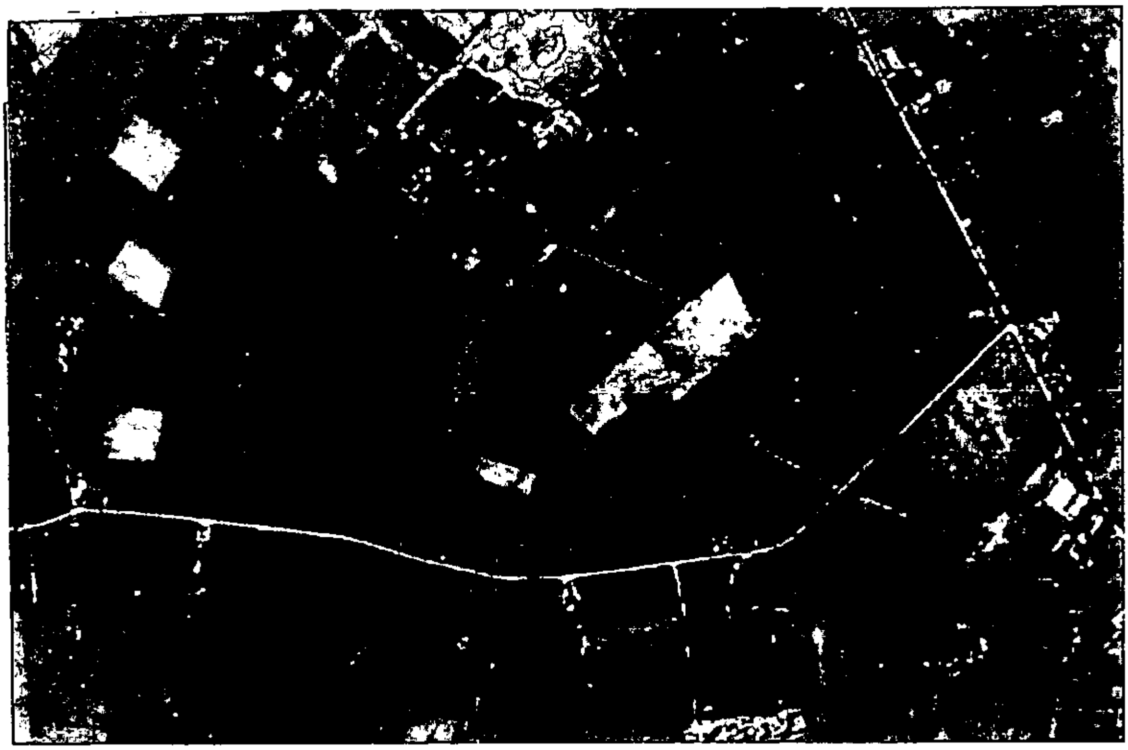


Taken from: Geology of North Mayo (GSI 1992)

BORD GÁIS	MAYO TO GALWAY PIPELINE		
	Title: SIMPLIFIED BEDROCK GEOLOGY FOR SECTION OF PIPELINE ROUTE NORTH OF CASTLEBAR		
ARUP	Scale: N.T.S.	Date: 25.04.01	Drawn By: EG
	Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.	Drg. No.: Figure 11.3	Rev. A



August 2000 Photograph



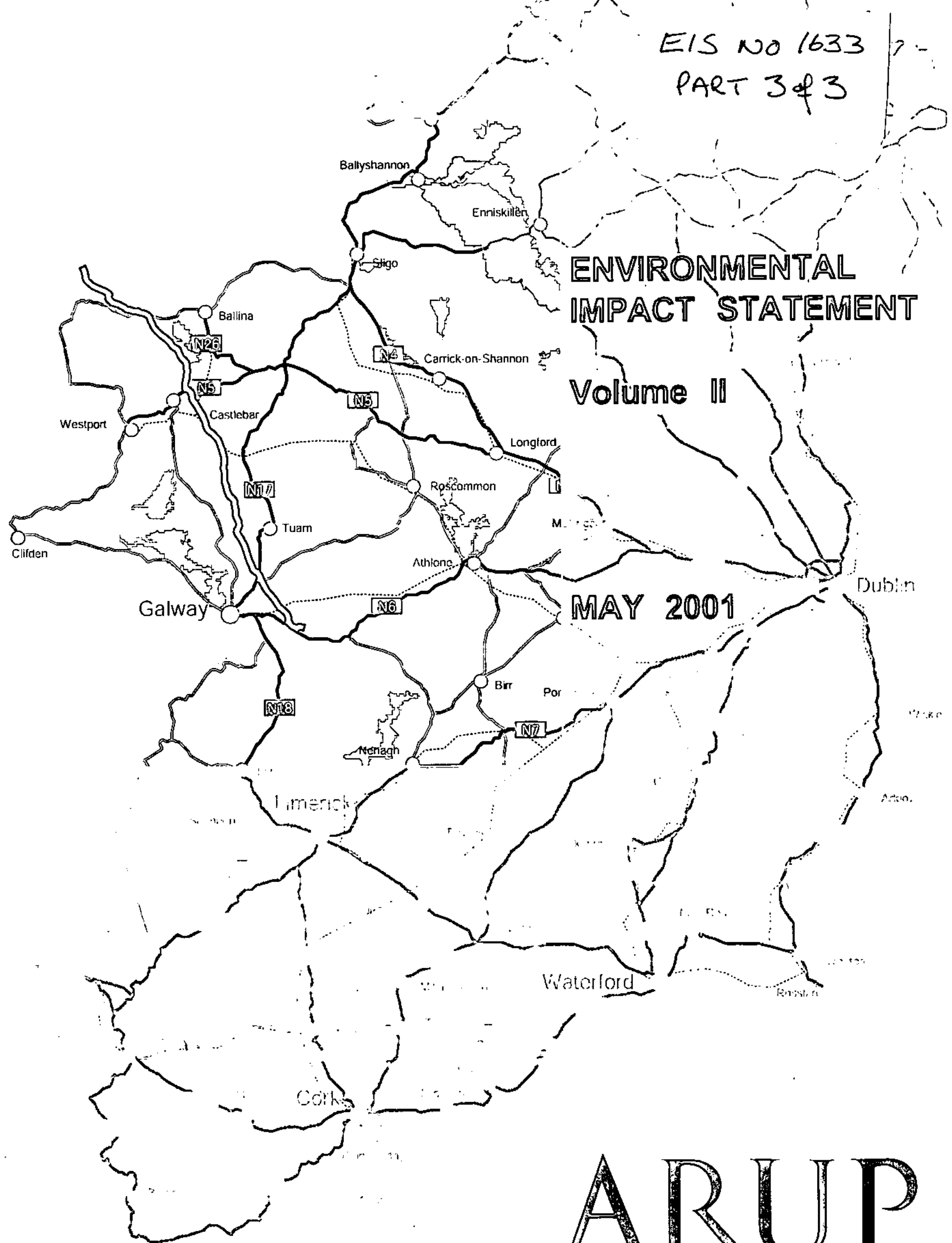
May 1973 Photograph

BORD GÁIS	MAYO TO GALWAY PIPELINE		
	Title: CHANGES IN SURFACE MORPHOLOGY SOUTH OF CASTLEHACKET		
ARUP	Scale: N.T.S.	Date: 25.04.01	Drawn By: EG
	Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Drg. No.: Figure 11.4	Rev. A

BORD GÁIS
TRANSMISSION BUSINESS UNIT

MAYO-GALWAY GAS PIPE LINE

EIS NO 1633
PART 3 of 3

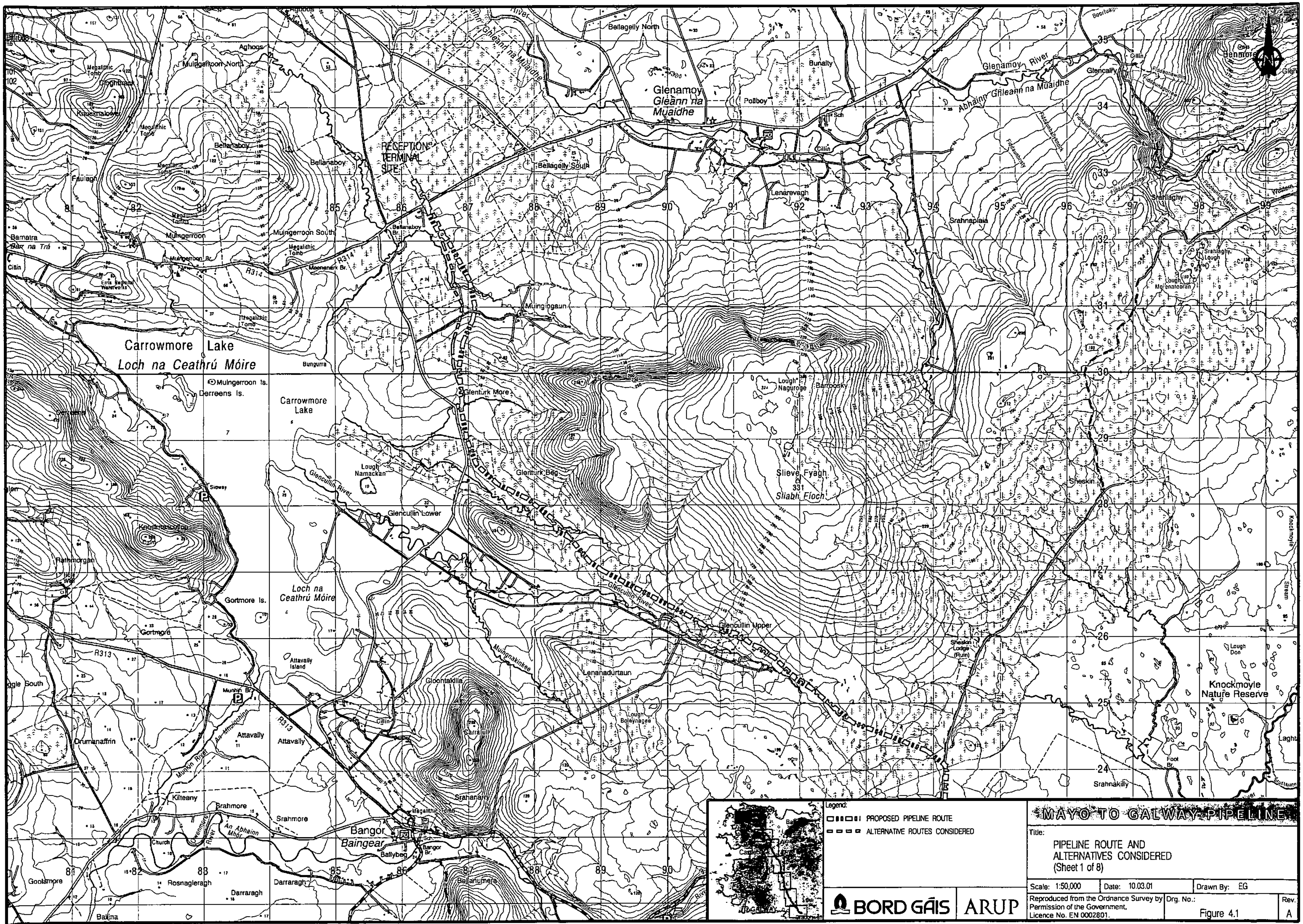


ENVIRONMENTAL IMPACT STATEMENT

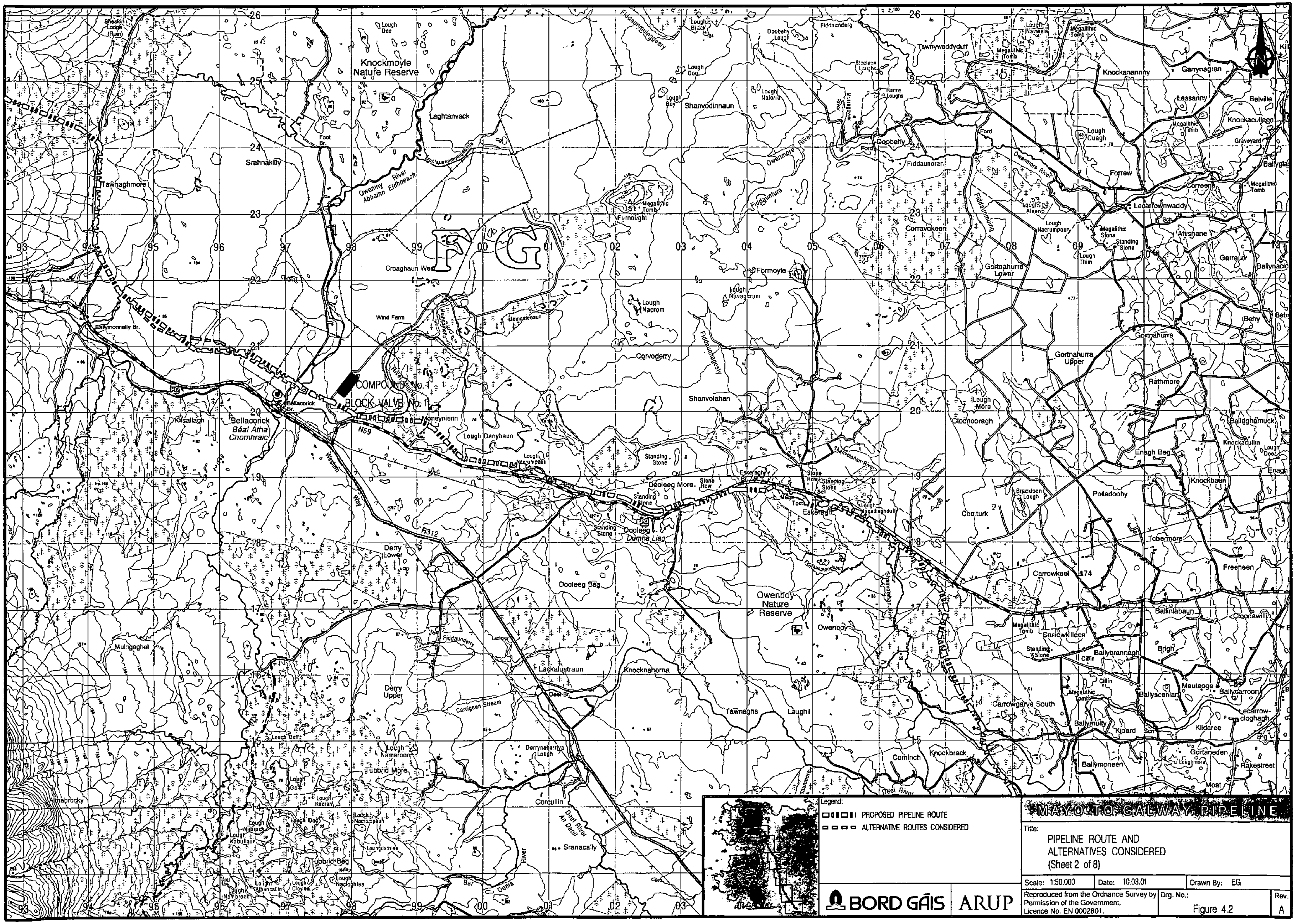
Volume II

MAY 2001

ARUP



...\10\EIS-R1.dgn May. 10, 2001 15:36:43



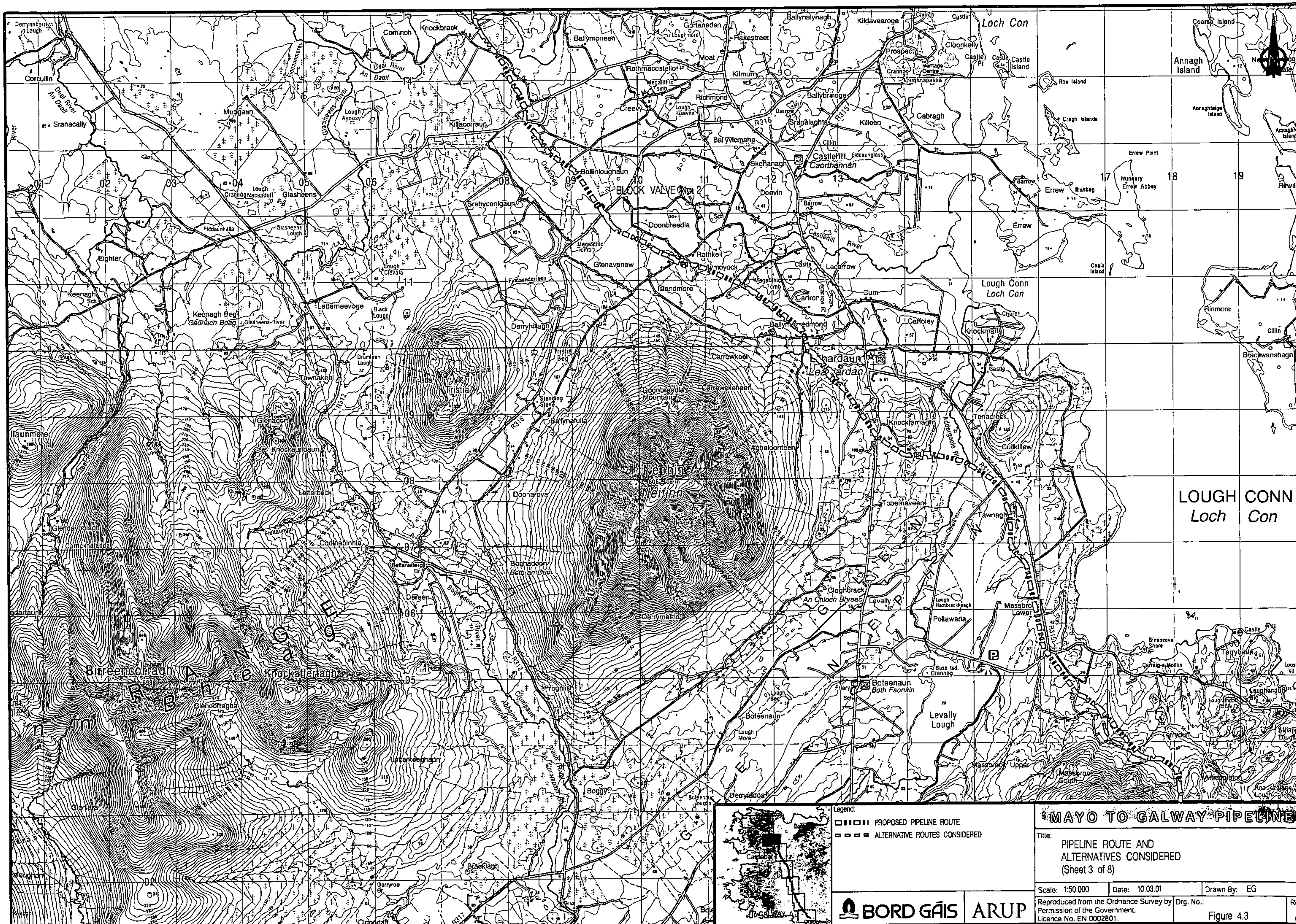
Legend:
PROPOSED PIPELINE ROUTE
ALTERNATIVE ROUTES CONSIDERED

MAYO TO GALWAY PIPELINE

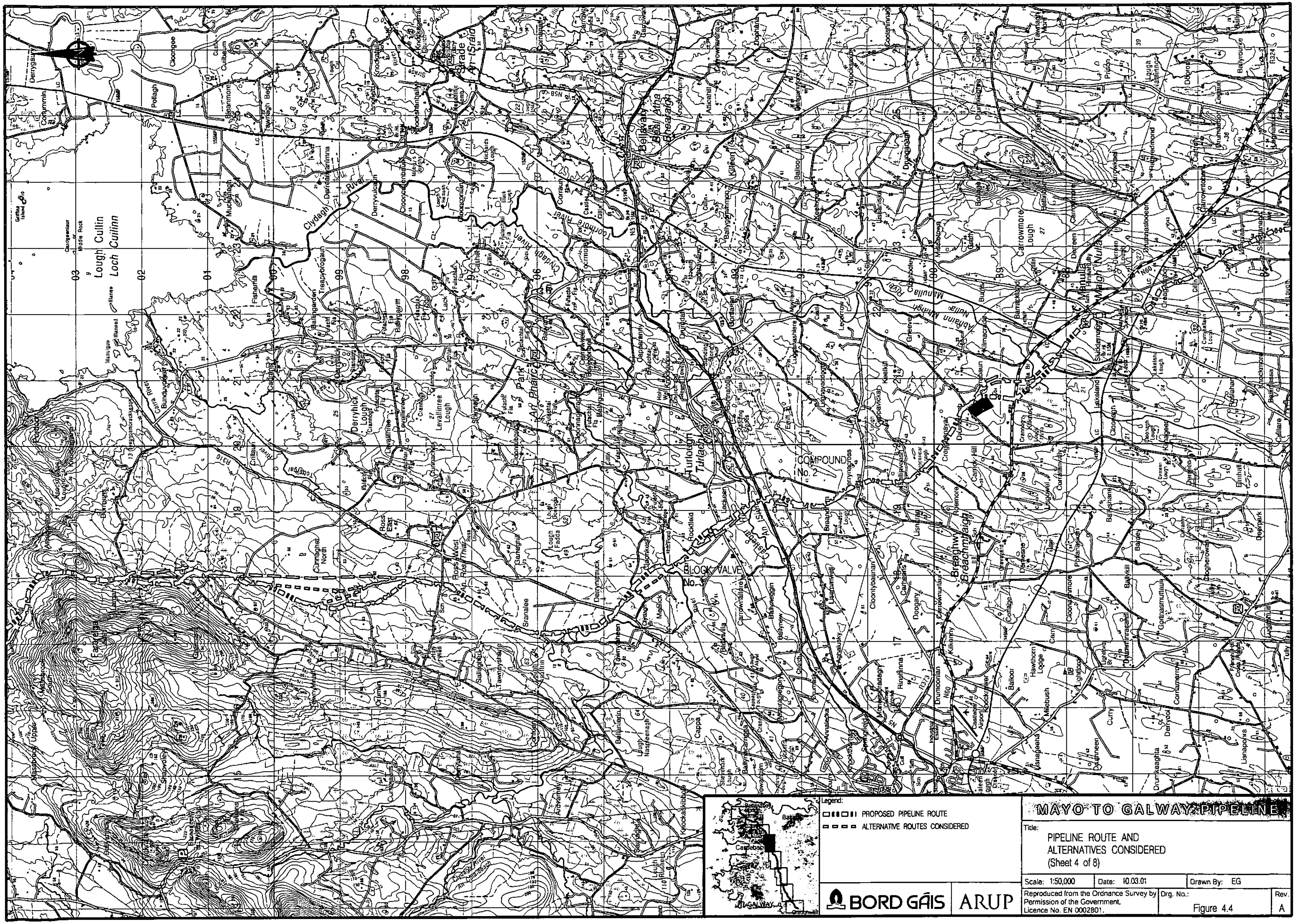
Title:
PIPELINE ROUTE AND ALTERNATIVES CONSIDERED (Sheet 2 of 8)

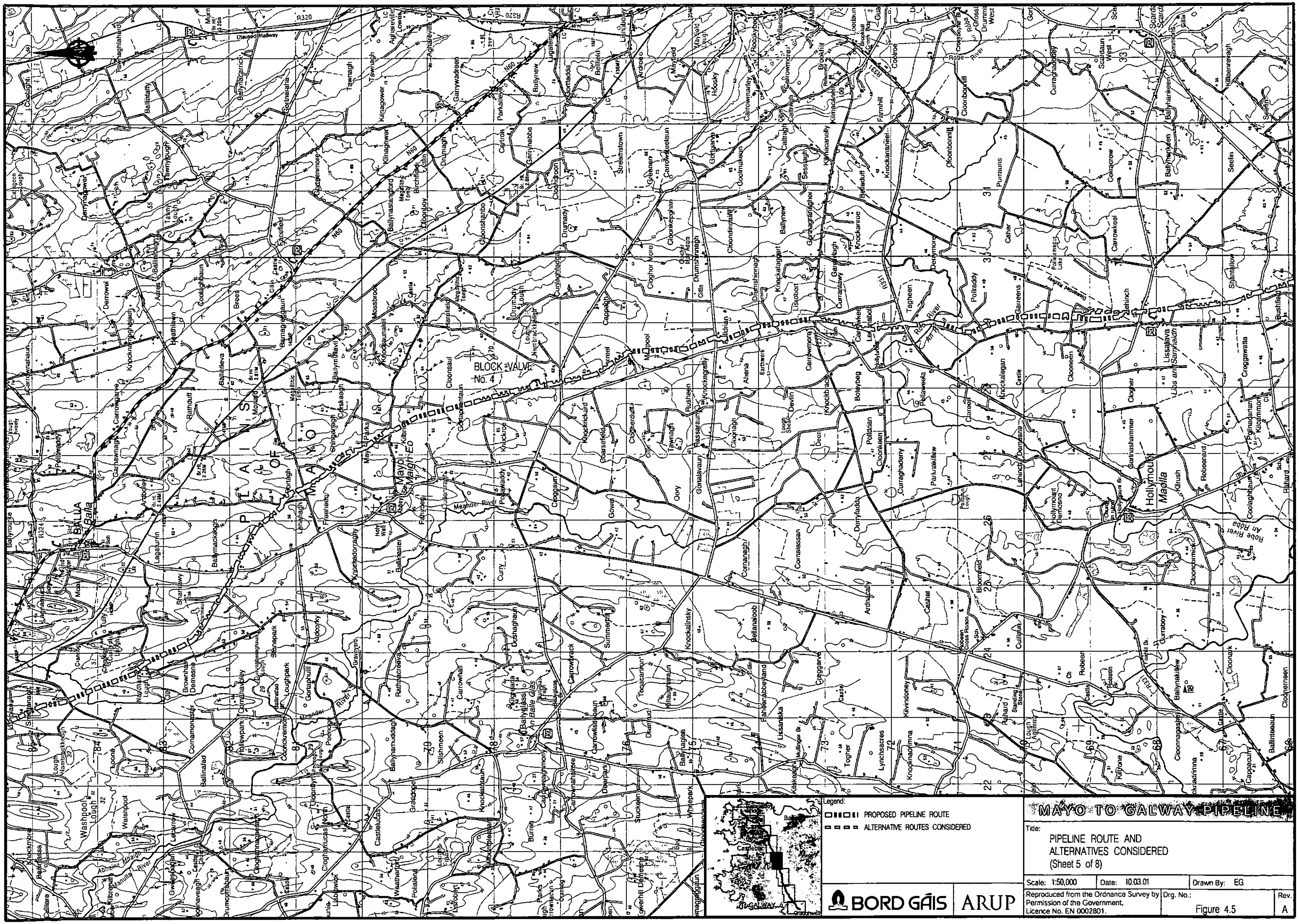
Scale: 1:50,000	Date: 10.03.01	Drawn By: EG	
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.	Drg. No.: Figure 4.2		Rev. A

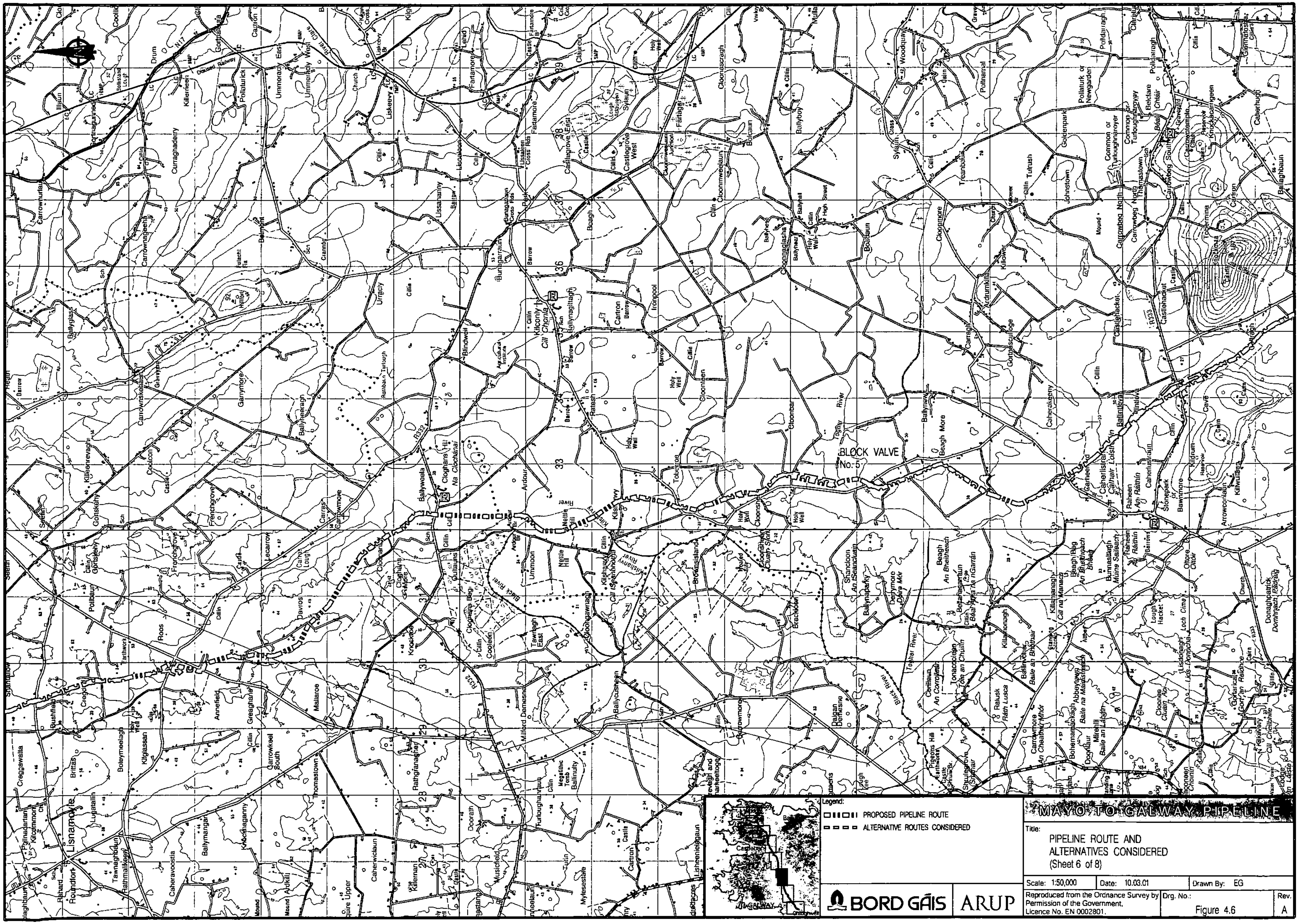
BORD GÁIS ARUP



MAYO TO GALWAY PIPELINE
Title:
PIPELINE ROUTE AND ALTERNATIVES CONSIDERED (Sheet 3 of 8)
Scale: 1:50,000
Date: 10.03.01
Drawn By: EG
Drg. No.:
Figure 4.3
Rev.
A
Legend:
PROPOSED PIPELINE ROUTE
ALTERNATIVE ROUTES CONSIDERED
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
LOUGH CONN
Loch Con
Lough Conn
Loch Con
BLOCK VALVE No. 2
Nephin
Neifinn
Lahardaun
Leath Ardán
Castlehill
Caorthannán
Bofeenaun
Both Faonáin
Birreencorragh
Knockaffertagh
Tristia
Levally Lough
Annagh Island
Errew


Legend:
PROPOSED PIPELINE ROUTE
ALTERNATIVE ROUTES CONSIDERED
MAYO TO GALWAY PIPELINE
Title:
PIPELINE ROUTE AND
ALTERNATIVES CONSIDERED
(Sheet 4 of 8)
Scale: 1:50,000
Date: 10.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 4.4
Rev.
A
COMPOUND No. 2
BLOCK VALVE No. 3


BLOCK VALVE
No. 4
Legend:
PROPOSED PIPELINE ROUTE
ALTERNATIVE ROUTES CONSIDERED
MAYO TO GALWAY PIPELINE
Title:
PIPELINE ROUTE AND
ALTERNATIVES CONSIDERED
(Sheet 5 of 8)
Scale: 1:50,000
Date: 10.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 4.5
Rev.
A



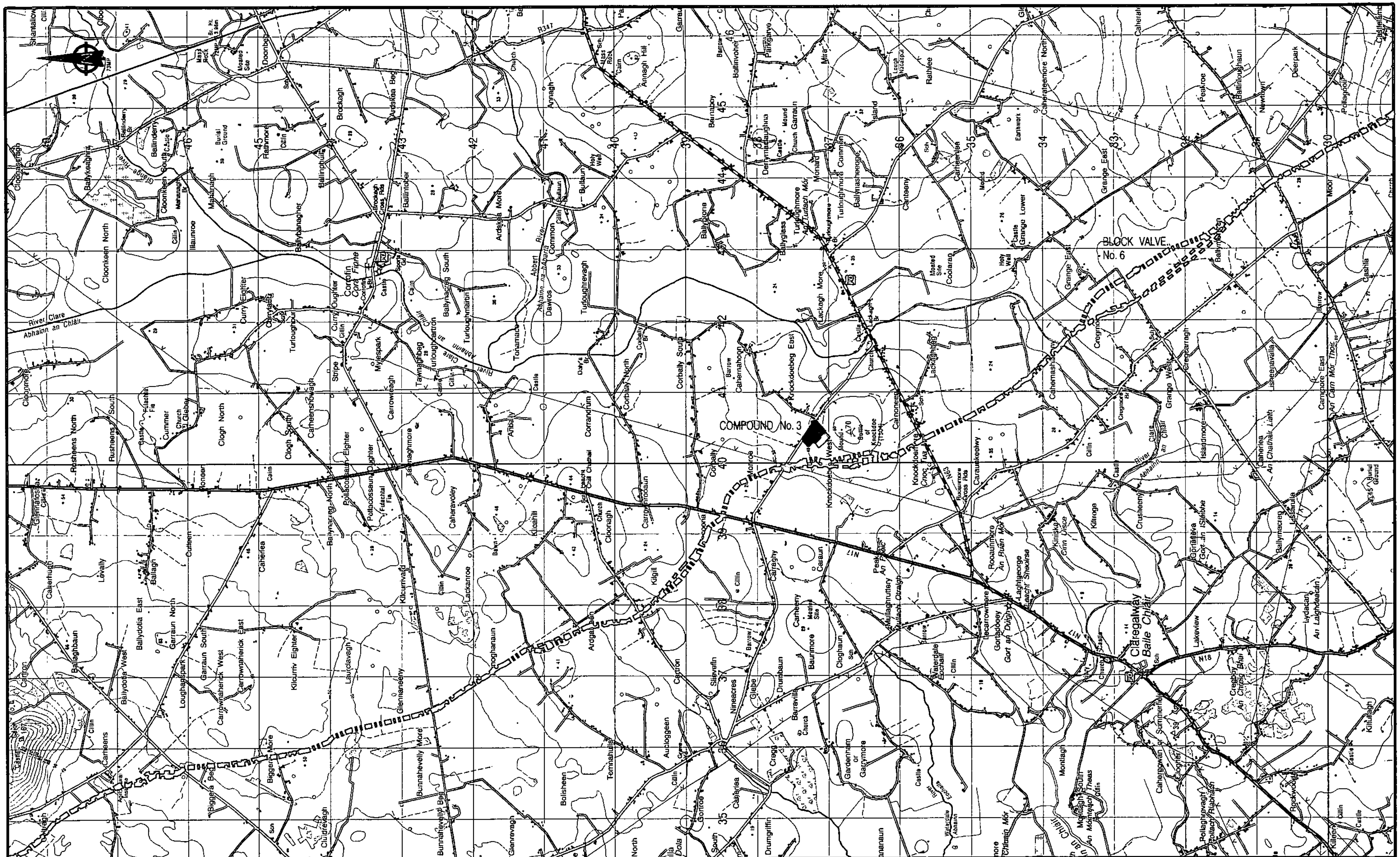
MAYO TO GALWAY PIPELINE

Title:
PIPELINE ROUTE AND
ALTERNATIVES CONSIDERED
(Sheet 6 of 8)

Scale: 1:50,000	Date: 10.03.01	Drawn By: EG

BORD GÁIS | ARUP

Drg. No.:	Rev.
Figure 4.6	A



Legend:

PROPOSED PIPELINE ROUTE

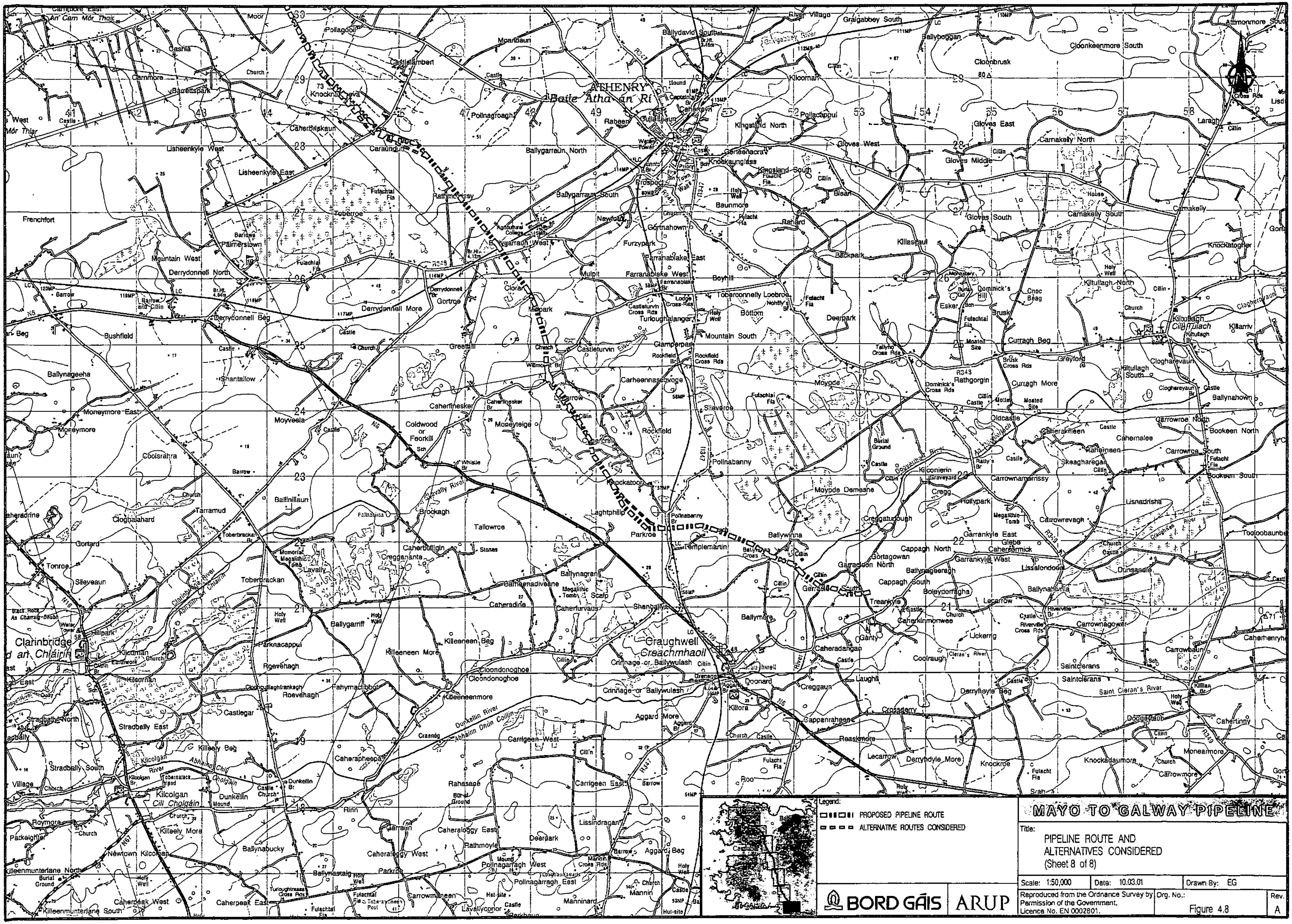
ALTERNATIVE ROUTES CONSIDERED

BORD GÁIS | ARUP

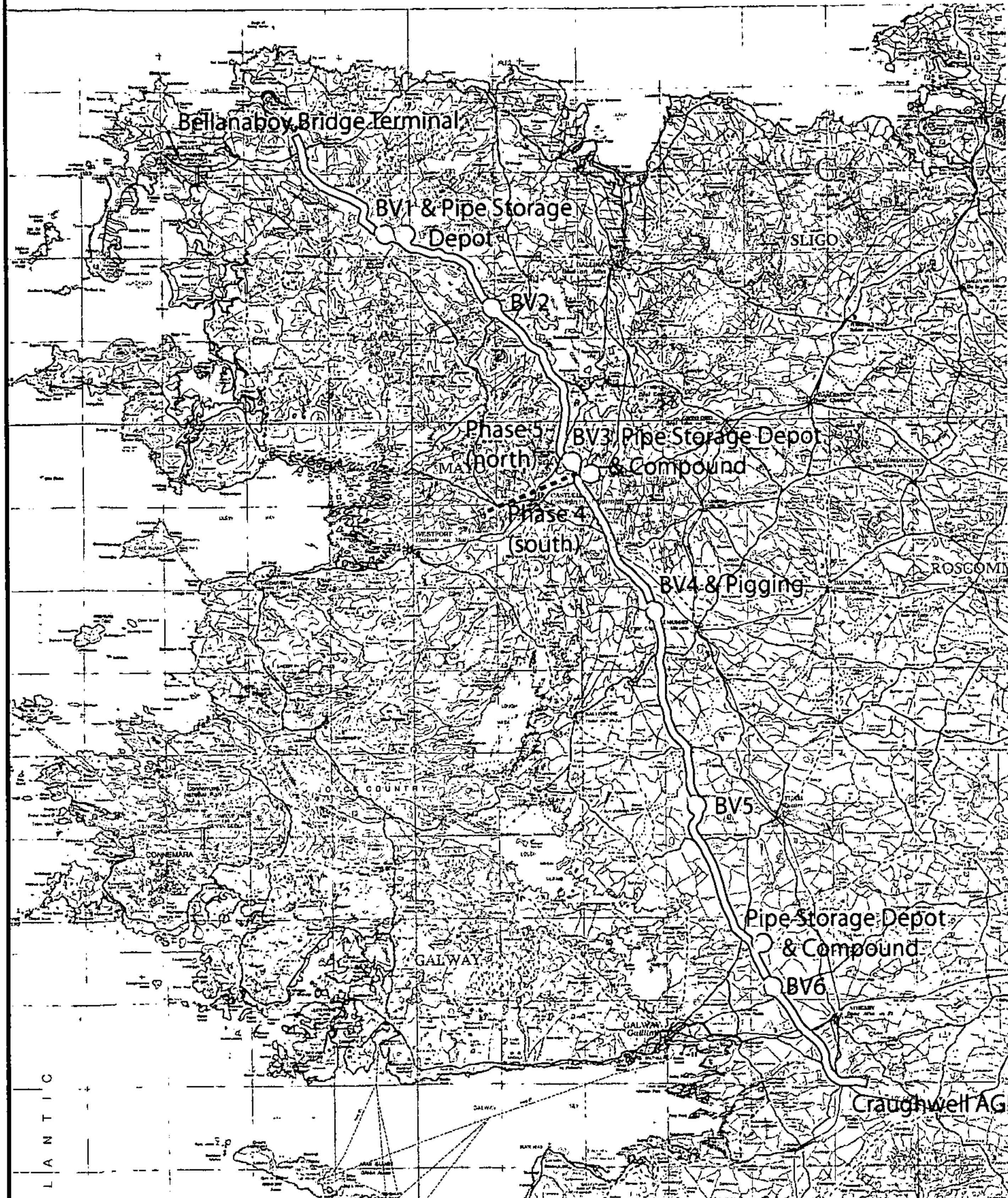
MAYO TO GALWAY PIPELINE

Title:
PIPELINE ROUTE AND
ALTERNATIVES CONSIDERED
(Sheet 7 of 8)

Scale: 1:50,000	Date: 10.03.01	Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Drg. No.: Figure 4.7	Rev. A



Legend:
PROPOSED PIPELINE ROUTE
ALTERNATIVE ROUTES CONSIDERED
BORD GÁIS
ARUP
MAYO TO GALWAY PIPELINE
Title:
PIPELINE ROUTE AND
ALTERNATIVES CONSIDERED
(Sheet 8 of 8)
Scale: 1:50,000
Date: 10.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 4.8
Rev.
A
ATHENRY
Baile Átha an Rí
Craughwell
Creachmhaoil
Clarinbridge
Kilcolgan
Cill Cholgáin



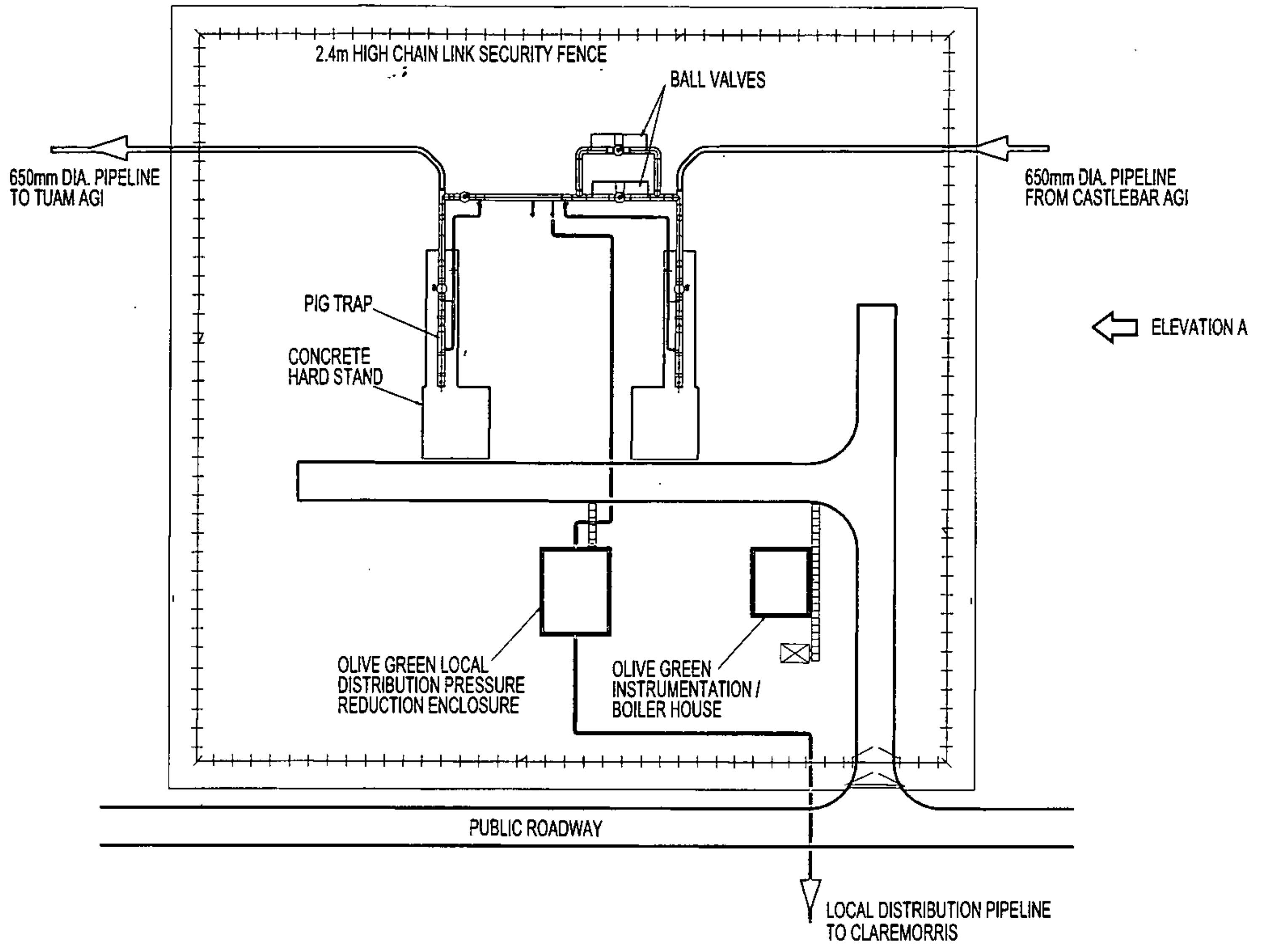
MAYO TO GALWAY PIPELINE

Title: LOCATION OF BLOCK VALVE STATIONS, PIPE STORAGE DEPOTS AND CONSTRUCTION COMPOUNDS

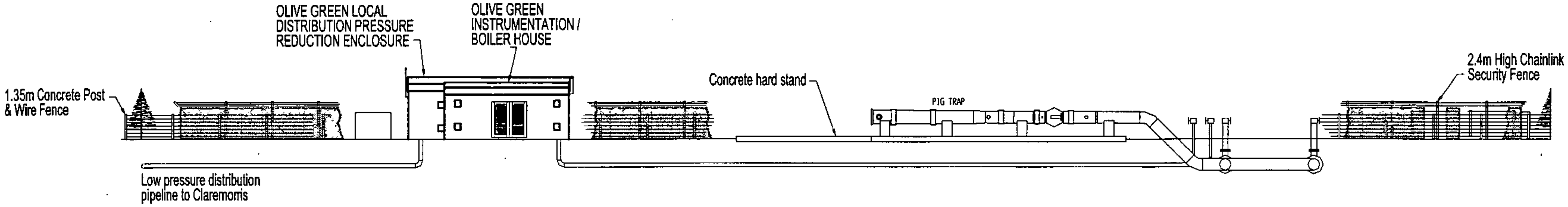
Scale: N.T.S.	Date: 20.04.01	Drawn By: EG

BORD GÁIS ARUP

Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Drg. No.: Figure 5.1	Rev. A



PLAN



ELEVATION A

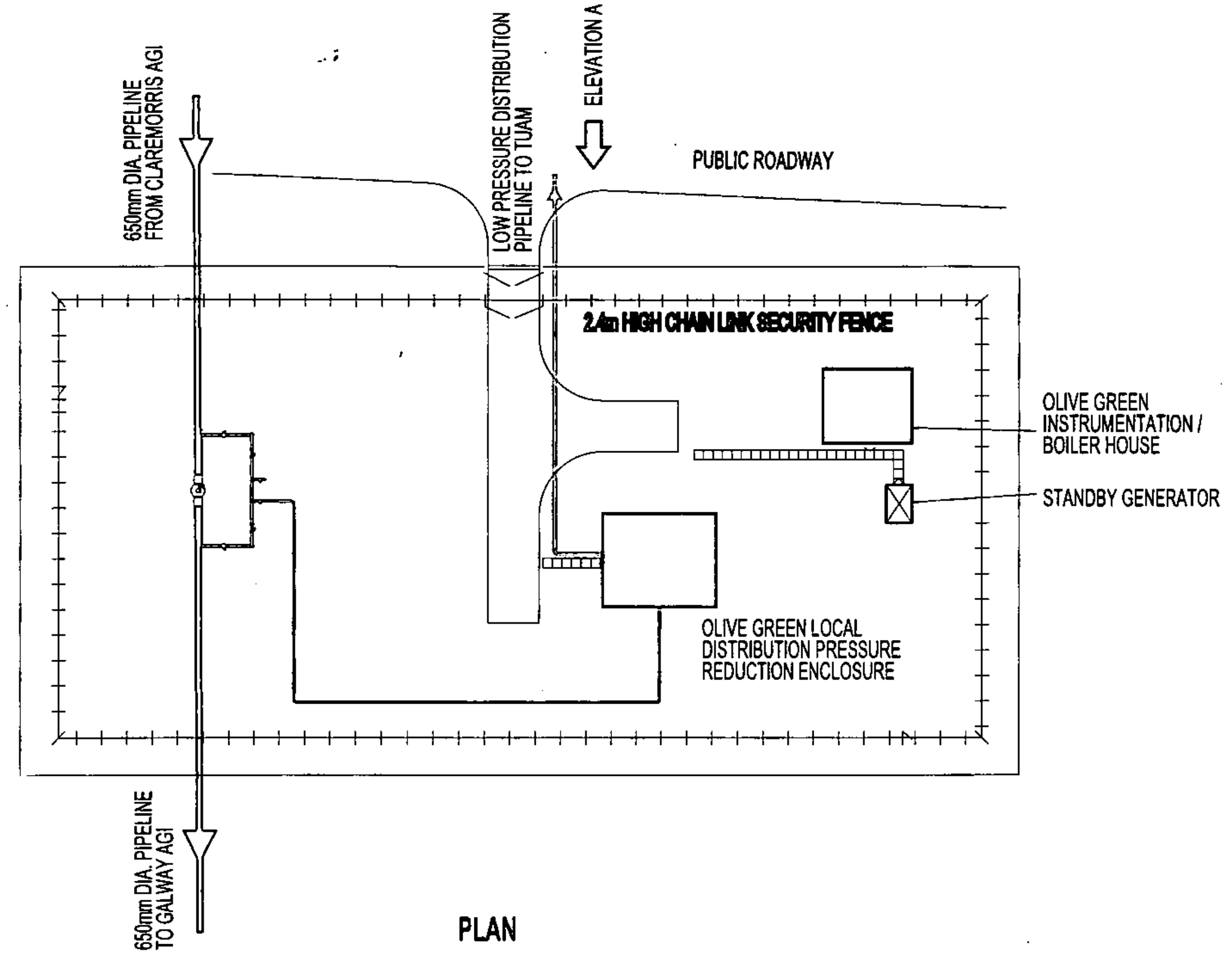
BORD GÁIS

ARUP

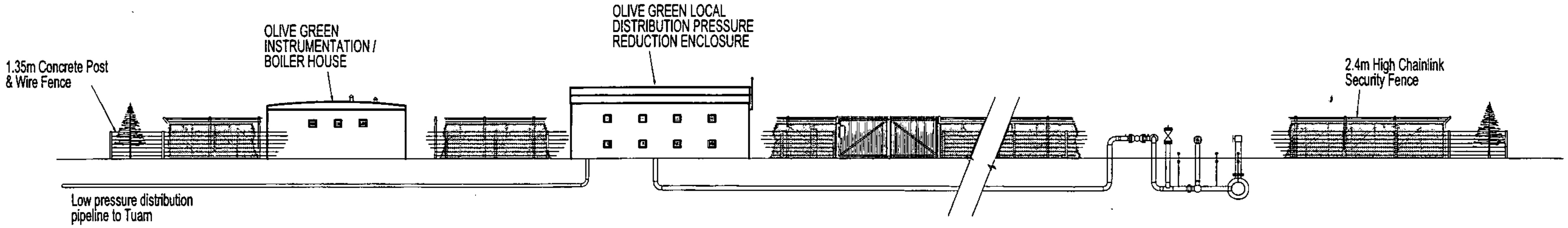
MAYO TO GALWAY PIPELINE

Title: TYPICAL LAYOUT OF A BLOCK VALVE STATION WITH PIG TRAP

Scale: N.T.S.	Date: 25.04.01	Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.	Drg. No.: Figure 5.2	Rev. A

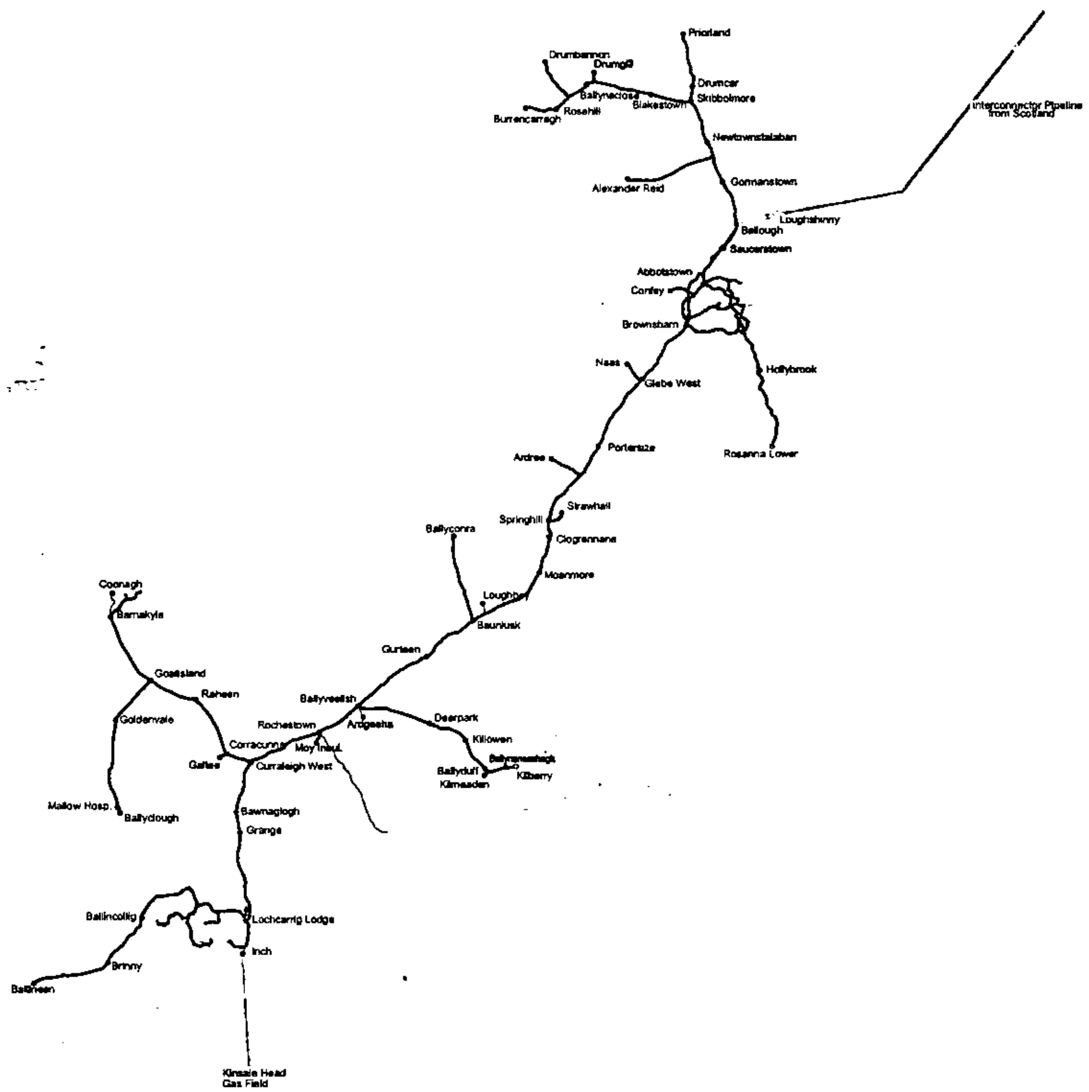


PLAN

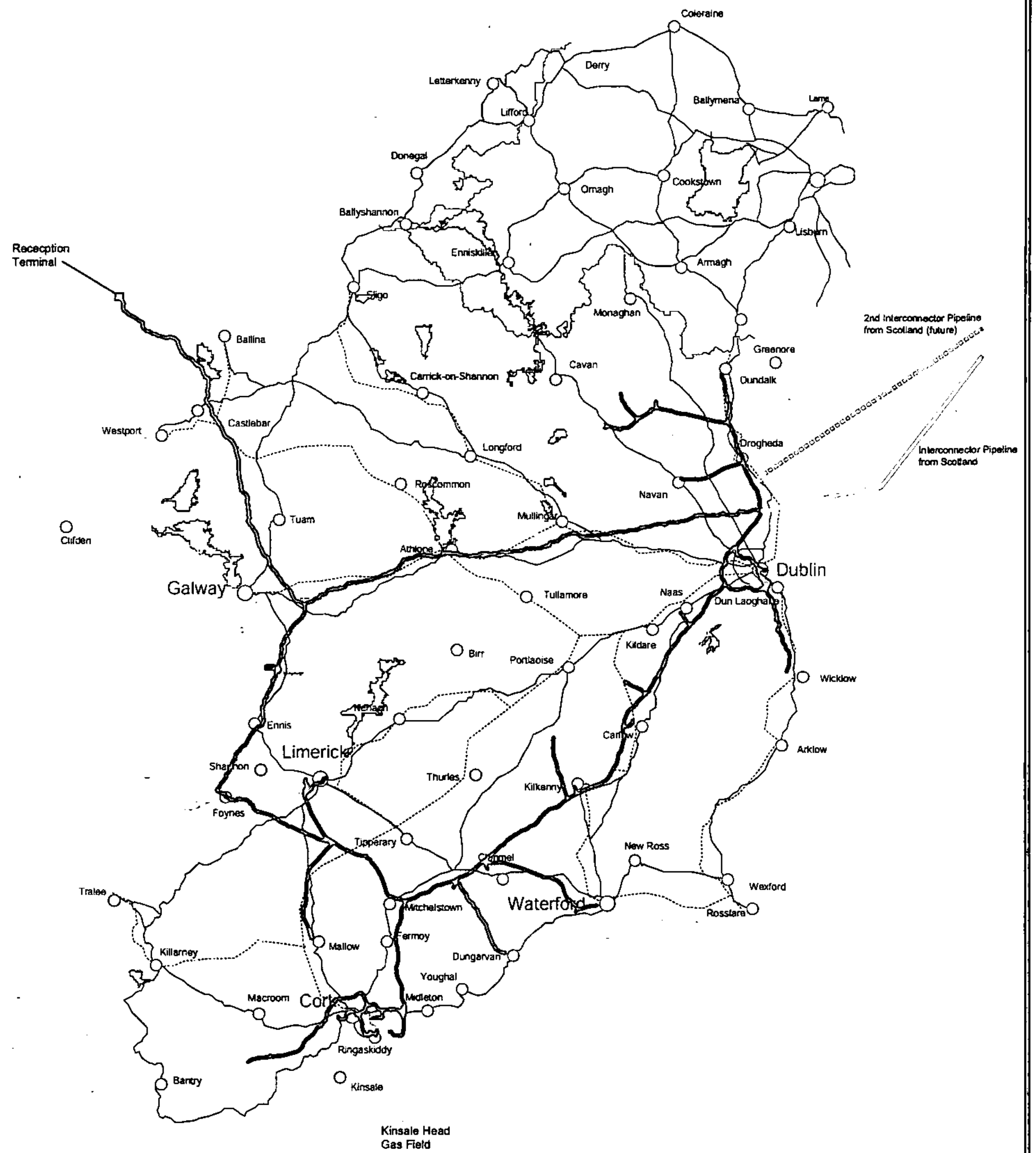


ELEVATION A

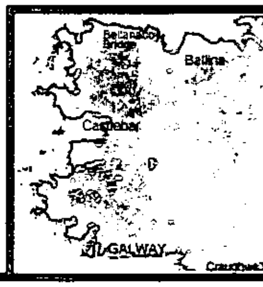
BORD GÁIS	MAYO TO GALWAY PIPELINE		
	Title: TYPICAL LAYOUT OF A BLOCK VALVE STATION		
ARUP	Scale: N.T.S.	Date: 25.04.01	Drawn By: EG
	Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Drg. No.: Figure 5.3	Rev. A



Existing Bord Gais Eireann Transmission Network



Proposed Bord Gais Eireann Network



Legend:

- Proposed Broadhaven to Galway Pipeline
- Proposed Galway to Dublin Pipeline
- Existing / Committed Pipelines
- Subsea Pipelines
- Possible Future Subsea Pipeline

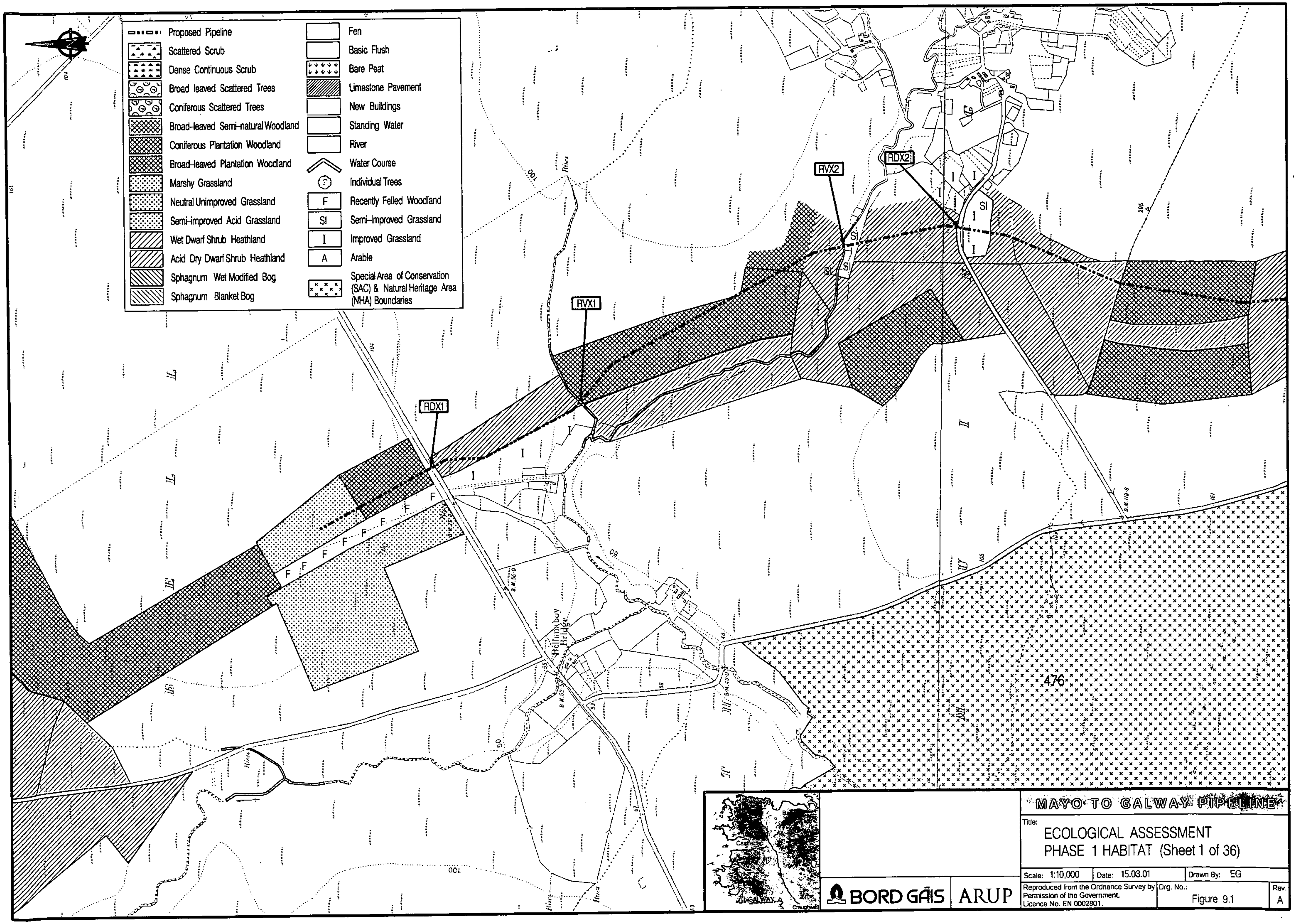
BORD GÁIS | ARUP

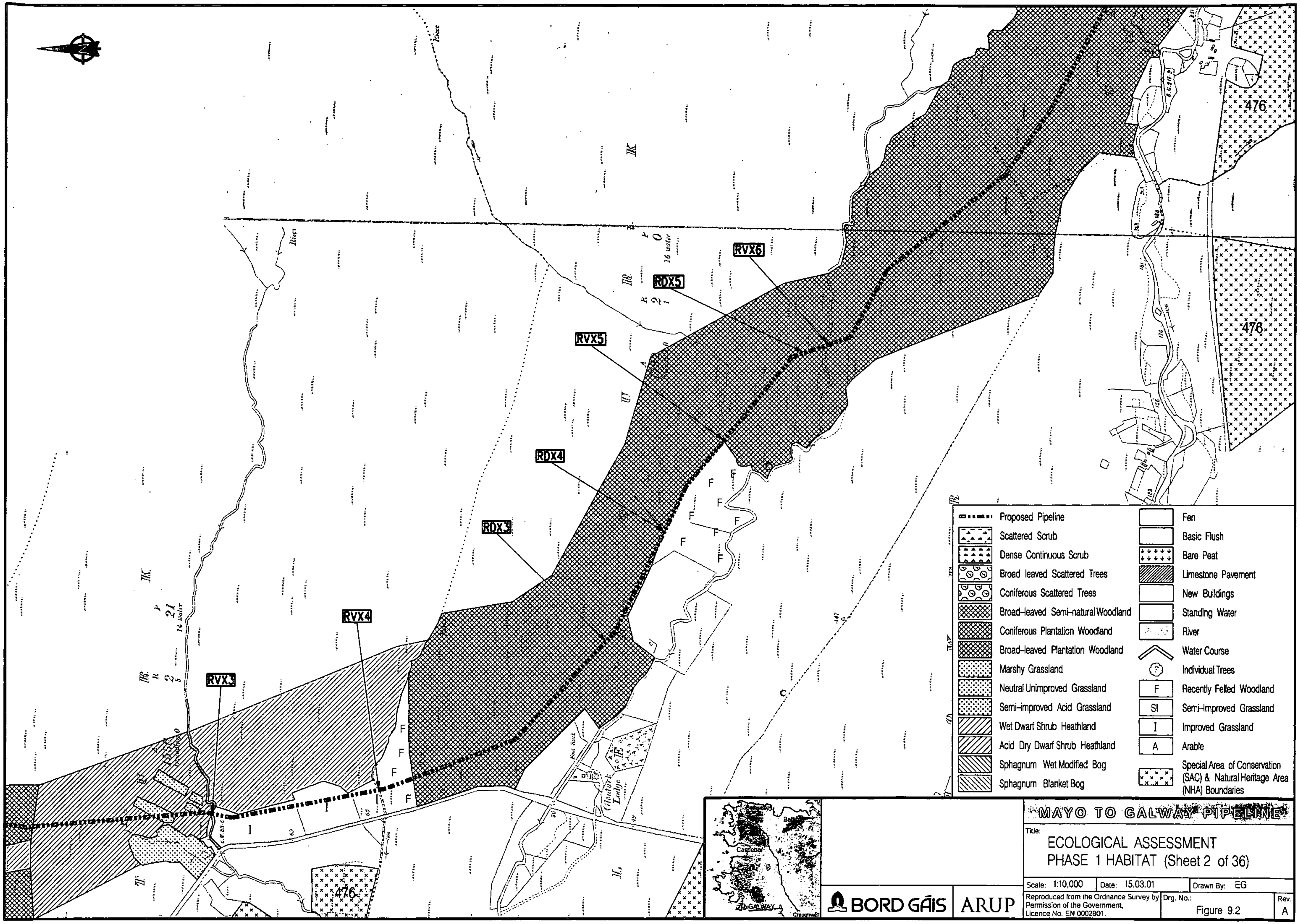
MAYO TO GALWAY PIPELINE

Title:

EXISTING & PROPOSED
BORD GAIS EIREANN NETWORK

Scale: N.T.S.	Date: N.T.S.	Drawn By: N.T.S.	
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.	Drg. No.:	Figure 8.1	Rev. A


Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
RDX1
RVX1
RVX2
RDX2
Bellanaboy Bridge
476
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 1 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.1
Rev.
A



MAYO TO GALWAY PIPELINE

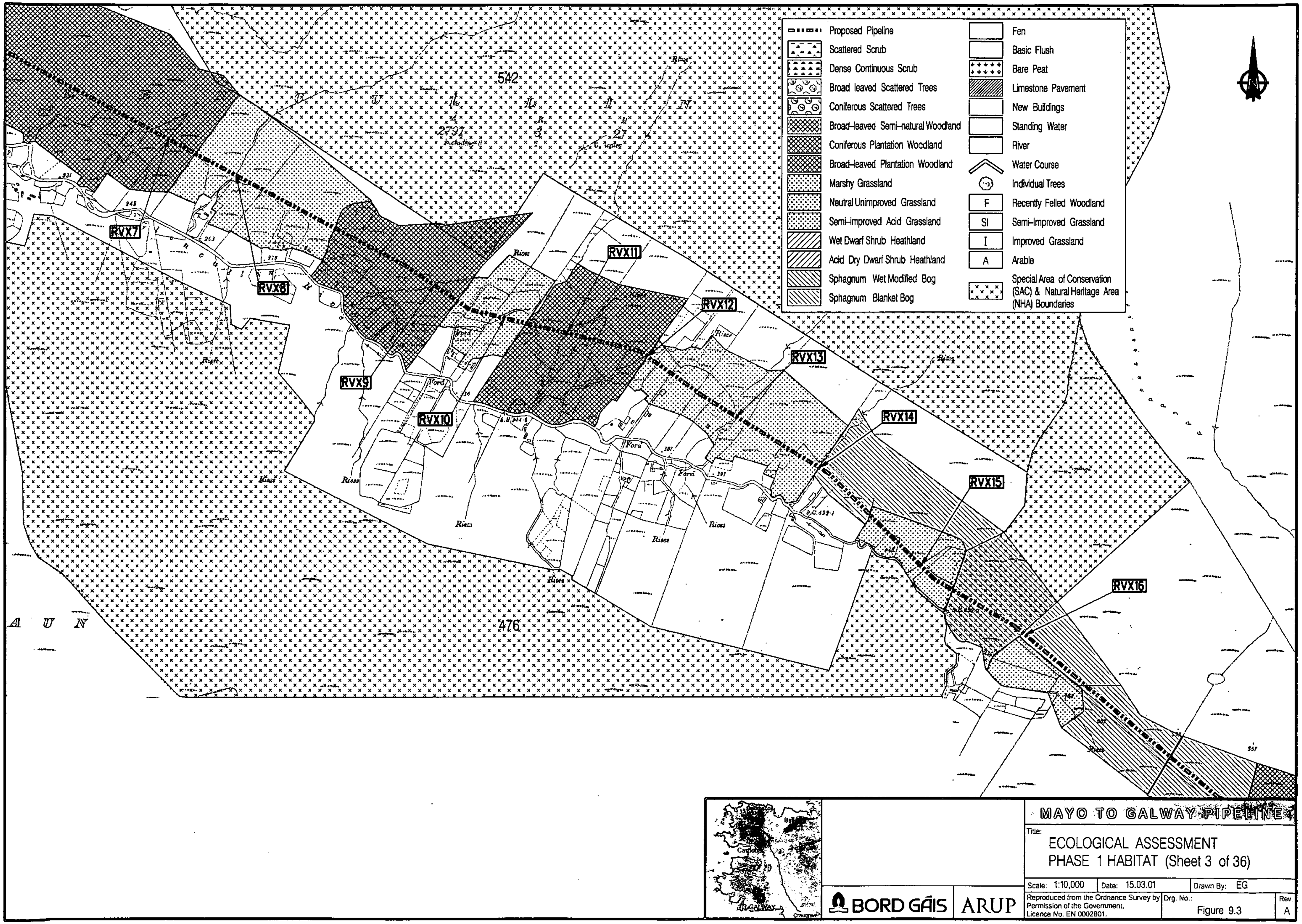
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 2 of 36)

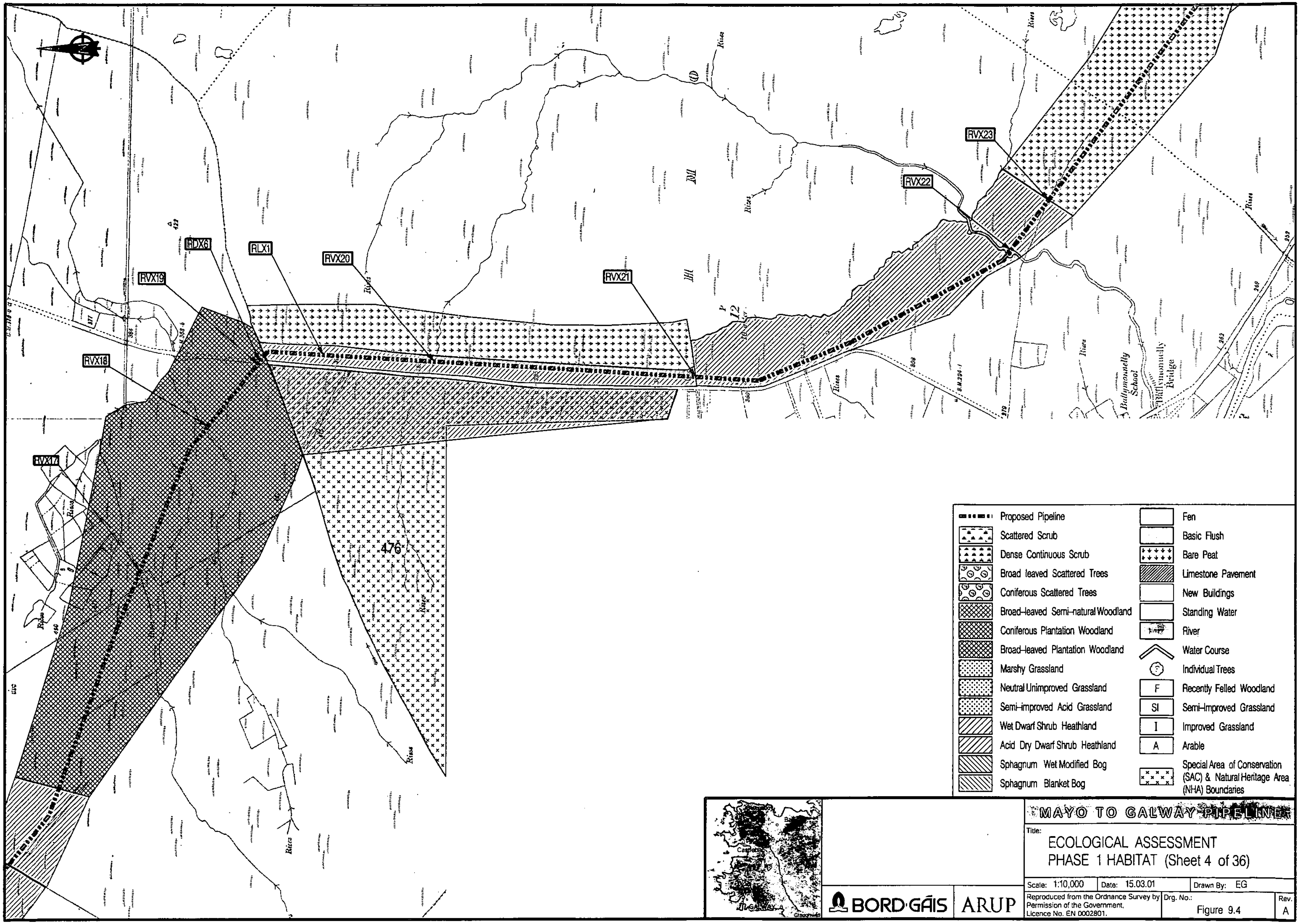
Scale: 1:10,000 | Date: 15.03.01 | Drawn By: EG

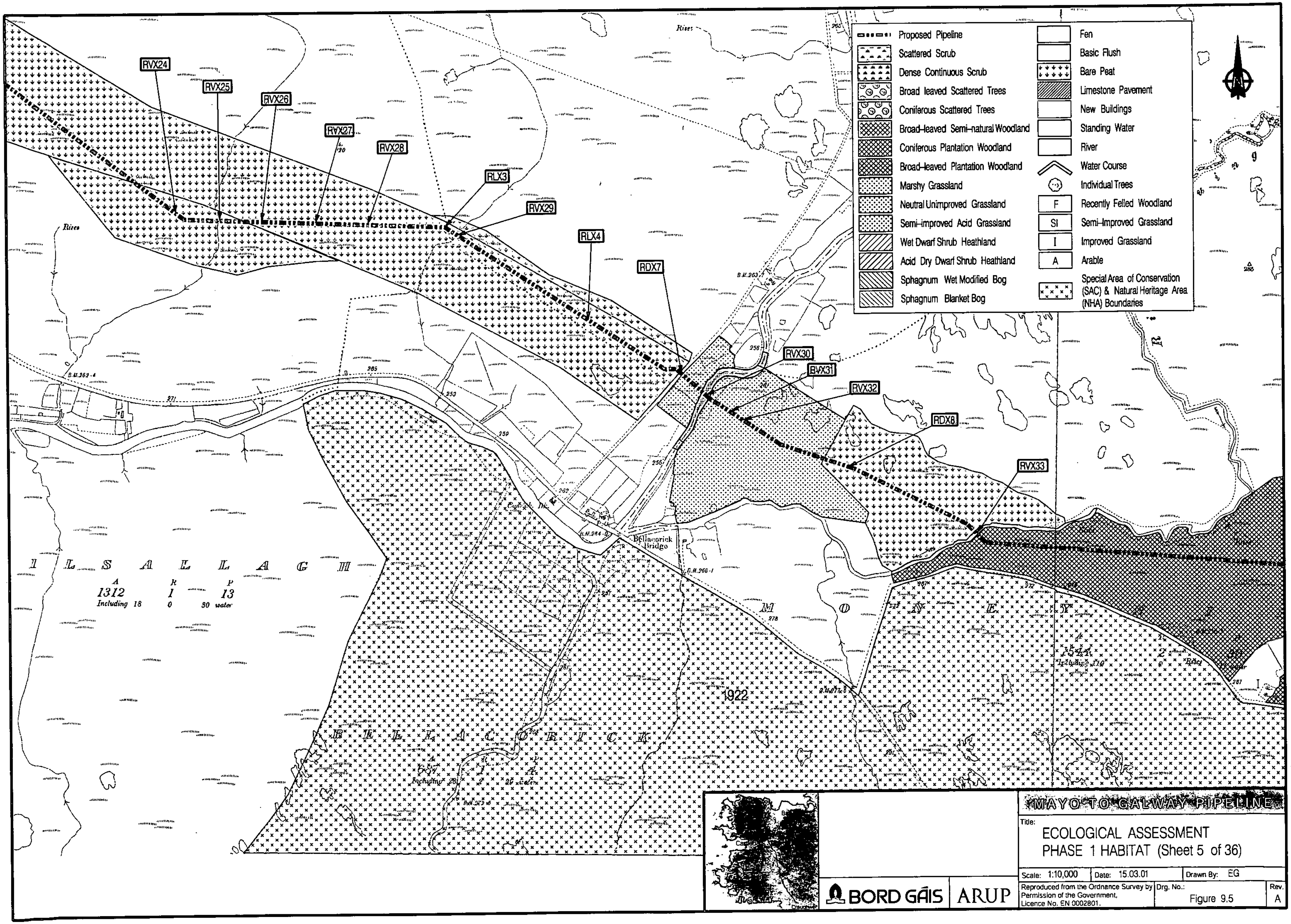
BORD GÁIS | ARUP

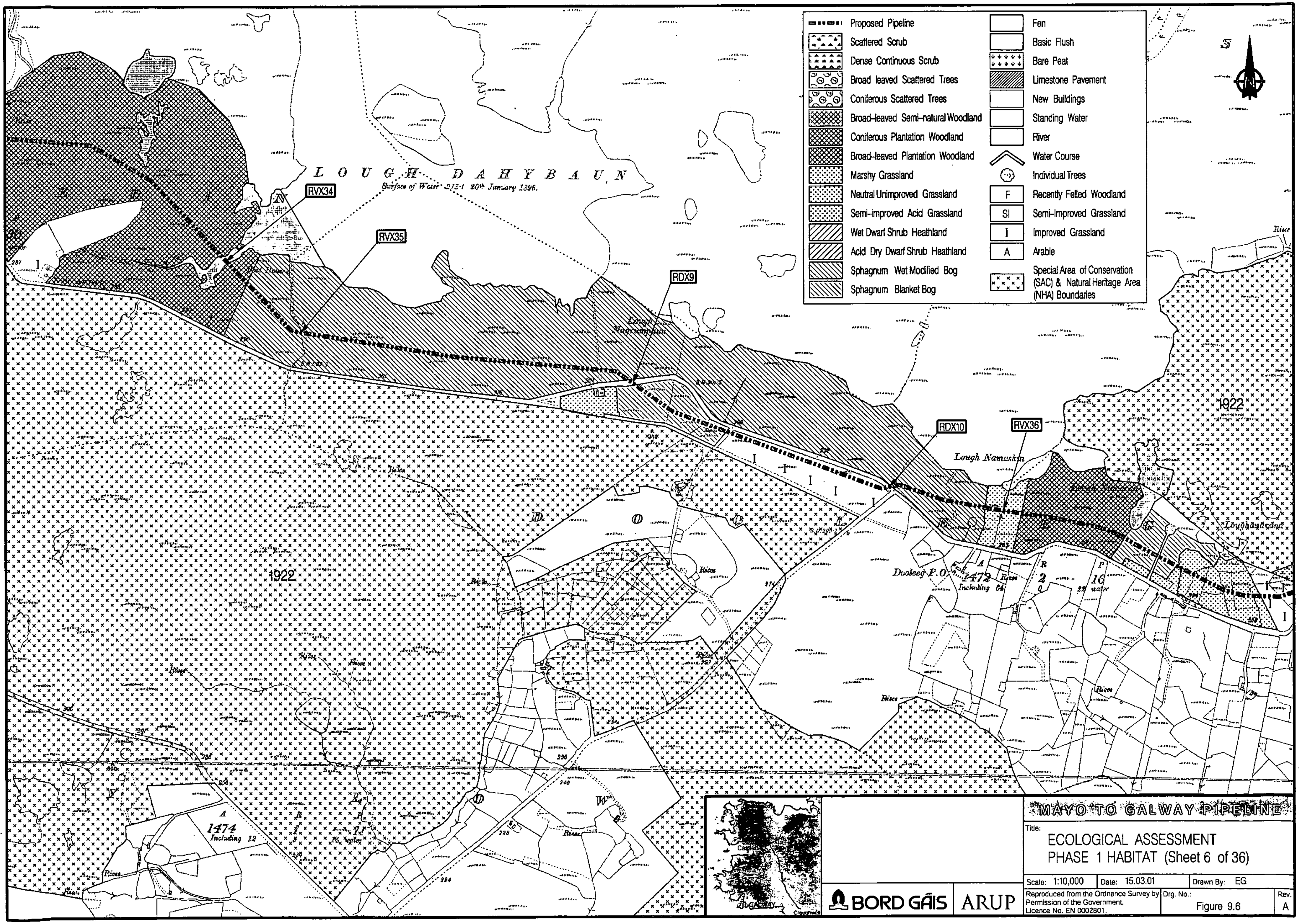
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.

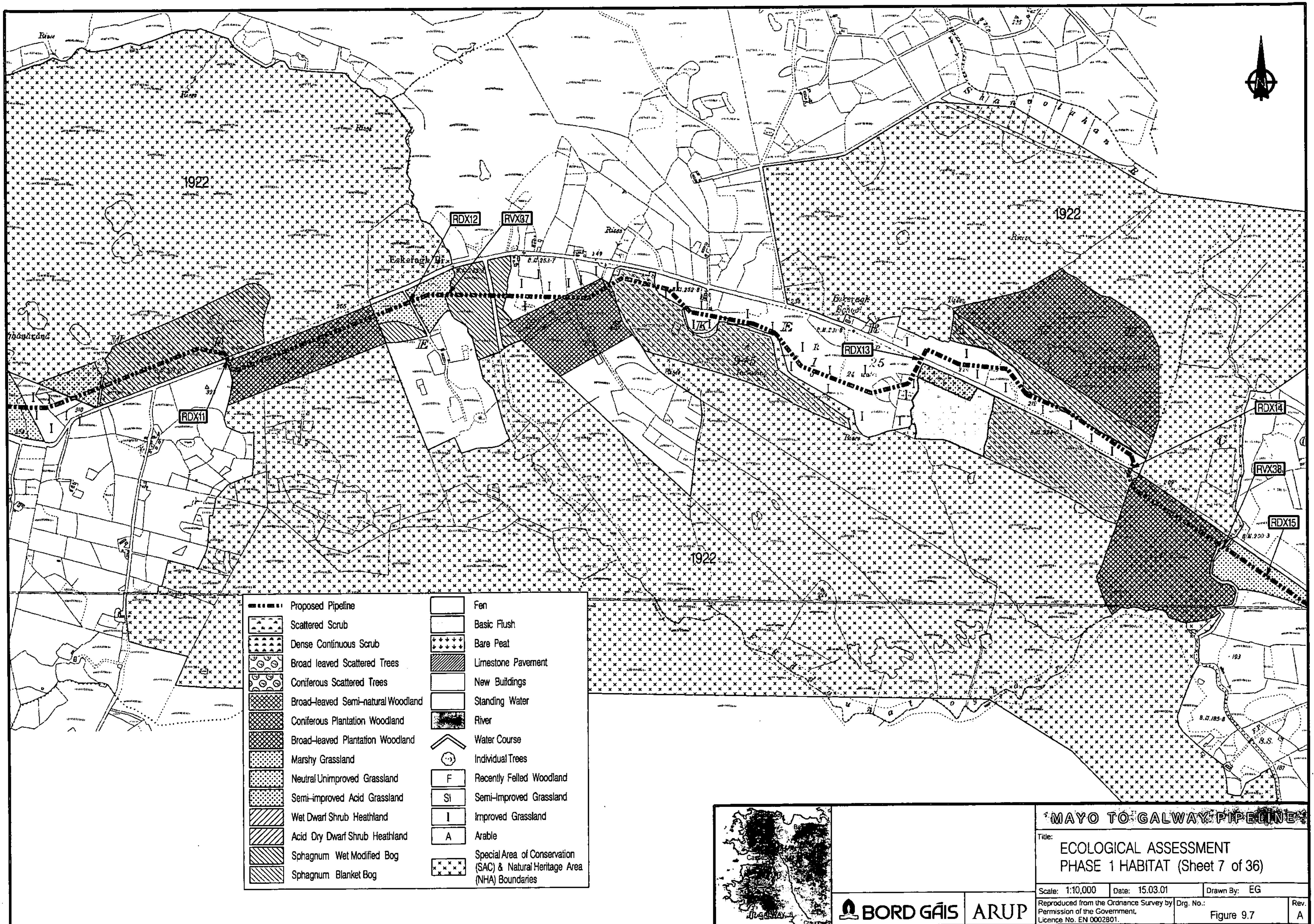
Drg. No.: Figure 9.2 | Rev. A

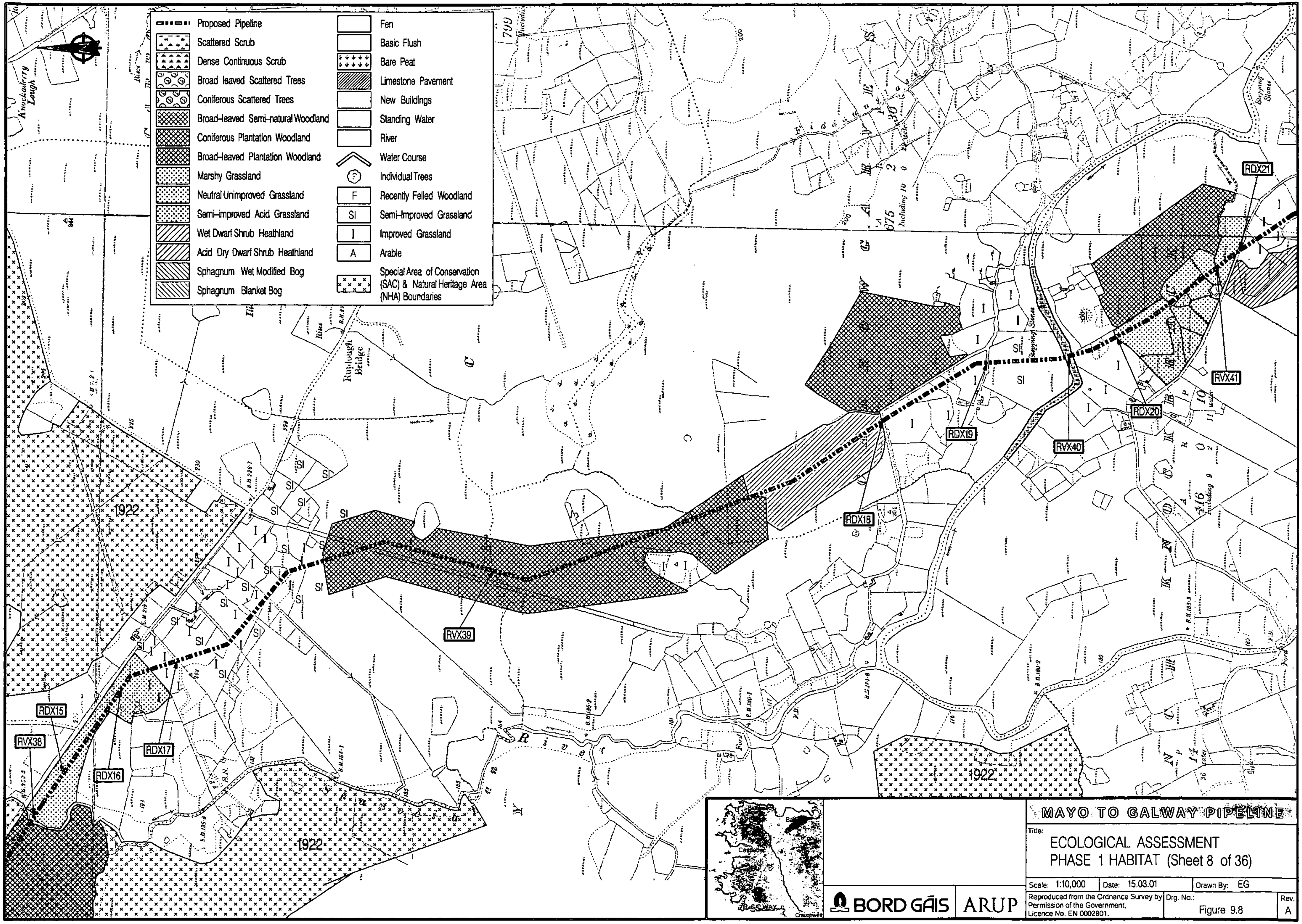

Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
542
476
RVX7
RVX8
RVX9
RVX10
RVX11
RVX12
RVX13
RVX14
RVX15
RVX16
BORD GÁIS
ARUP
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 3 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.
Drg. No.:
Figure 9.3
Rev.
A


RVX17
RVX18
RVX19
RDX6
RLX1
RVX20
RVX21
RVX22
RVX23
476
Ballymonnelly School
Ballymonnelly Bridge
Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 4 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.: Figure 9.4
Rev. A

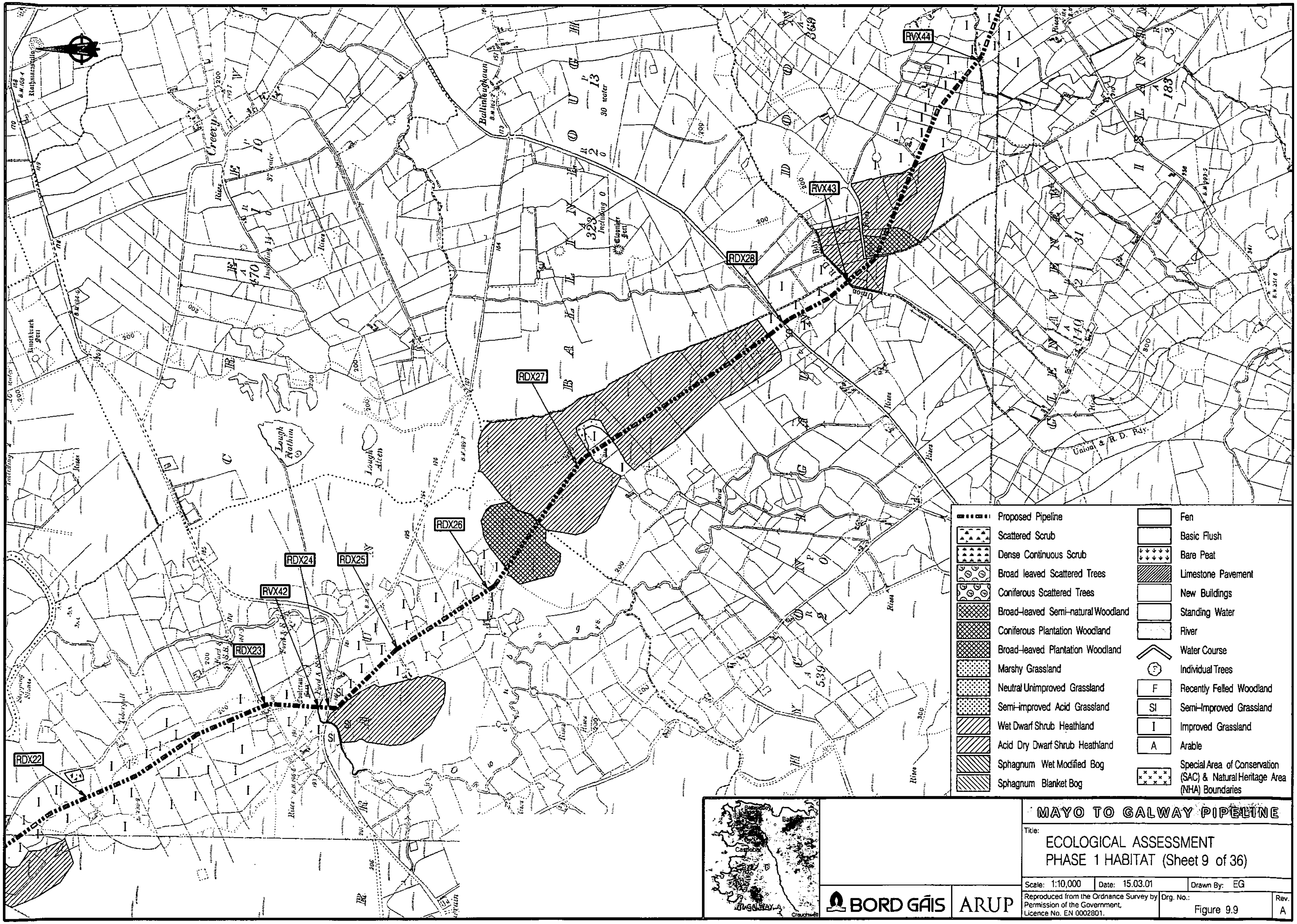

Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F
Recently Felled Woodland
SI
Semi-Improved Grassland
I
Improved Grassland
A
Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
RVX24
RVX25
RVX26
RVX27
RVX28
RLX3
RVX29
RLX4
RDX7
RVX30
BVX31
RVX32
RDX8
RVX33
Bellacorick Bridge
1312
Including 18 0 30 water
1922
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 5 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.5
Rev.
A
BORD GÁIS
ARUP

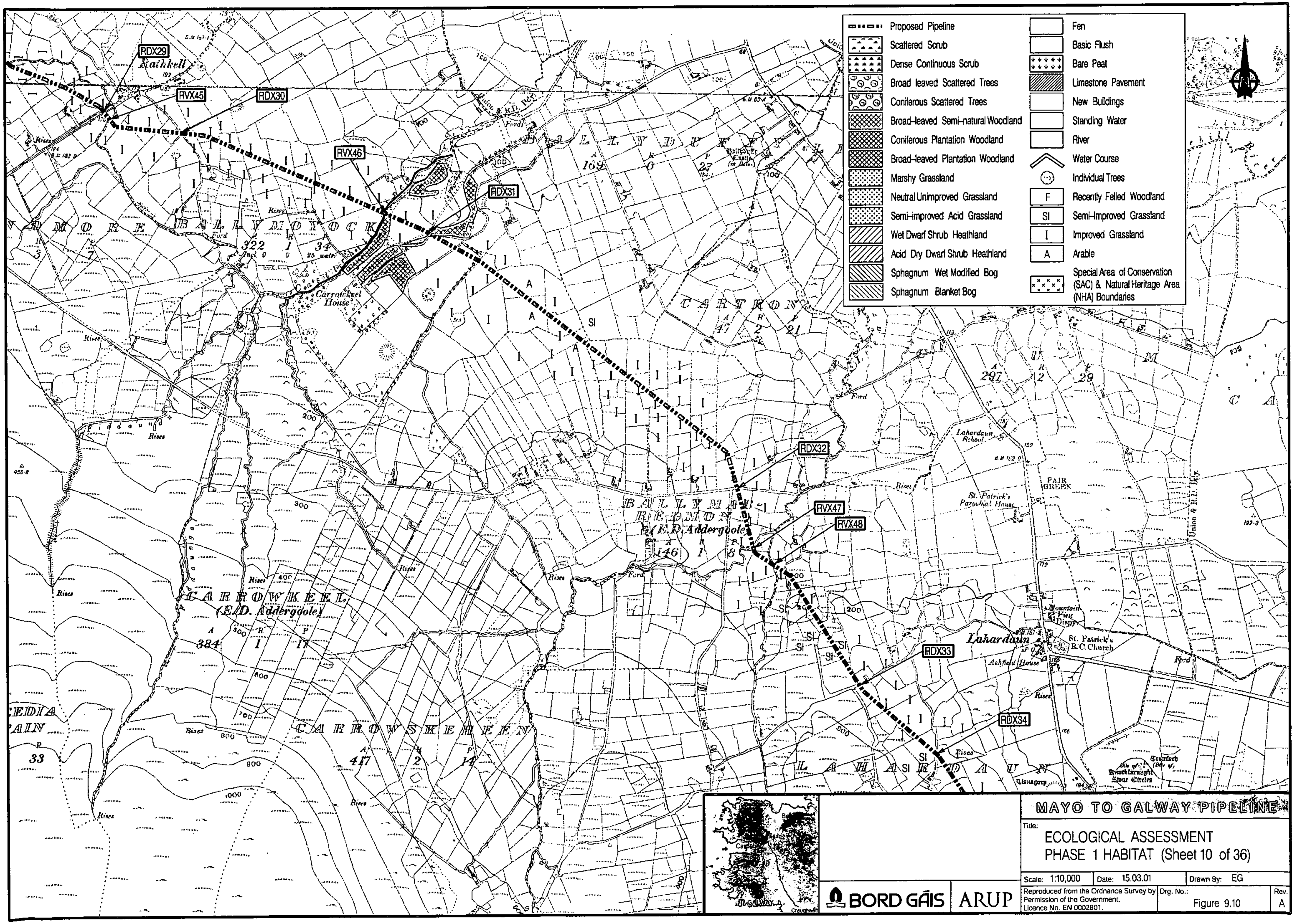

Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
LOUGH DAHYBAUN
RVX34
RVX35
RDX9
RDX10
RVX36
Lough Namuskin
1922
1474
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 6 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.6
Rev.
A
BORD GÁIS
ARUP


1922
1922
1922
RDX11
RDX12
RVX37
RDX13
RDX14
RVX38
RDX15
Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 7 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.
Drg. No.:
Figure 9.7
Rev.
A

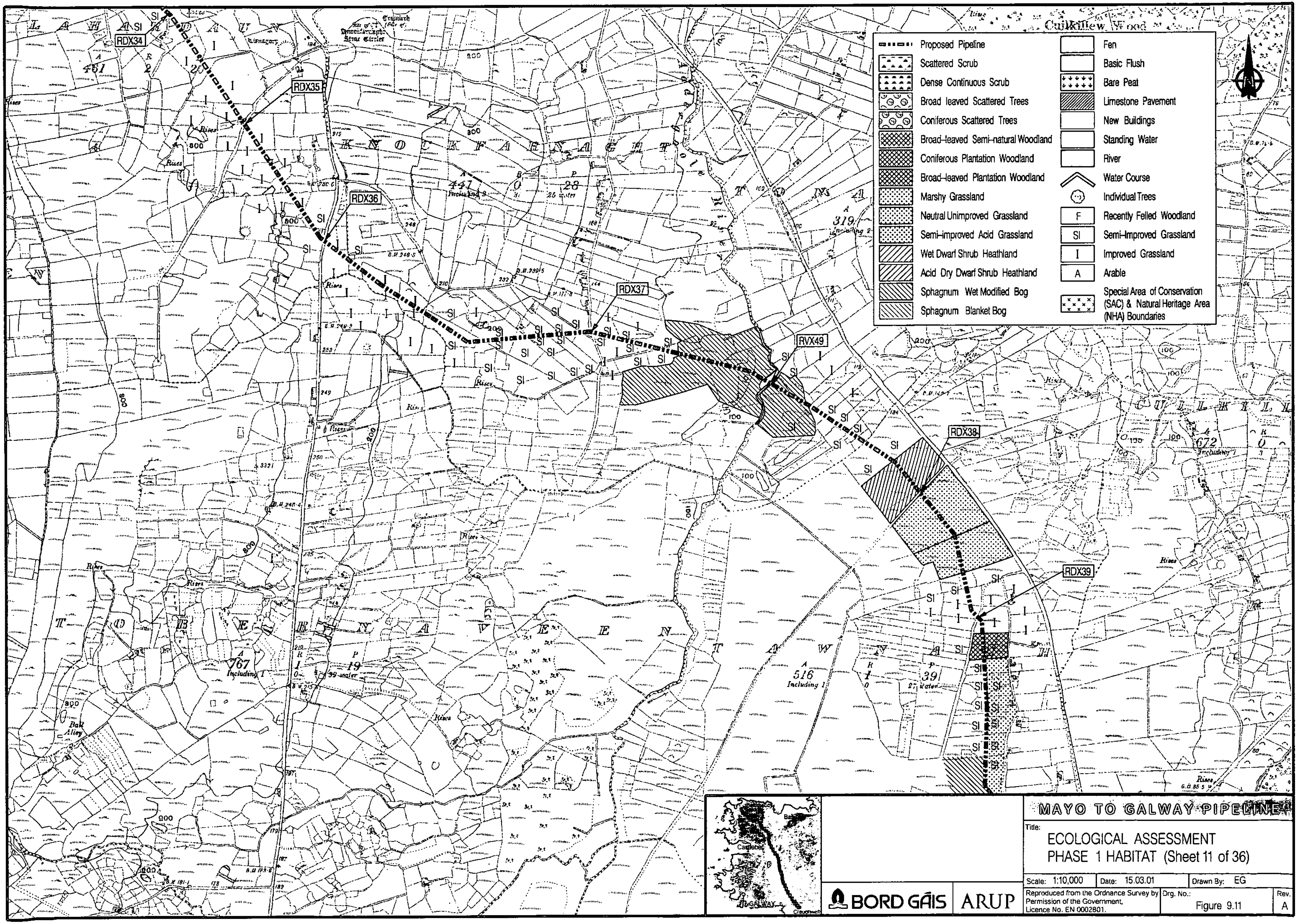


Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
Knockalerry Lough
Runlough Bridge
Stepping Stones
1922
RDX15
RVX38
RDX16
RDX17
RVX39
RDX18
RDX19
RVX40
RDX20
RVX41
RDX21
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 8 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.8
Rev.
A
BORD GÁIS
ARUP

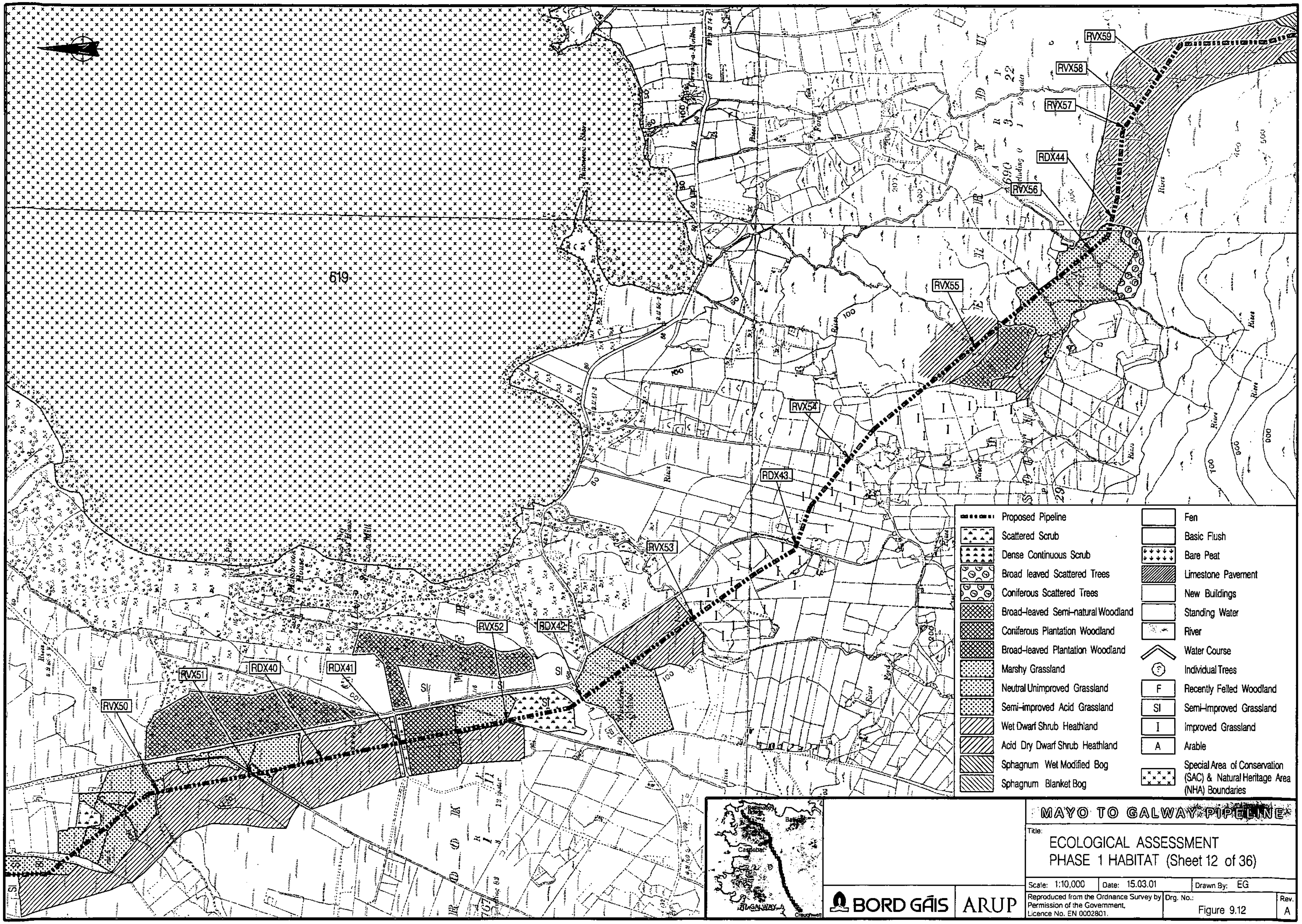

RVX44
RVX43
RDX28
RDX27
RDX26
RDX25
RDX24
RVX42
RDX23
RDX22
Lough Nathin
Lough Aleen
Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 9 of 36)
BORD GÁIS
ARUP
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.9
Rev.
A



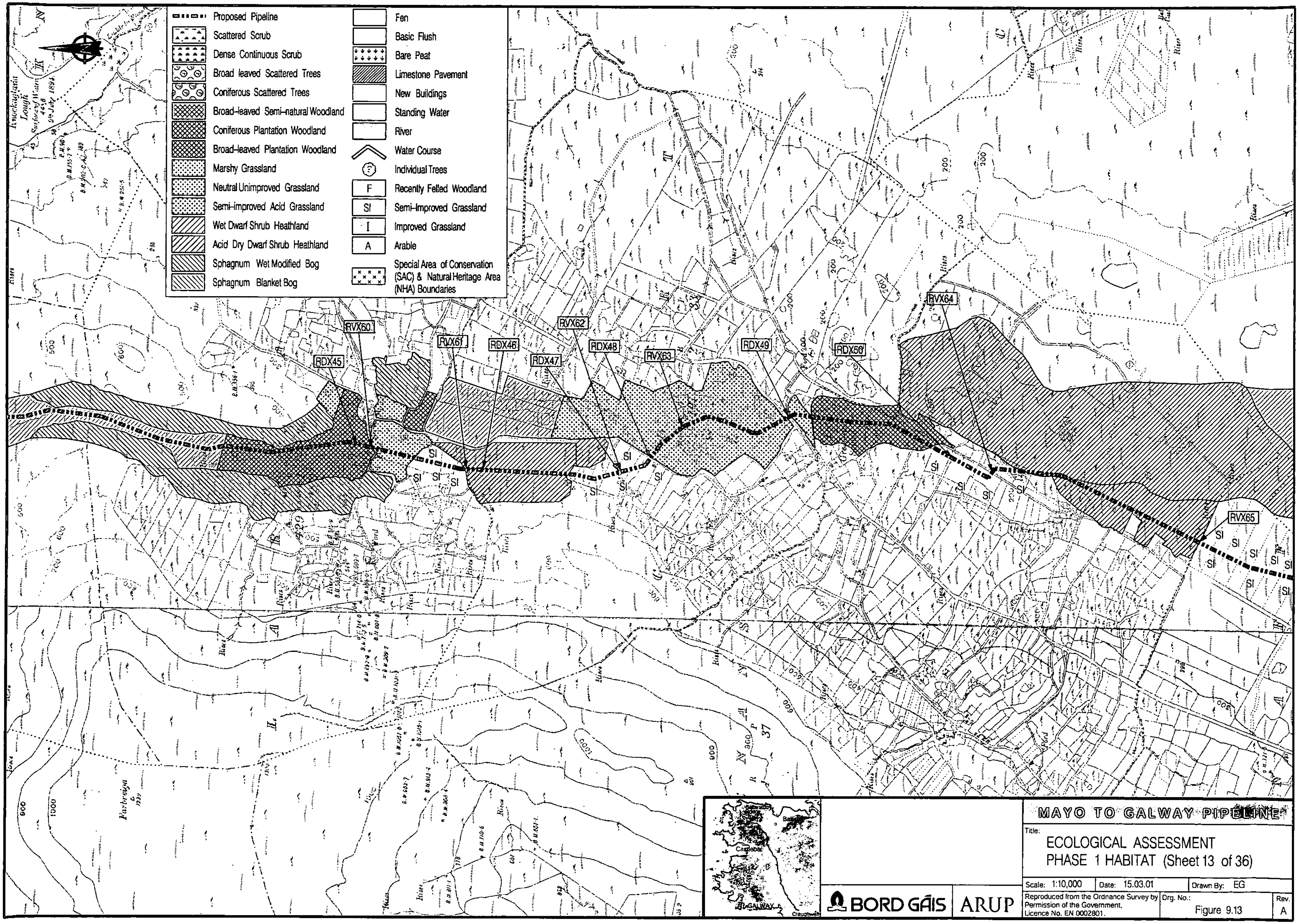
Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
RDX29
RVX45
RDX30
RVX46
RDX31
RDX32
RVX47
RVX48
RDX33
RDX34
Rathkell
Ballymoyock
Carrowkeel House
Cartron
Ballymac-Redmon (E.D. Addergoole)
Carrowkeel (E.D. Addergoole)
Carrowskeheen
Lahardaun
Lahardaun School
St. Patrick's Parochial House
Fair Green
St. Patrick's R.C. Church
Ashfield House
Mountain View Dispy.
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 10 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.
Drg. No.:
Figure 9.10
Rev.
A

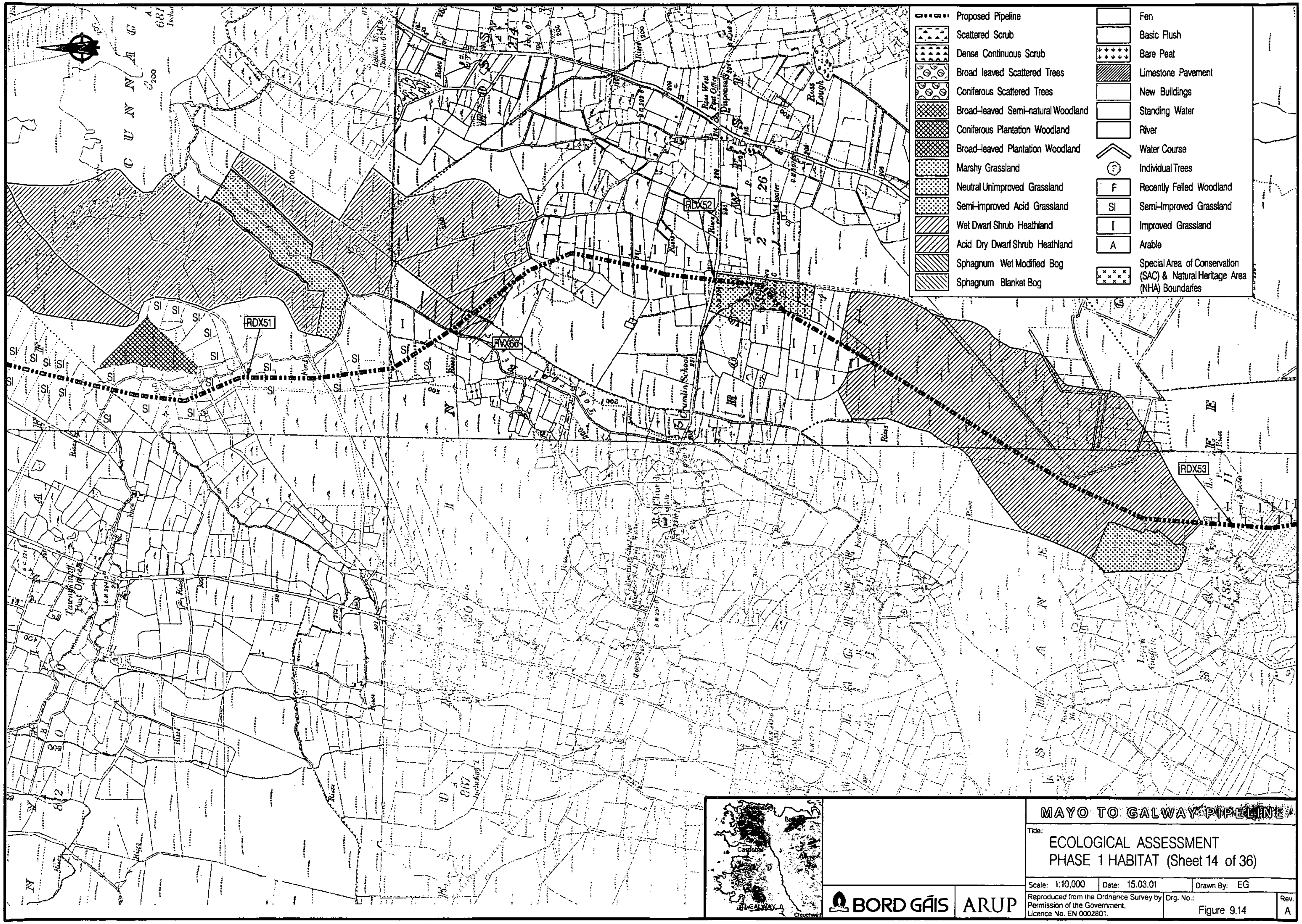


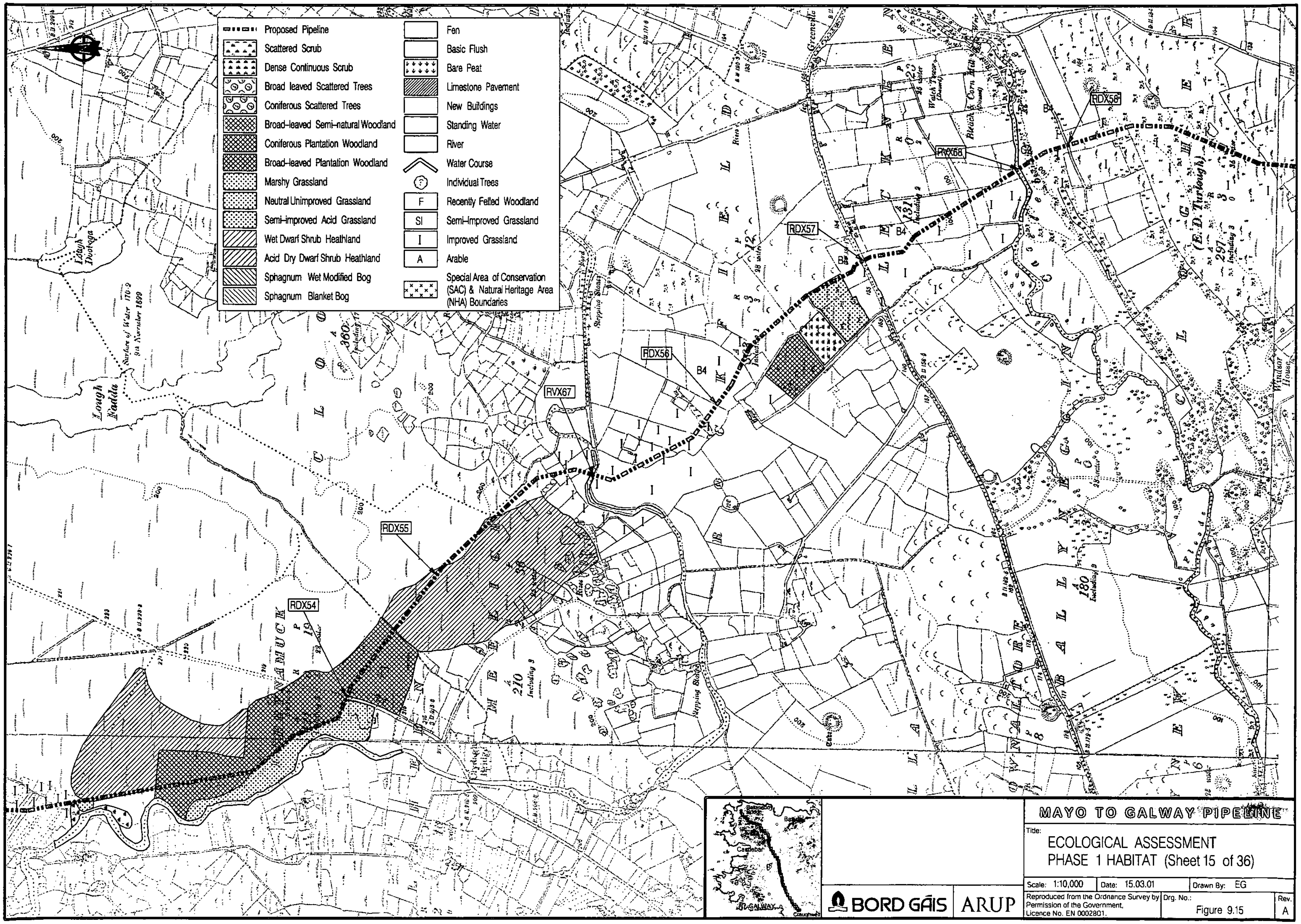
Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
RDX34
RDX35
RDX36
RDX37
RVX49
RDX38
RDX39
Cuilkillew Wood
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 11 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.11
Rev.
A

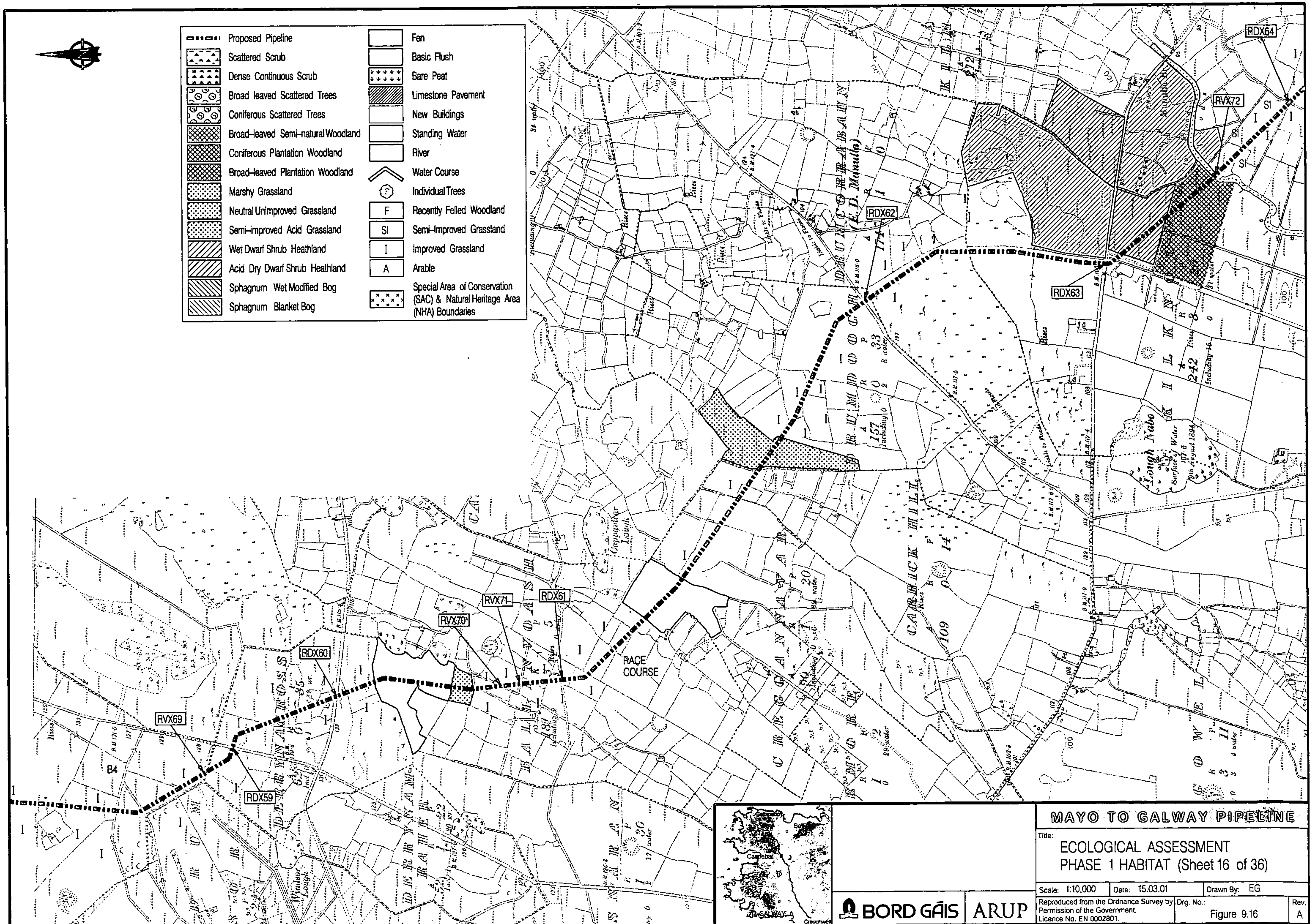


RVX59
RVX58
RVX57
RDX44
RVX56
RVX55
RVX54
RDX43
RVX53
RVX52
RDX42
RDX41
RDX40
RVX51
RVX50
619
SI
I
Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 12 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.12
Rev.
A
BORD GÁIS
ARUP

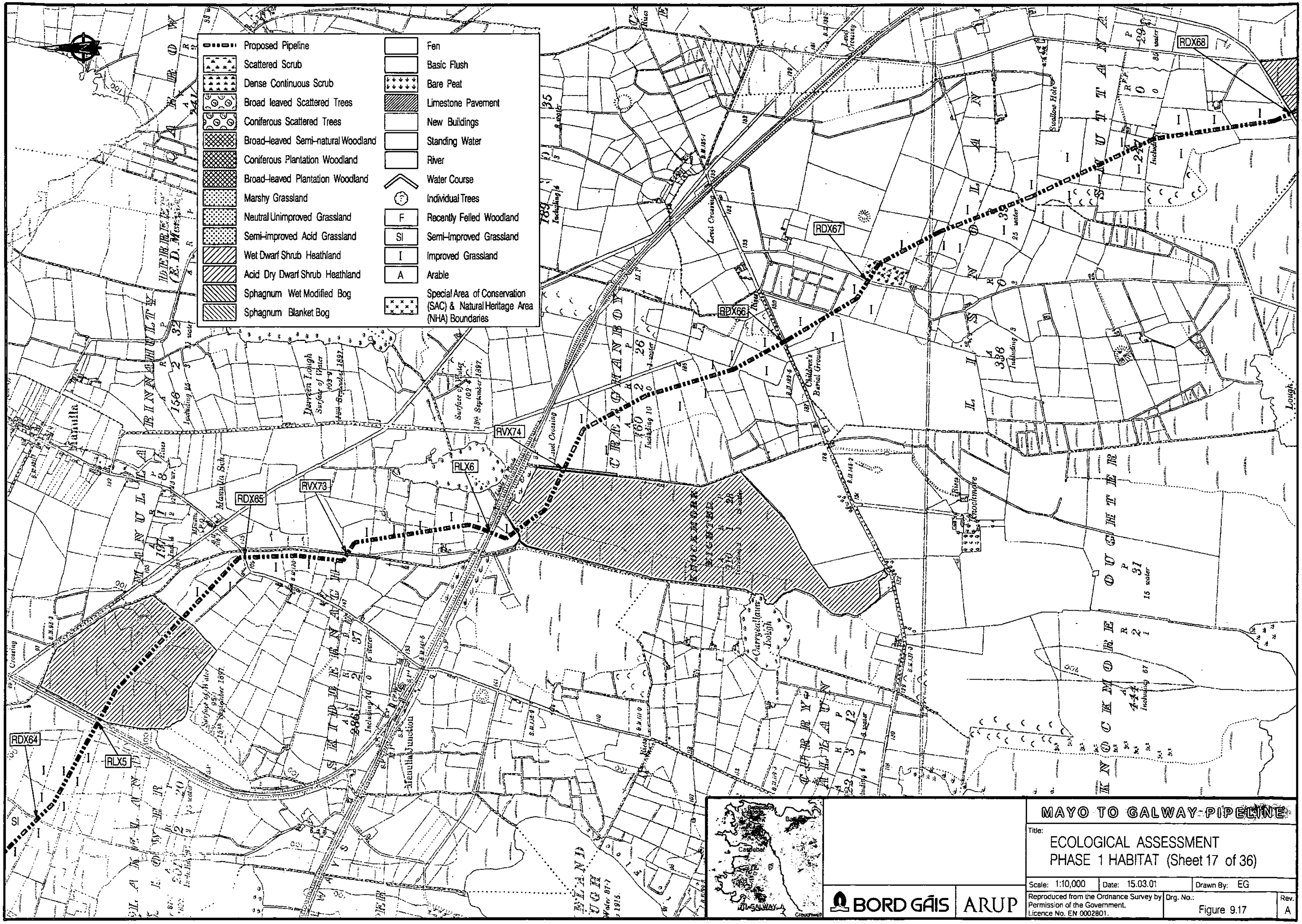

Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
RVX60
RDX45
RVX61
RDX46
RDX47
RVX62
RDX48
RVX63
RDX49
RDX50
RVX64
RVX65
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 13 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.13
Rev.
A
BORD GÁIS
ARUP

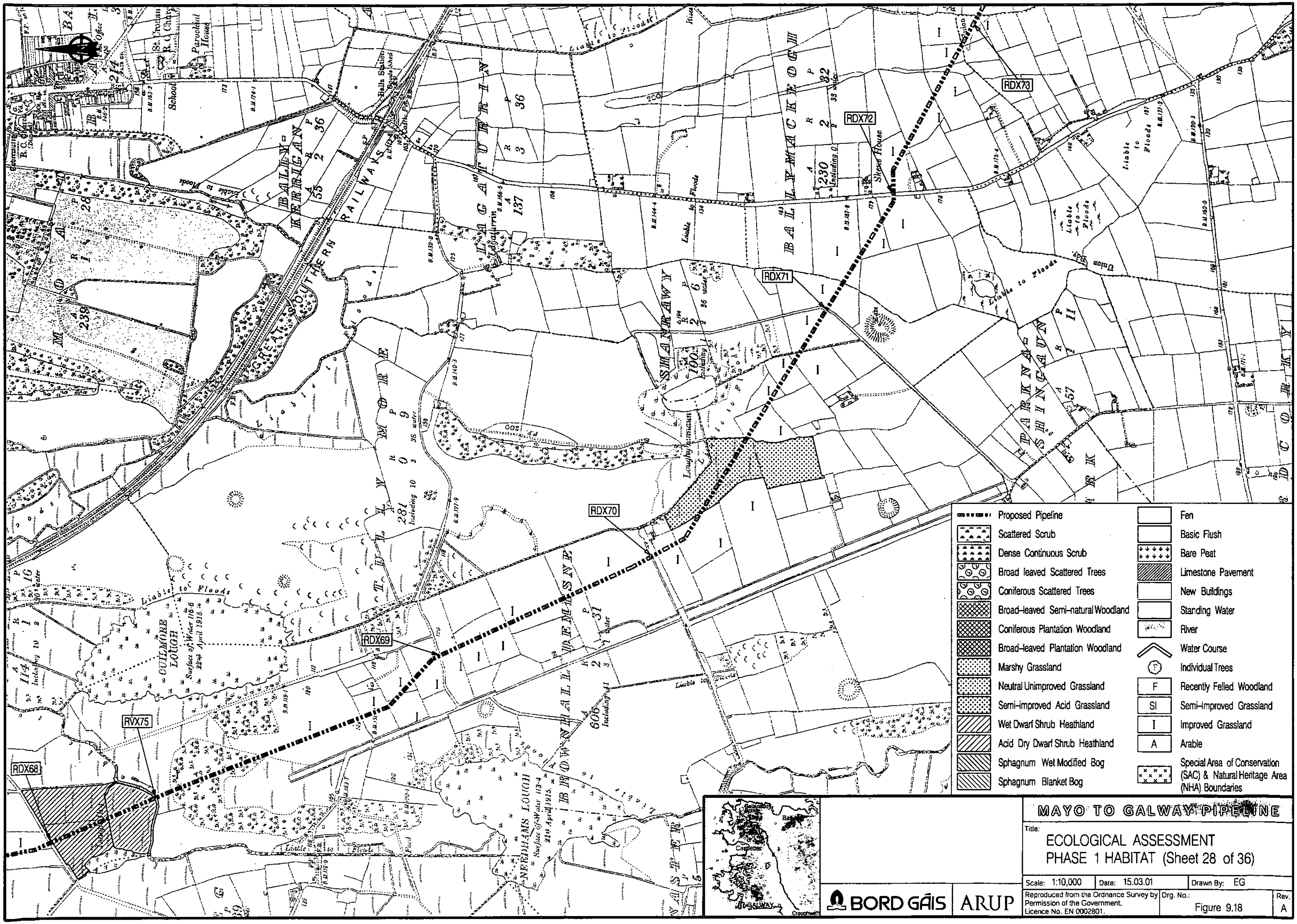

Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
RDX51
RDX52
RDX53
RVX66
BORD GÁIS
ARUP
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 14 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.
Drg. No.:
Figure 9.14
Rev.
A

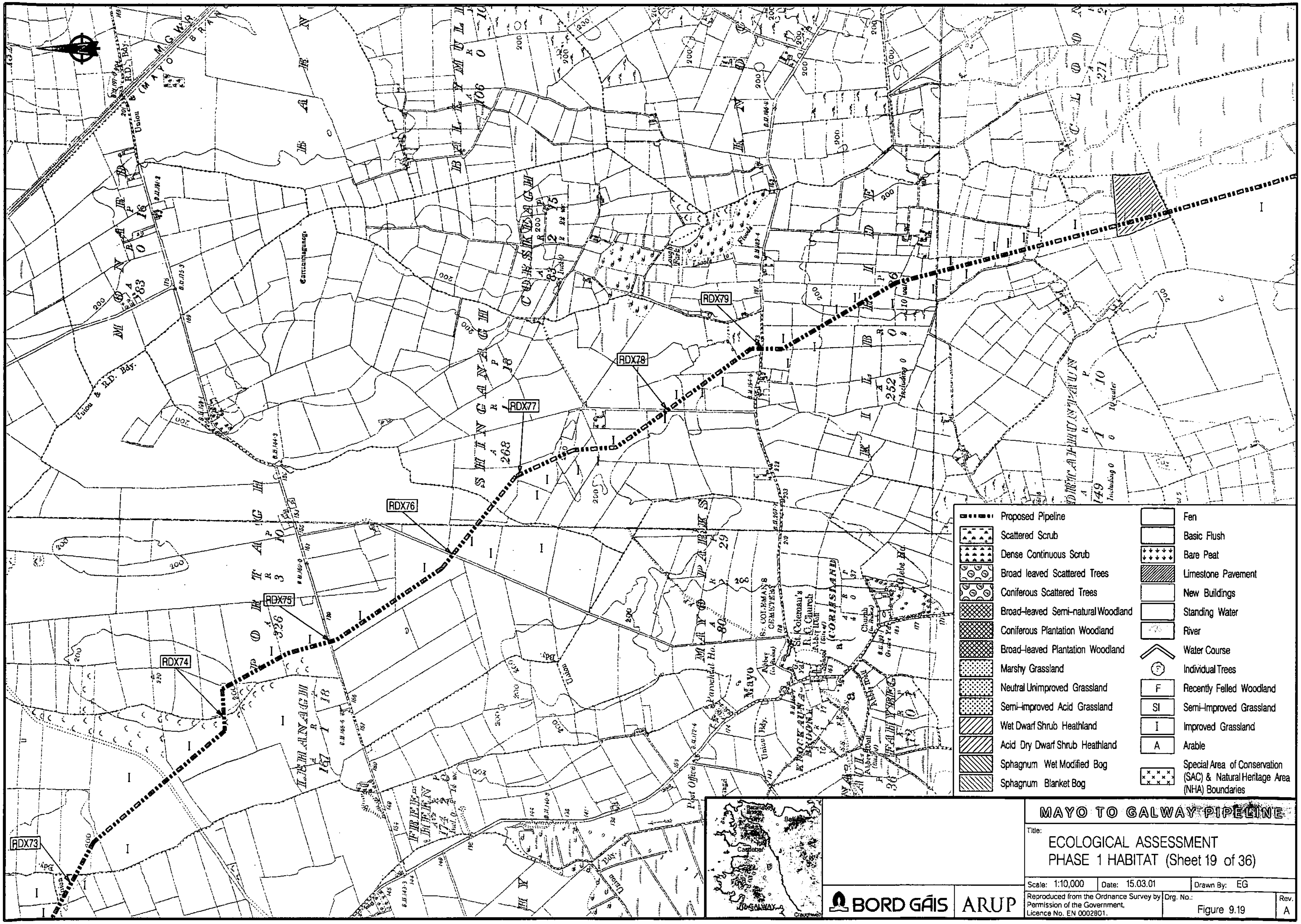

Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
RDX54
RDX55
RDX56
RDX57
RDX58
RVX67
RVX68
Lough Faddle
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 15 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.15
Rev.
A
BORD GÁIS
ARUP



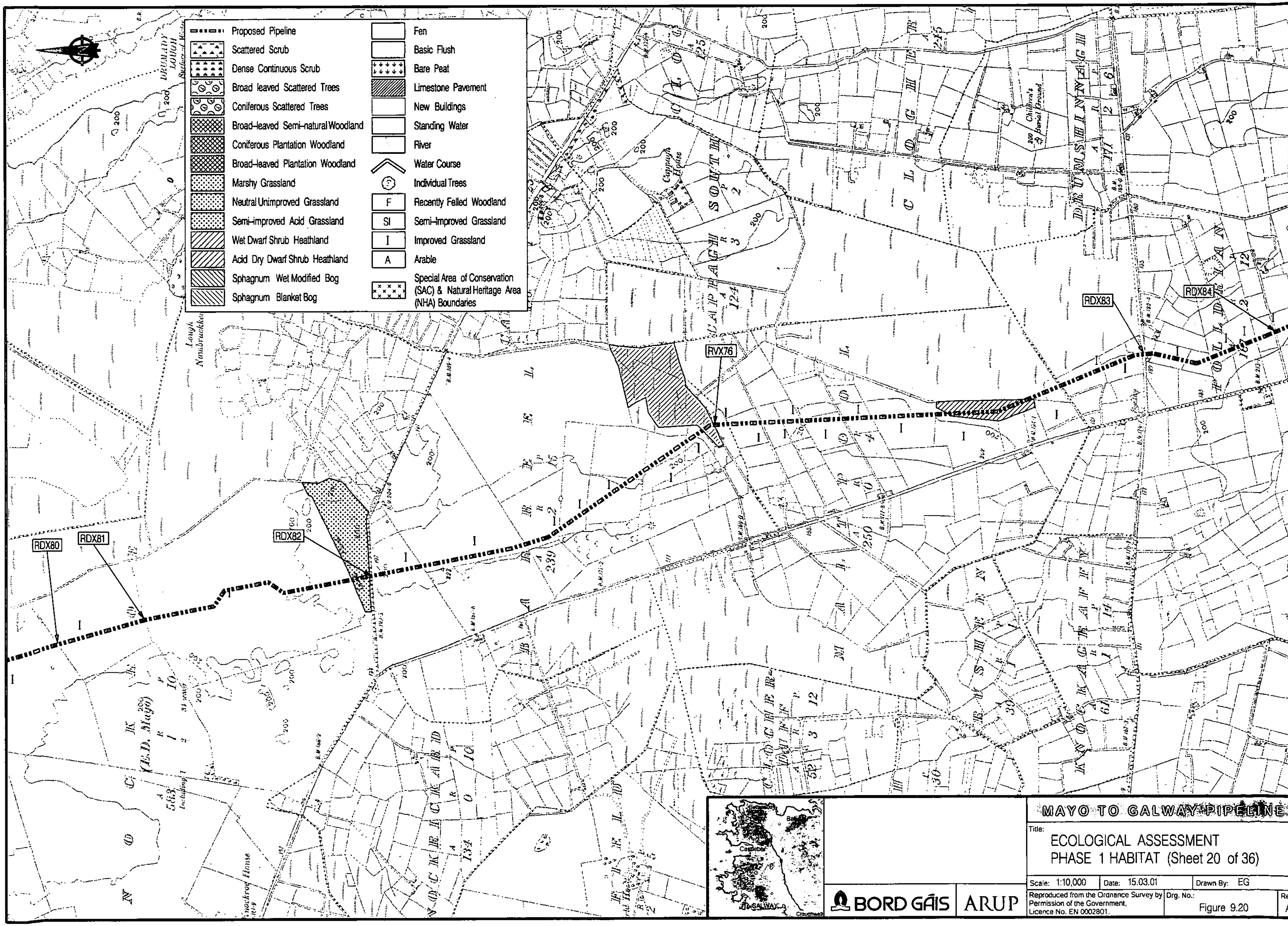
Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
RDX64
RVX72
RDX62
RDX63
RDX61
RVX71
RVX70
RDX60
RVX69
RDX59
RACE COURSE
Lough Nabo
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 16 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.
Drg. No.:
Figure 9.16
Rev. A
BORD GÁIS
ARUP

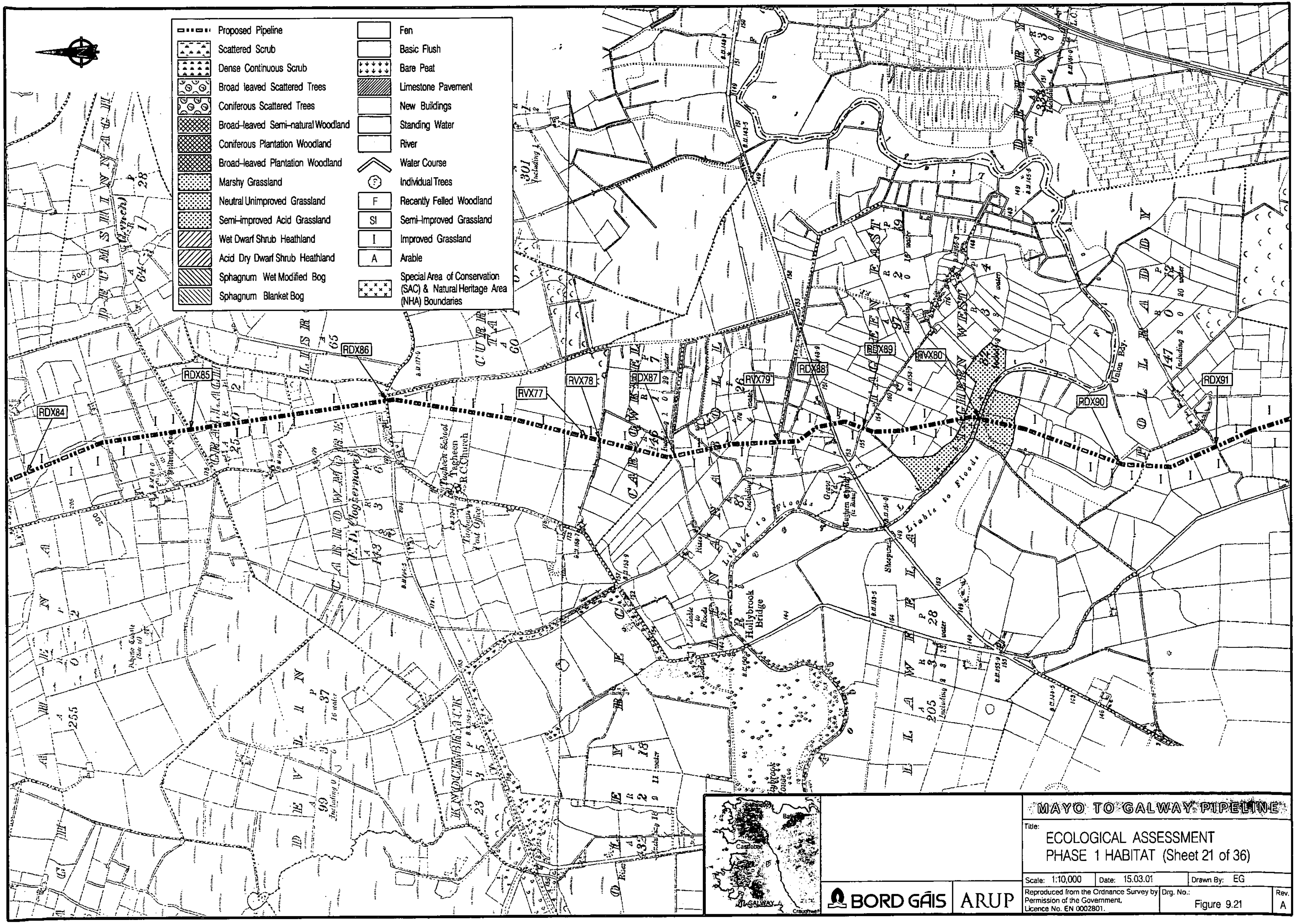

Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
RDX64
RLX5
RDX65
RVX73
RLX6
RVX74
RDX66
RDX67
RDX68
Manulla
Manulla Junction
Derreen Lough
Curryeallaun Lough
Children's Burial Ground
Level Crossing
Lough
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 17 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.
Drg. No.:
Figure 9.17
Rev.
A
BORD GÁIS
ARUP

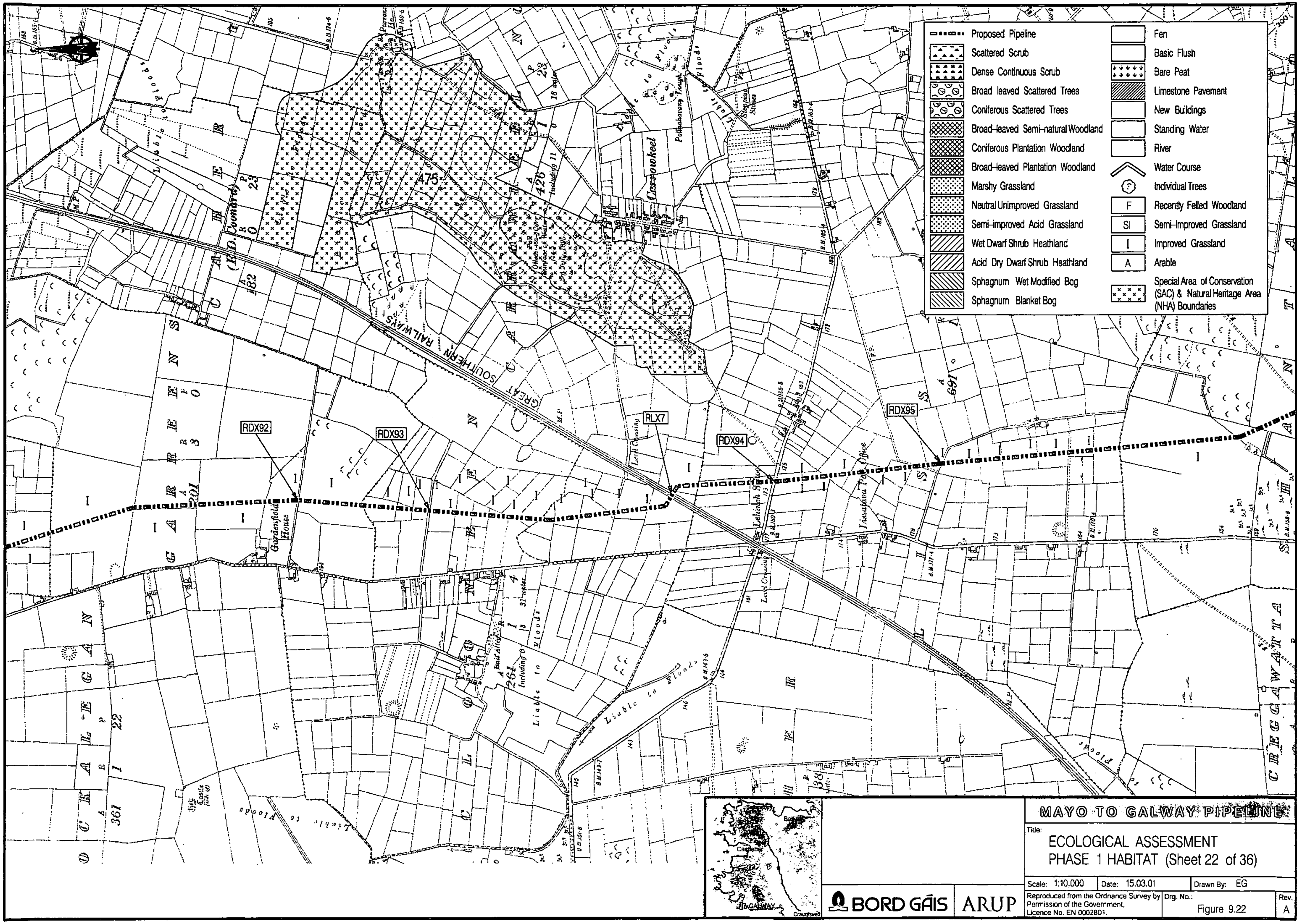

RDX68
RVX75
RDX69
RDX70
RDX71
RDX72
RDX73
Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
BORD GÁIS
ARUP
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 28 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.
Drg. No.: Figure 9.18
Rev. A



Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
RDX73
RDX74
RDX75
RDX76
RDX77
RDX78
RDX79
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 19 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.19
Rev. A
BORD GÁIS
ARUP


Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
RDX80
RDX81
RDX82
RVX76
RDX83
RDX84
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 20 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.
Drg. No.:
Figure 9.20
Rev.
A
BORD GÁIS
ARUP


Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
RDX84
RDX85
RDX86
RVX77
RVX78
RDX87
RVX79
RDX88
RDX89
RVX80
RDX90
RDX91
Tagheen School
Tagheen R.C.Church
Tagheen Post Office
Hollybrook Bridge
Liable to Floods
Union Bog
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 21 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.
Drg. No.: Figure 9.21
Rev. A
BORD GÁIS
ARUP



MAYO TO GALWAY PIPELINE

Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 22 of 36)

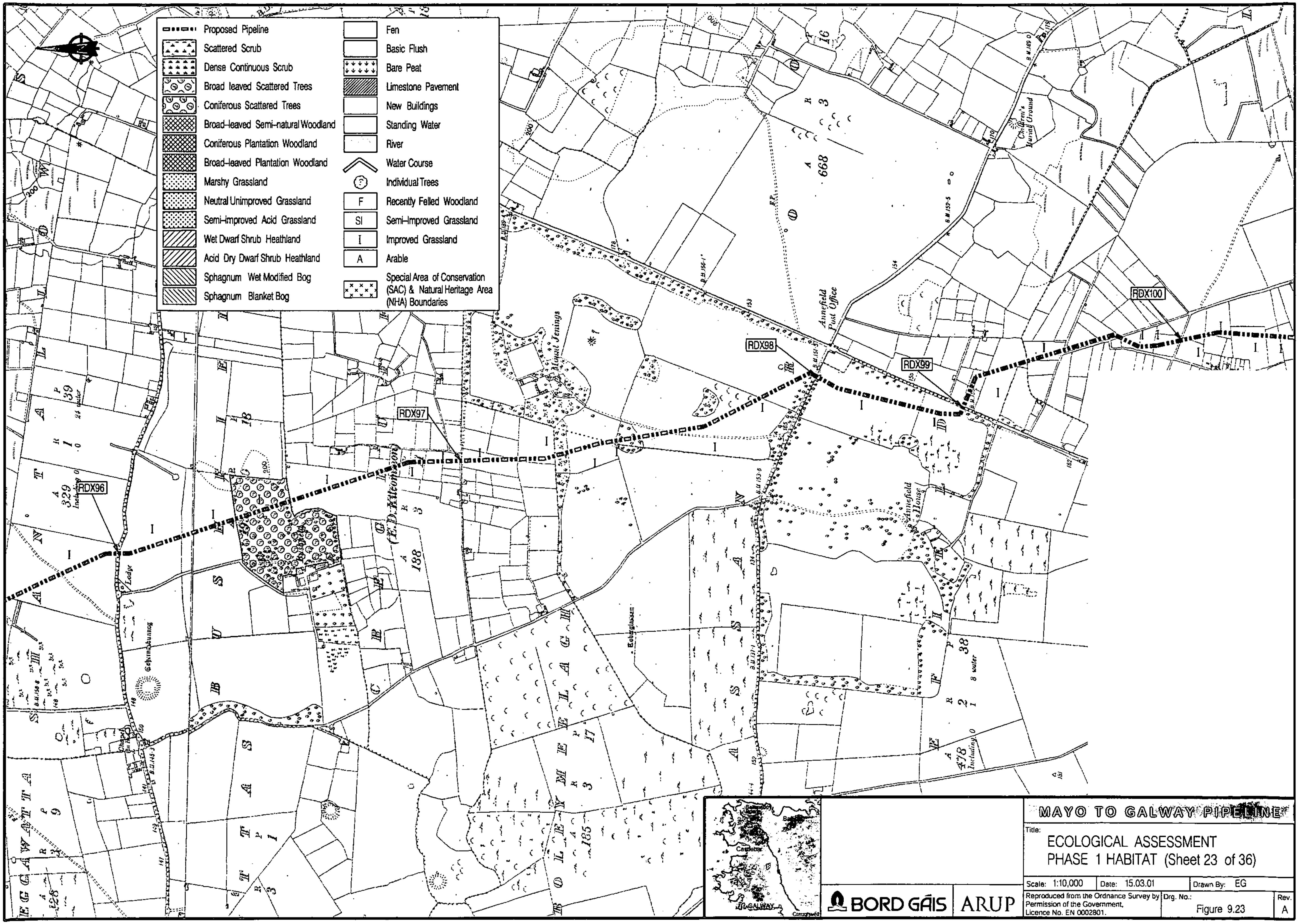
Scale: 1:10,000 | Date: 15.03.01 | Drawn By: EG

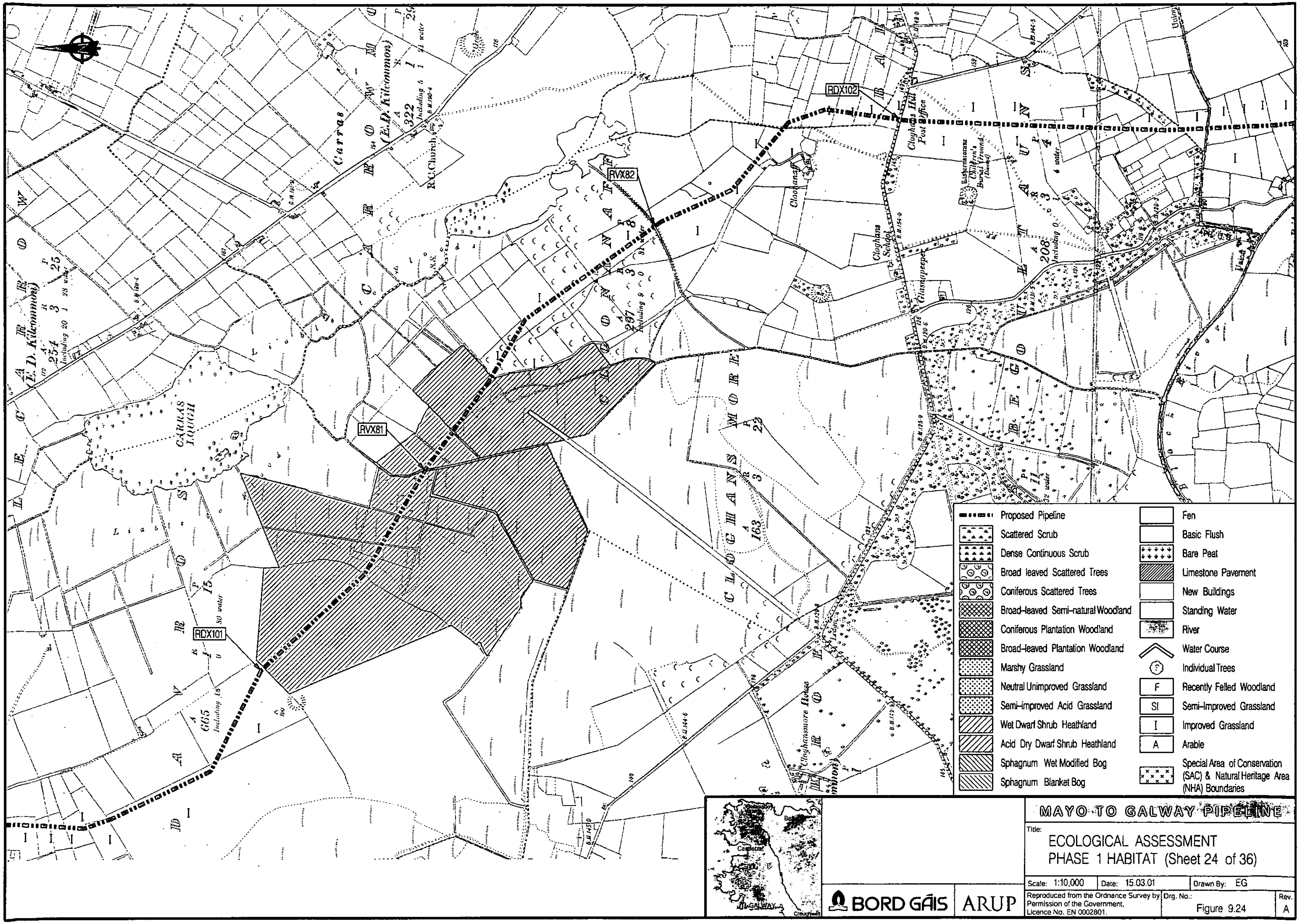
BORD GÁIS | ARUP

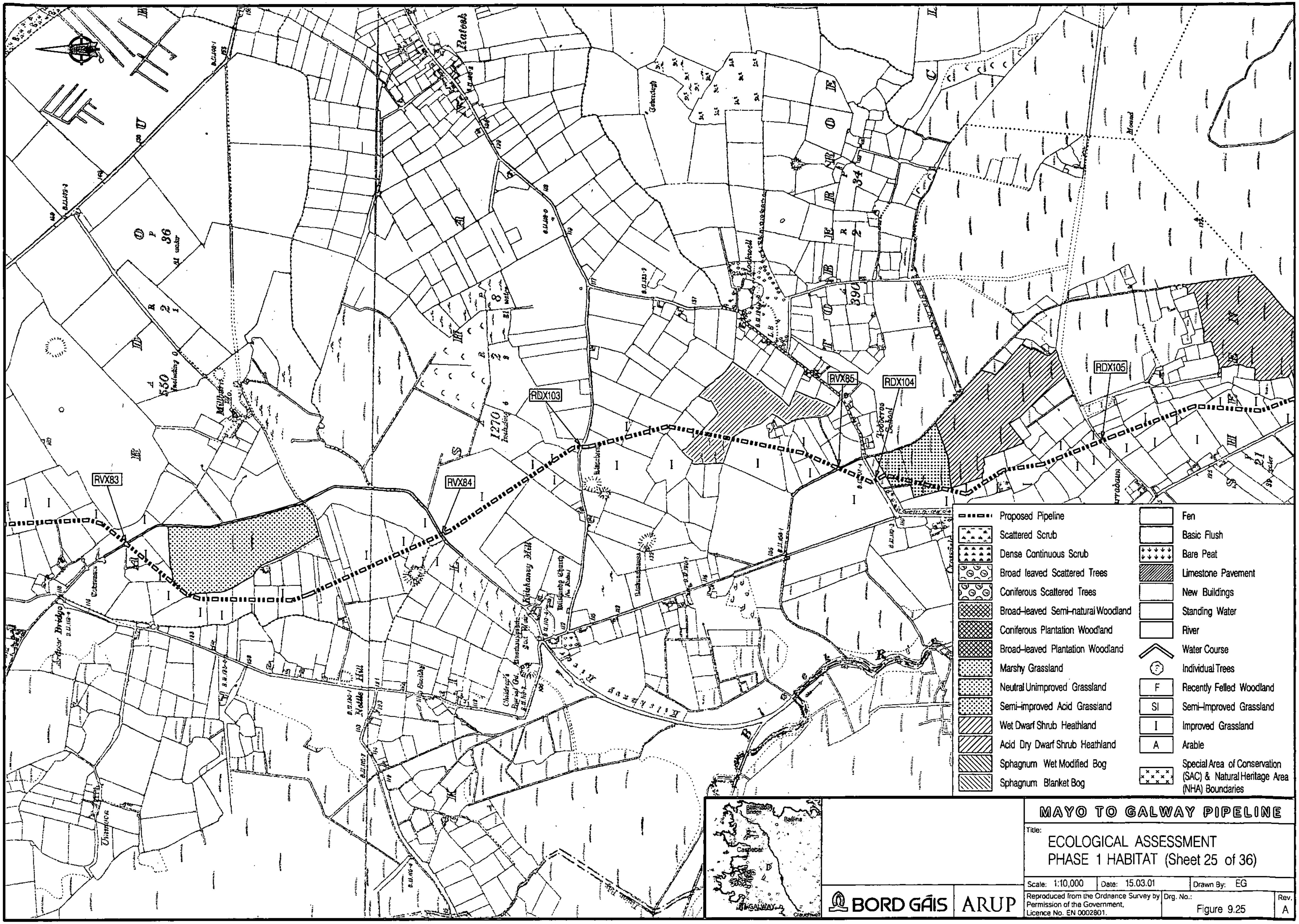
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.

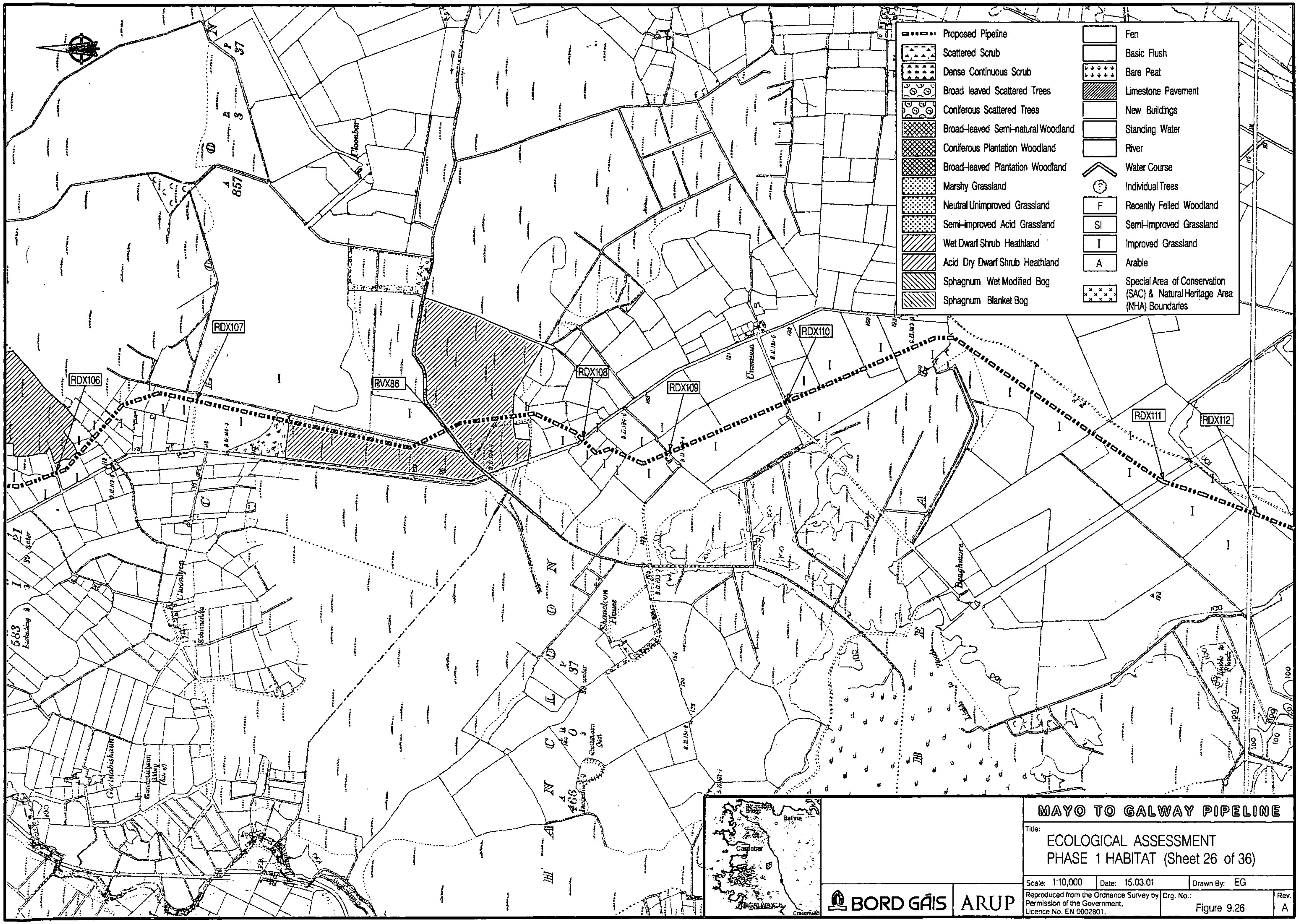
Drg. No.: Figure 9.22

Rev. A


Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
RDX96
RDX97
RDX98
RDX99
RDX100
Annefield Post Office
Annefield House
Children's Burial Ground
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 23 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.23
Rev.
A


RDX102
RVX82
RVX81
RDX101
CARRAS LOUGH
Cloghans School
Cloghans Hill Post Office
R.C.Church
Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 24 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.24
Rev.
A
BORD GÁIS
ARUP


RDX103
RDX104
RDX105
RVX83
RVX84
RVX85
Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
Ballina
Castlebar
GALWAY
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 25 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.
Drg. No.:
Figure 9.25
Rev.
A

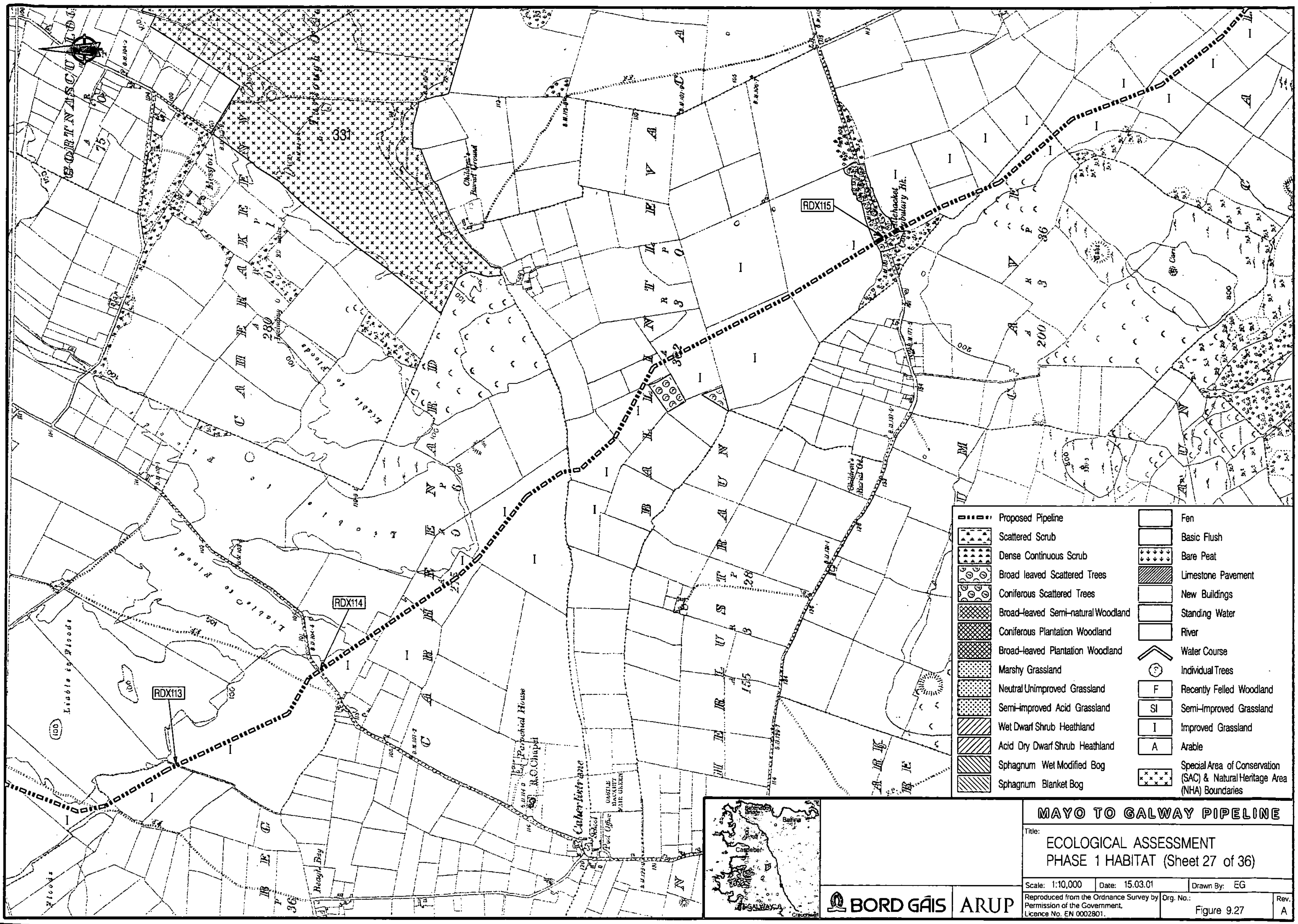


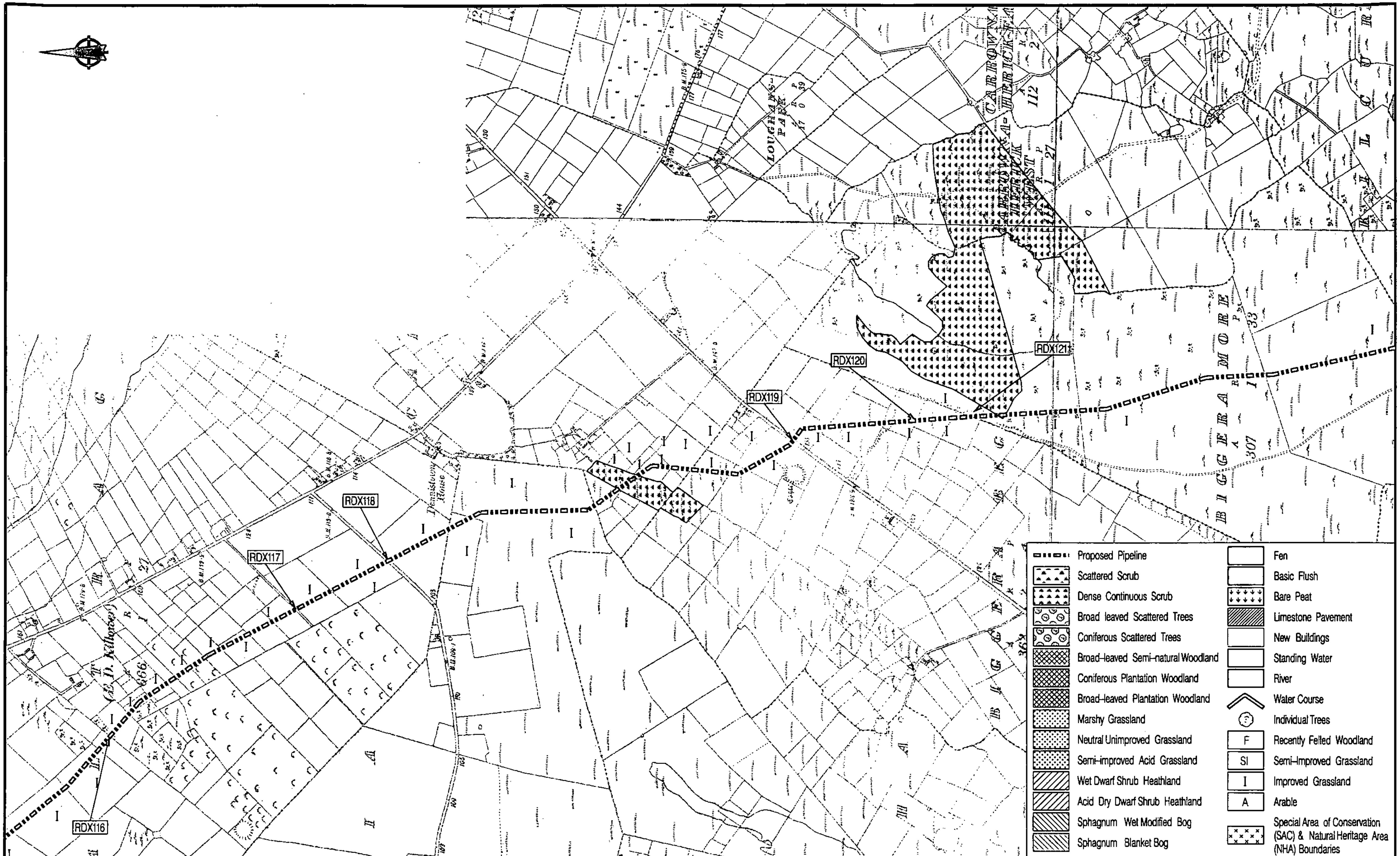
MAYO TO GALWAY PIPELINE

Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 26 of 36)

Scale: 1:10,000	Date: 15.03.01	Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Drg. No.: Figure 9.26	Rev. A

BORD GÁIS | ARUP


RDX115
RDX114
RDX113
Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 27 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.
Drg. No.:
Figure 9.27
Rev.
A

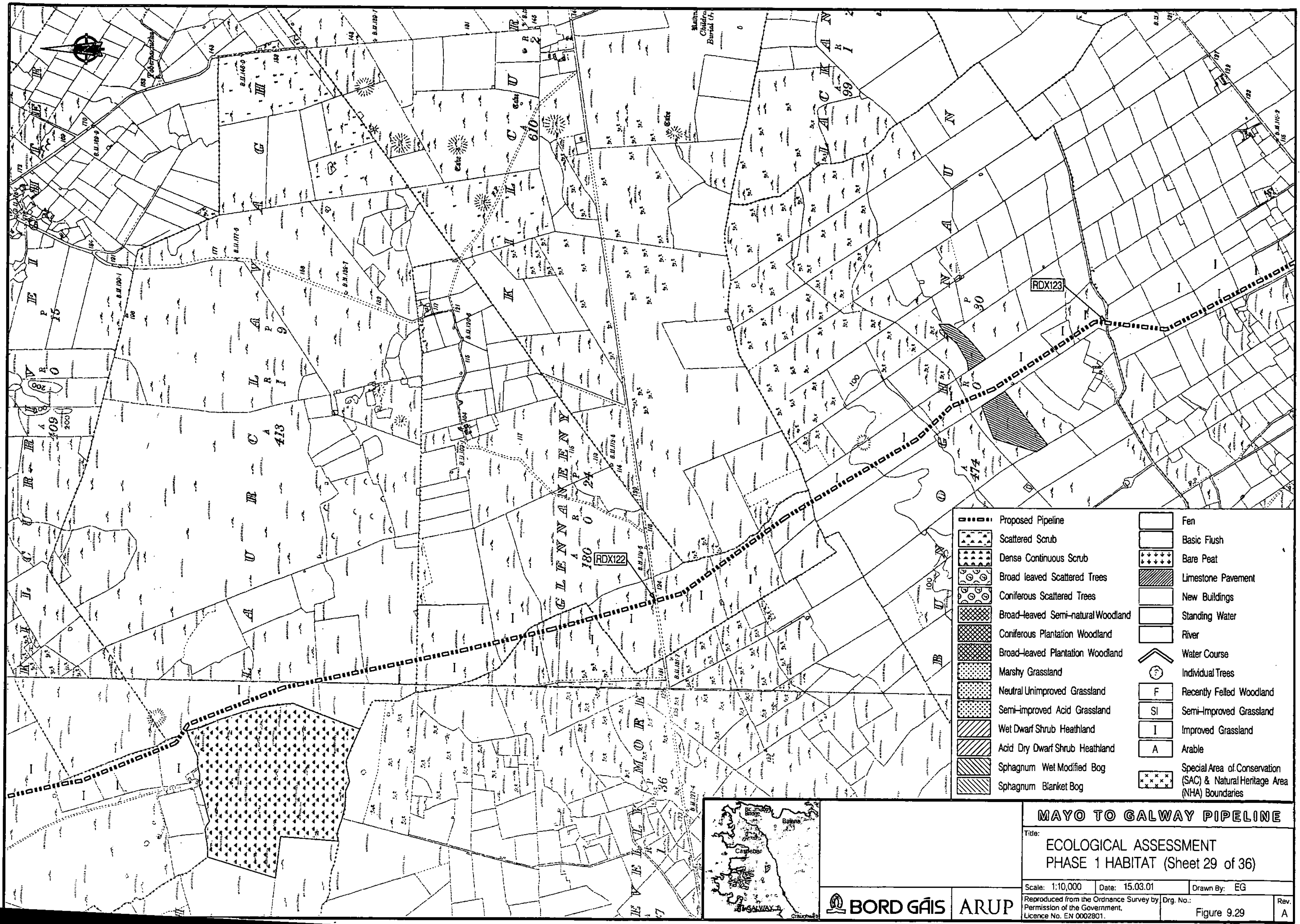


MAYO TO GALWAY PIPELINE

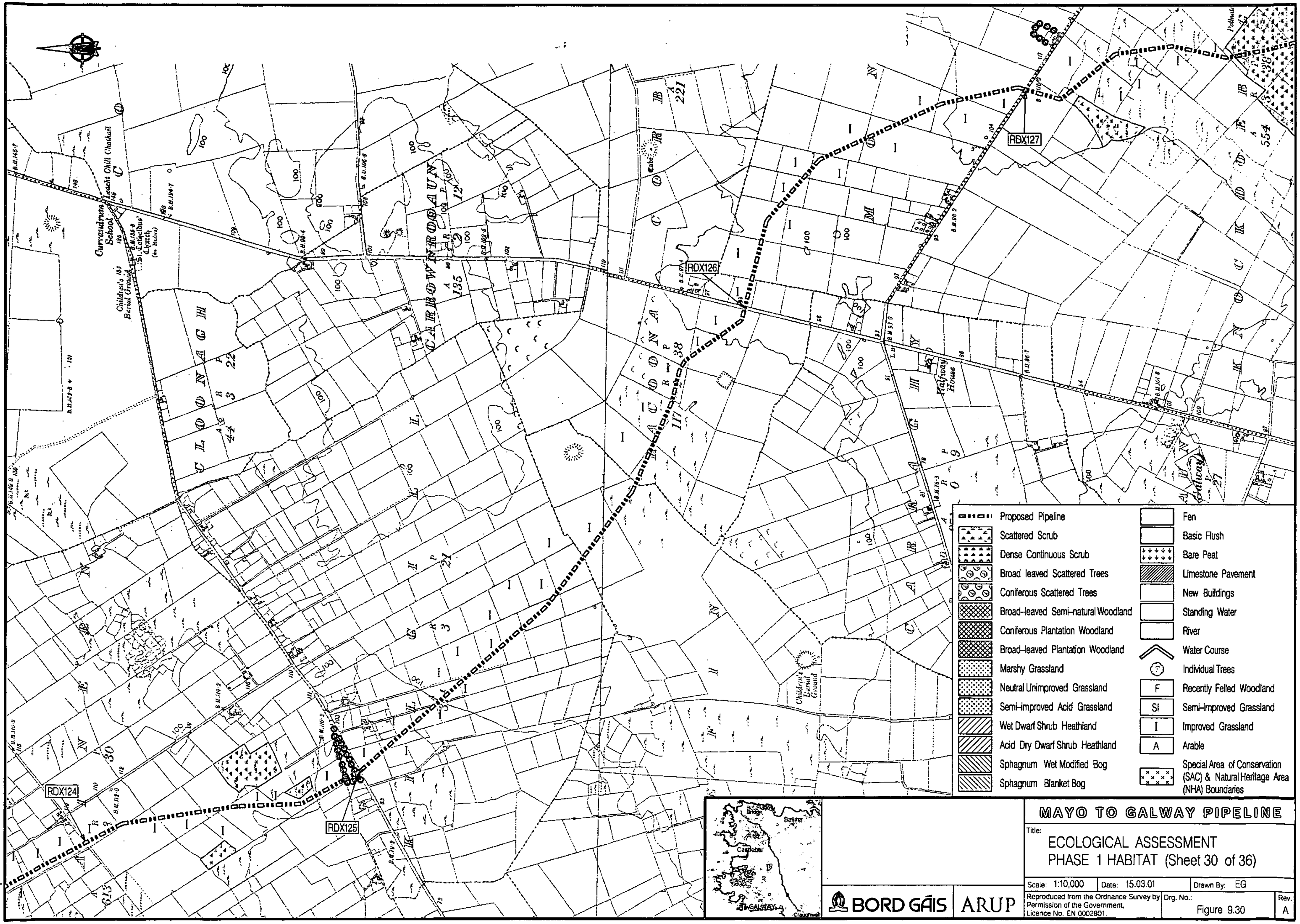
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 28 of 36)

Scale: 1:10,000	Date: 15.03.01	Drawn By: EG	
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.	Drg. No.:	Figure 9.28	Rev. A

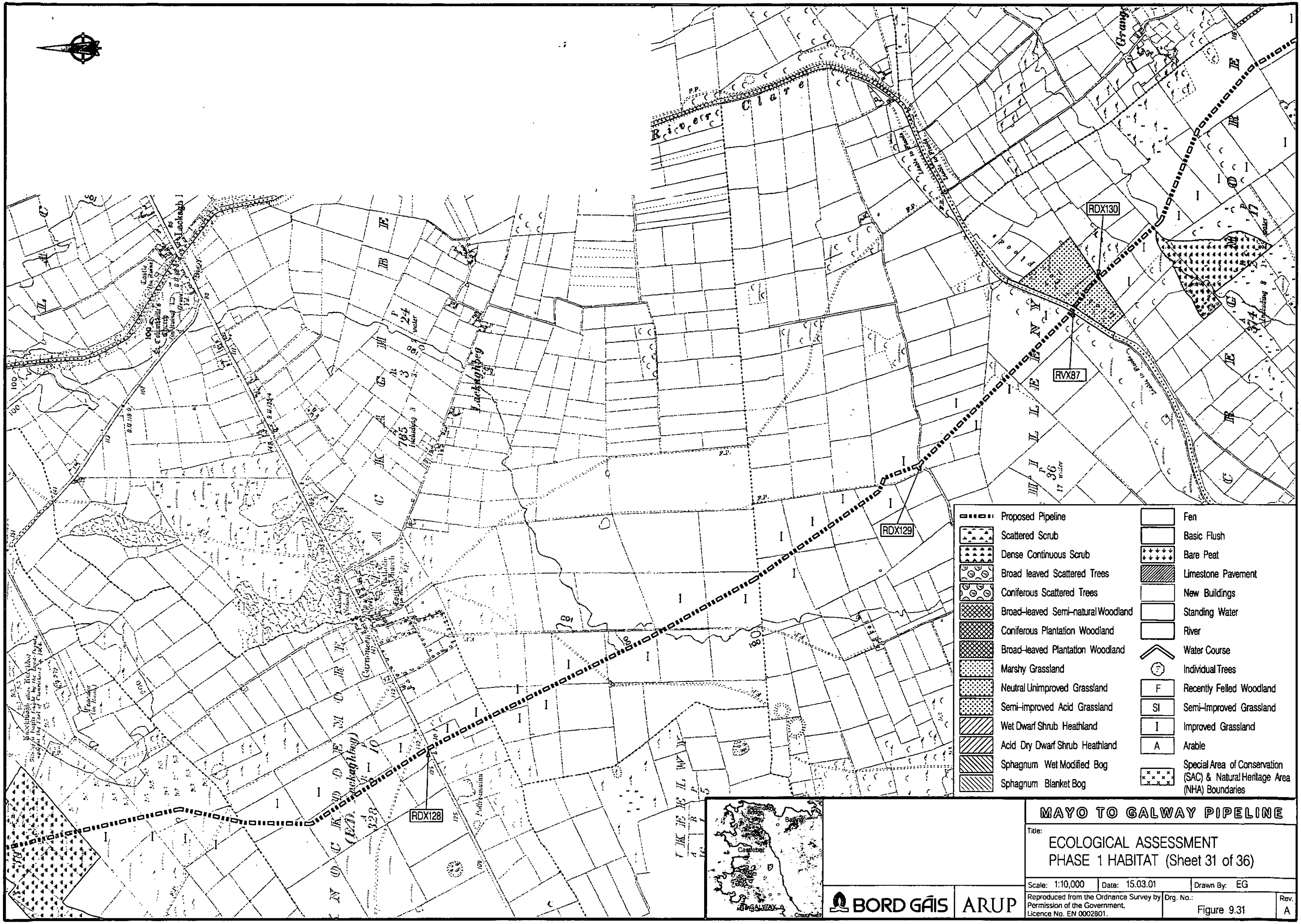
BORD GÁIS ARUP

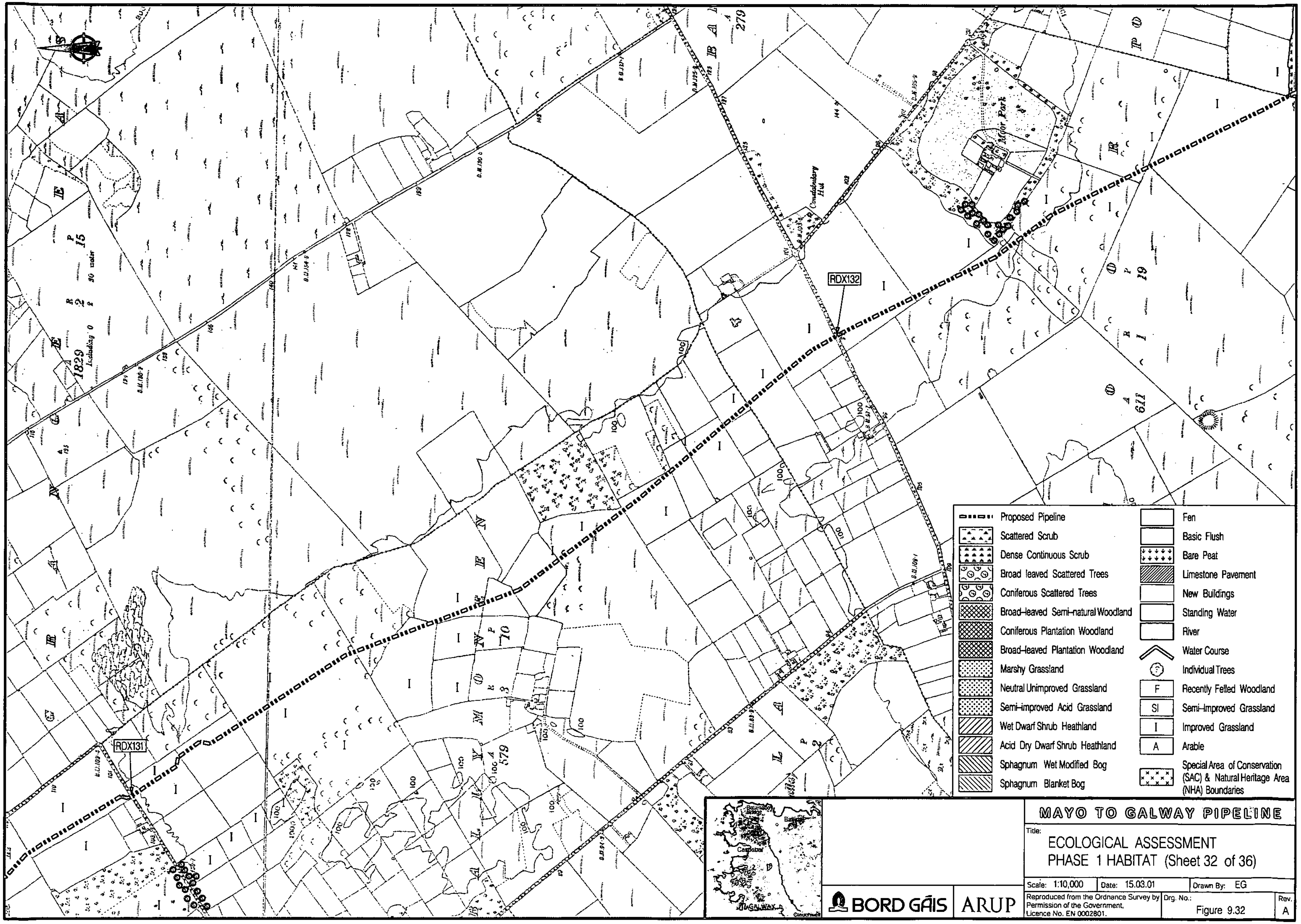


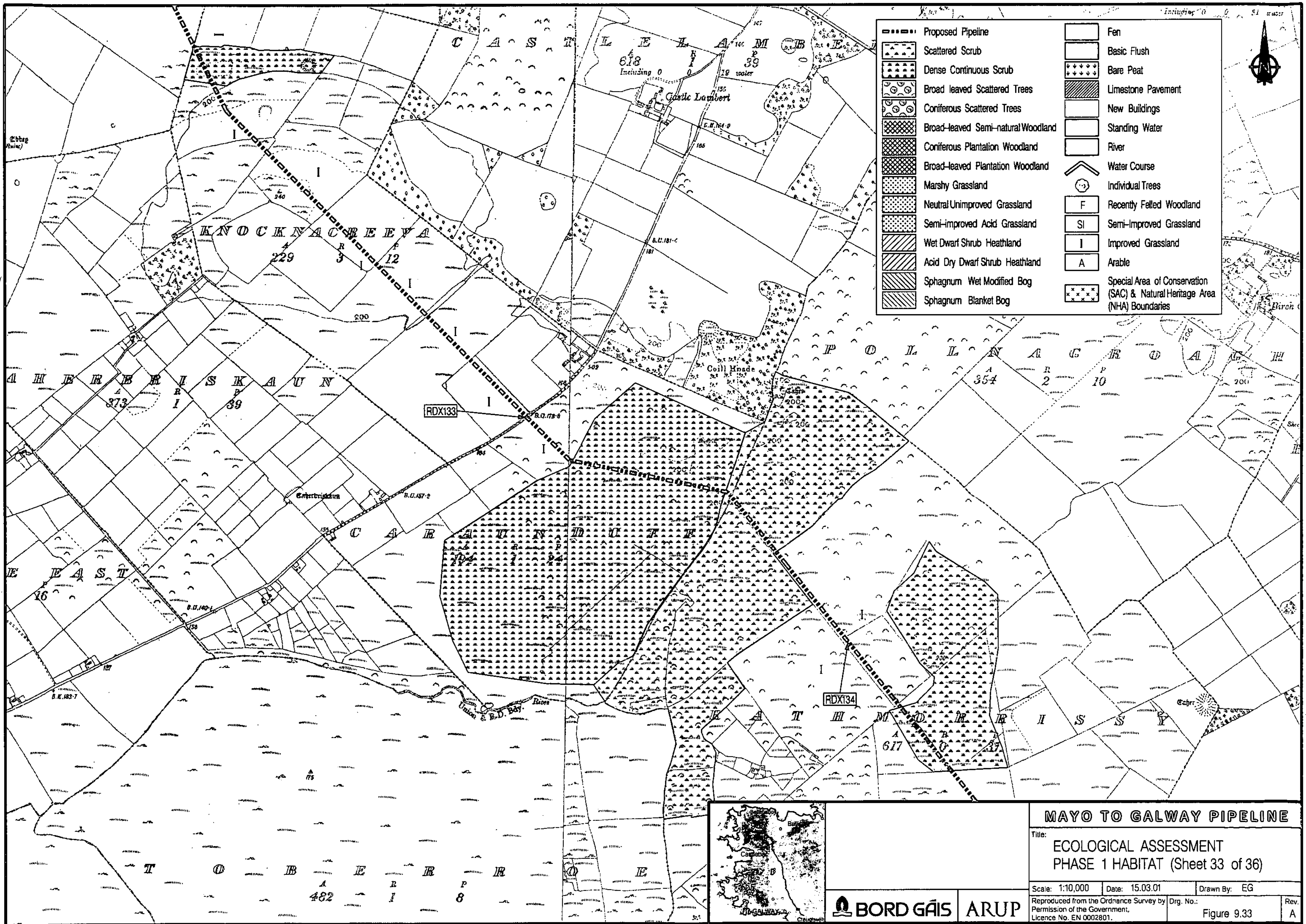
RDX123
RDX122
Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
Ballina
Castlebar
GALWAY
BORD GÁIS
ARUP
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 29 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.29
Rev.
A



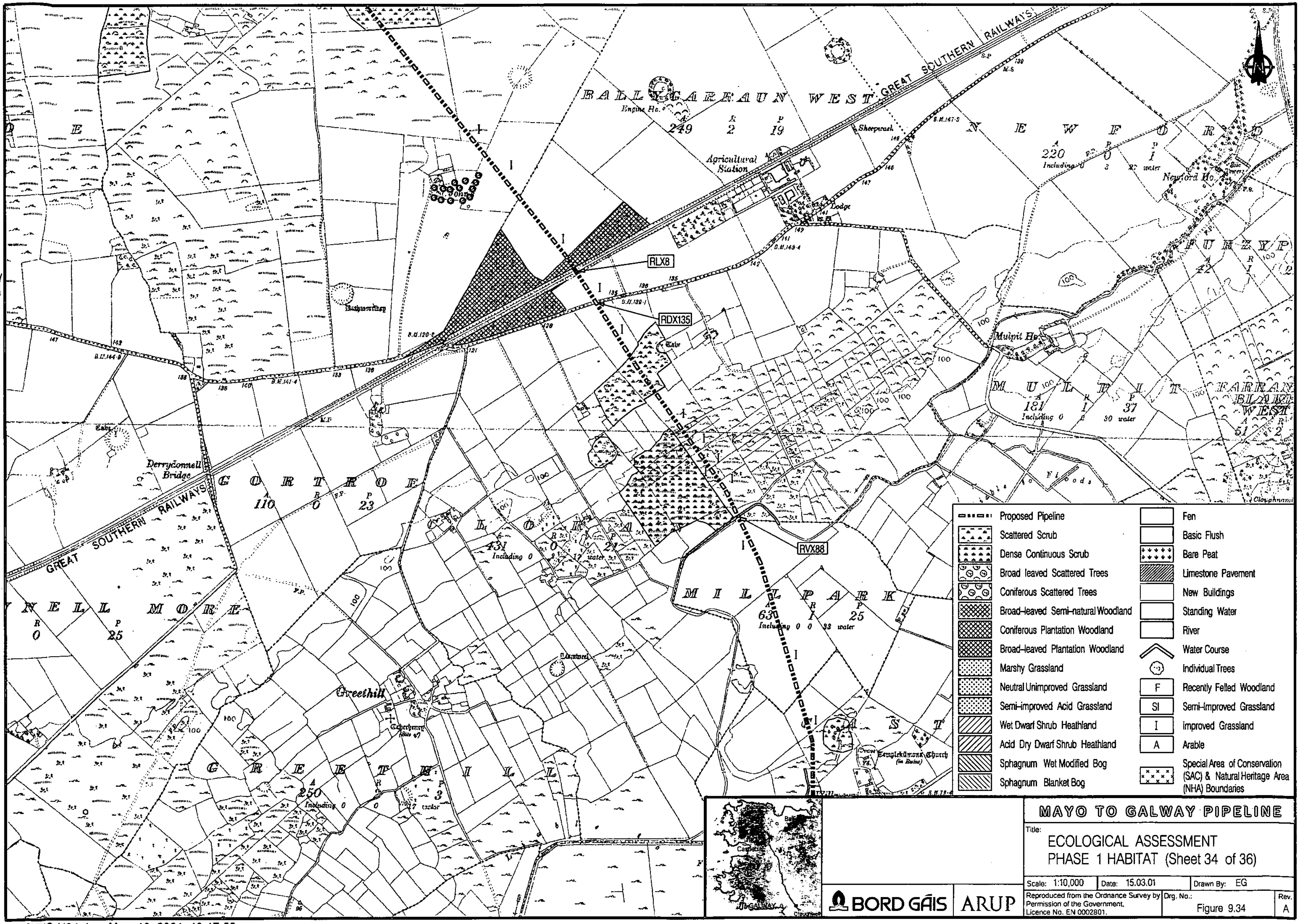
RDX124
RDX125
RDX126
RDX127
Curraundrum School
Leacht Chill Chathail
St. Colgelbus' Church (in Ruins)
Children's Burial Ground
Halfway House
Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
Ballina
Castlebar
Galway
BORD GÁIS
ARUP
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 30 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.: Figure 9.30
Rev. A


RDX128
RDX129
RDX130
RVX87
Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 31 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.31
Rev.
A

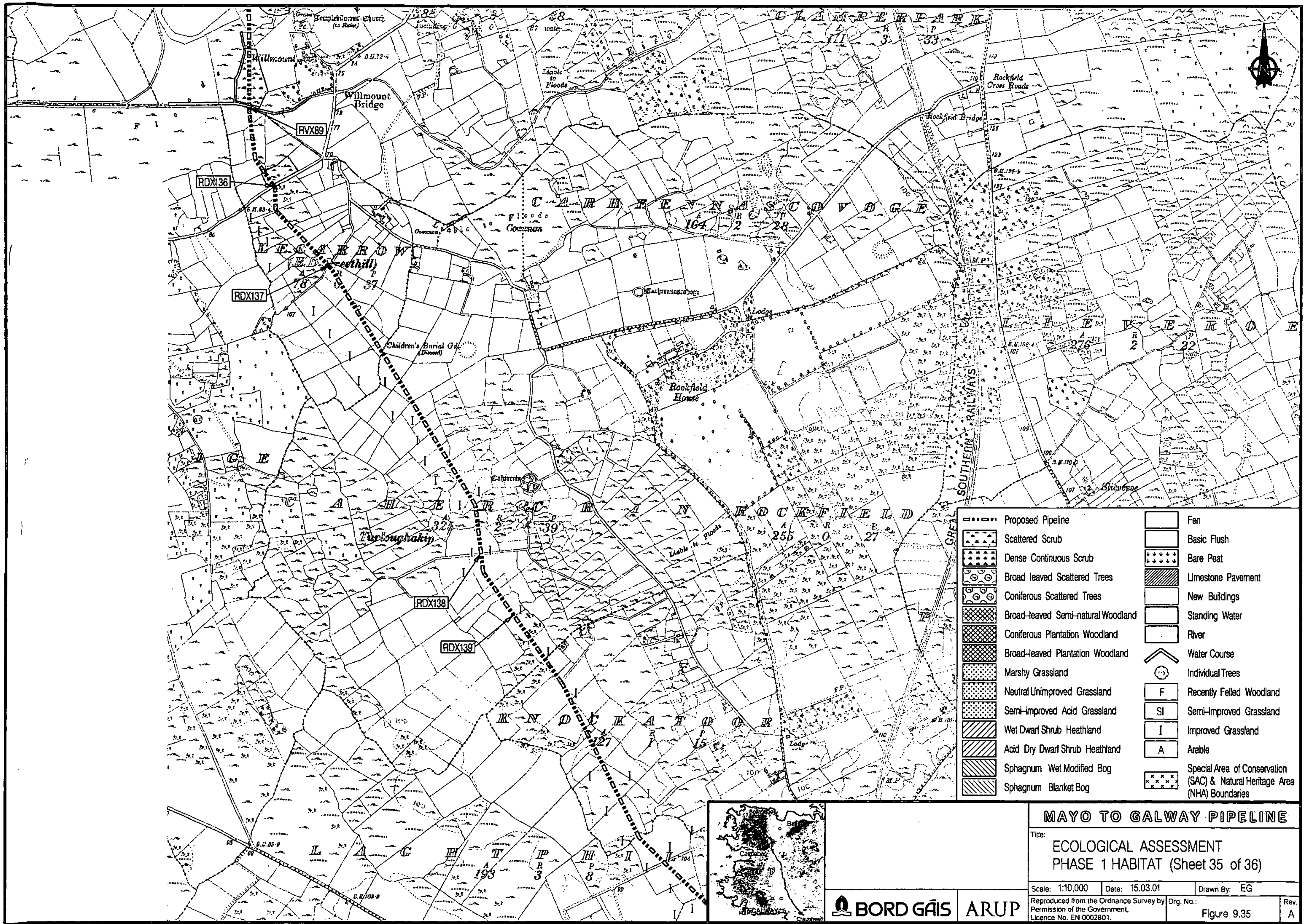

RDX132
RDX131
Moor Park
Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 32 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.32
Rev.
A

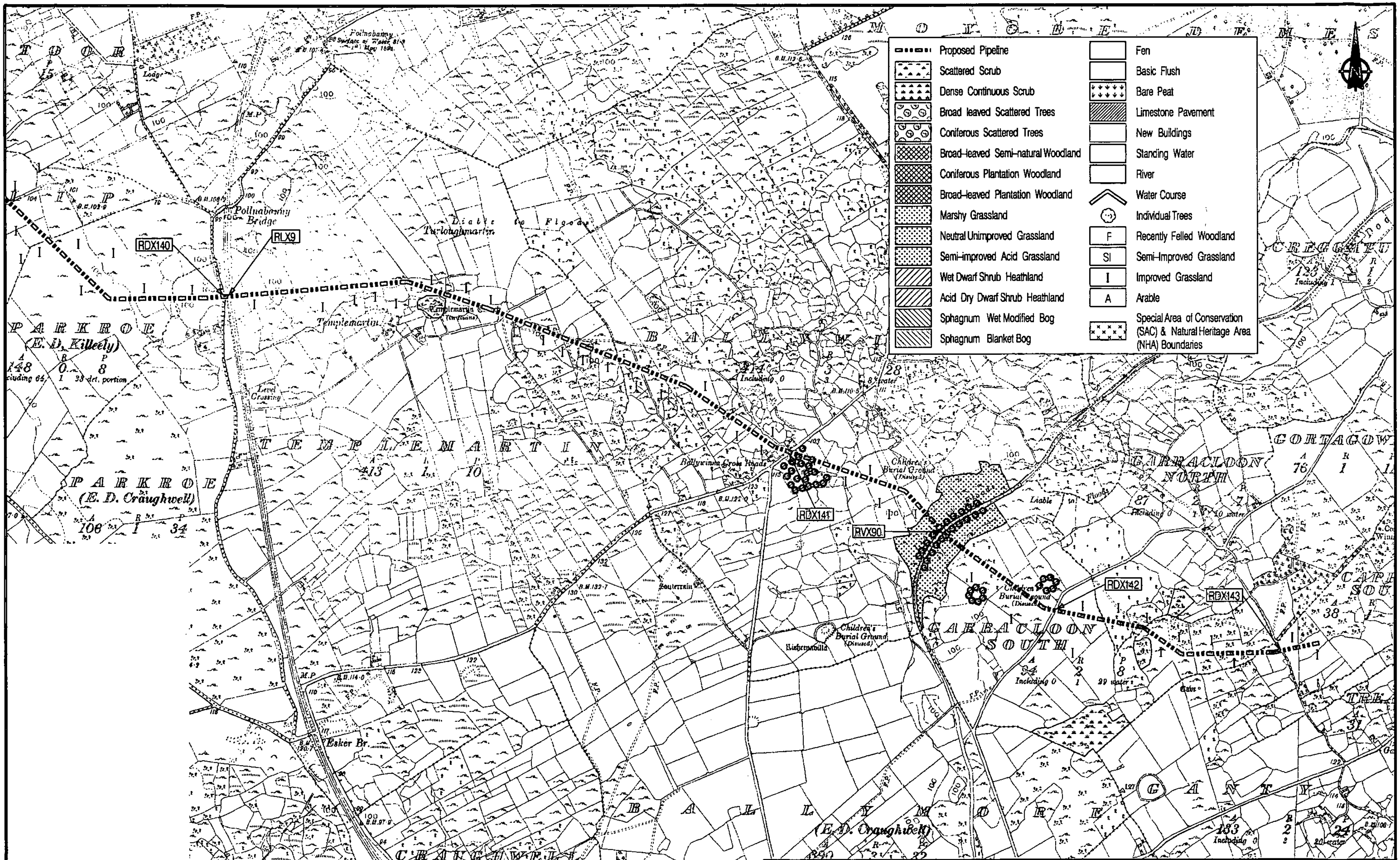


...\10\EIS-H33.dgn May. 10, 2001 19:49:21



...\10\EIS-H34.dgn May. 10, 2001 19:47:55


Proposed Pipeline
Scattered Scrub
Dense Continuous Scrub
Broad leaved Scattered Trees
Coniferous Scattered Trees
Broad-leaved Semi-natural Woodland
Coniferous Plantation Woodland
Broad-leaved Plantation Woodland
Marshy Grassland
Neutral Unimproved Grassland
Semi-improved Acid Grassland
Wet Dwarf Shrub Heathland
Acid Dry Dwarf Shrub Heathland
Sphagnum Wet Modified Bog
Sphagnum Blanket Bog
Fen
Basic Flush
Bare Peat
Limestone Pavement
New Buildings
Standing Water
River
Water Course
Individual Trees
F Recently Felled Woodland
SI Semi-Improved Grassland
I Improved Grassland
A Arable
Special Area of Conservation (SAC) & Natural Heritage Area (NHA) Boundaries
RVX89
RDX136
RDX137
RDX138
RDX139
Willmount Bridge
Rockfield Bridge
Rockfield House
Children's Burial Gd. (Disused)
SOUTHERN RAILWAYS
MAYO TO GALWAY PIPELINE
Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 35 of 36)
Scale: 1:10,000
Date: 15.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 9.35
Rev.
A
BORD GÁIS
ARUP



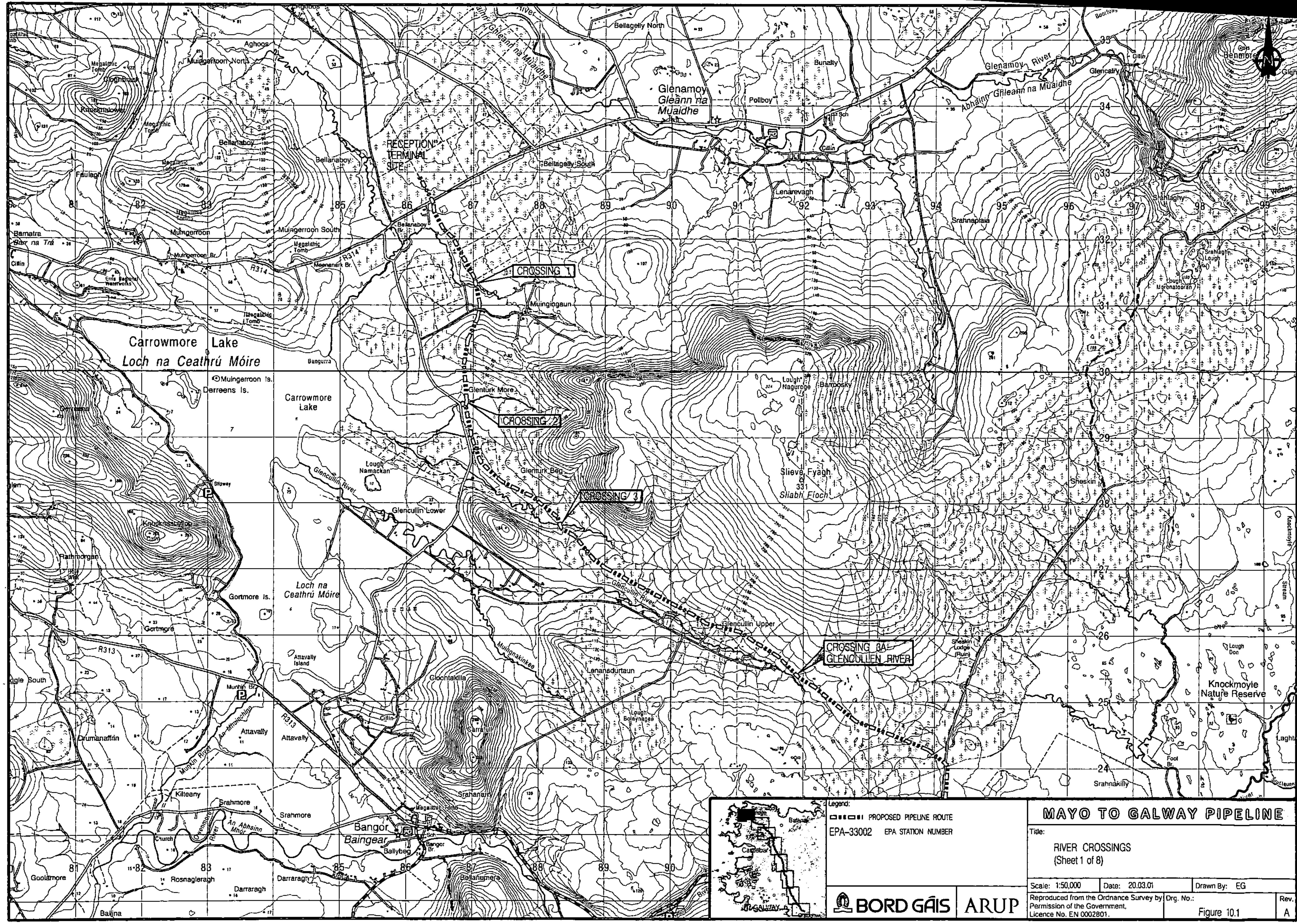
MAYO TO GALWAY PIPELINE

Title:
ECOLOGICAL ASSESSMENT
PHASE 1 HABITAT (Sheet 36 of 36)

Scale: 1:10,000	Date: 15.03.01	Drawn By: EG	
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.	Drg. No.:	Figure 9.36	Rev. A

BORD GÁIS ARUP

...\10\EIS-H36.dgn May. 10, 2001 19:44:44



Legend:
PROPOSED PIPELINE ROUTE
EPA-33002 EPA STATION NUMBER

BORD GÁIS | ARUP

MAYO TO GALWAY PIPELINE

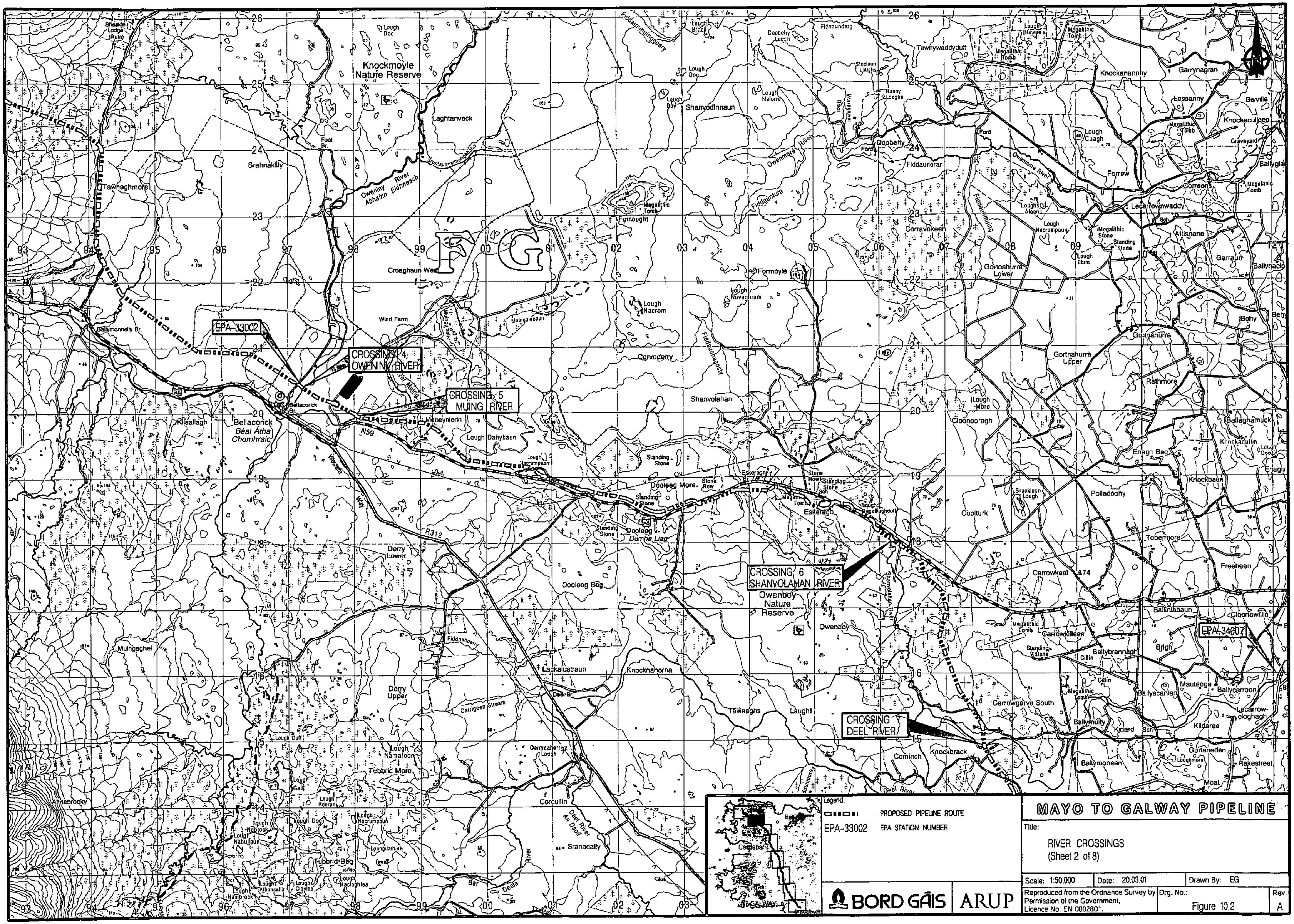
Title:
RIVER CROSSINGS
(Sheet 1 of 8)

Scale: 1:50,000 | Date: 20.03.01 | Drawn By: EG

Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.

Drg. No.: Figure 10.1

Rev. A



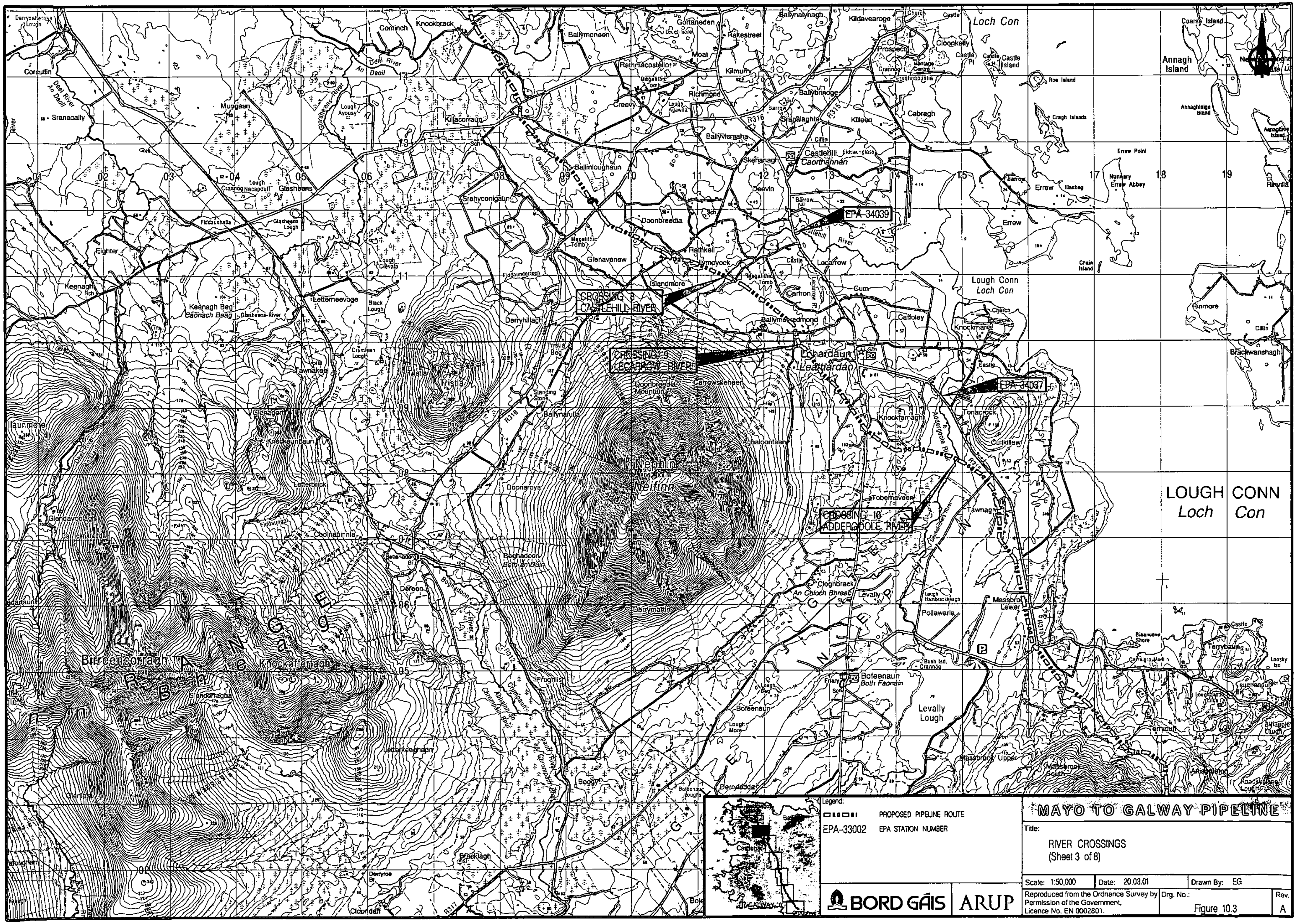
MAYO TO GALWAY PIPELINE

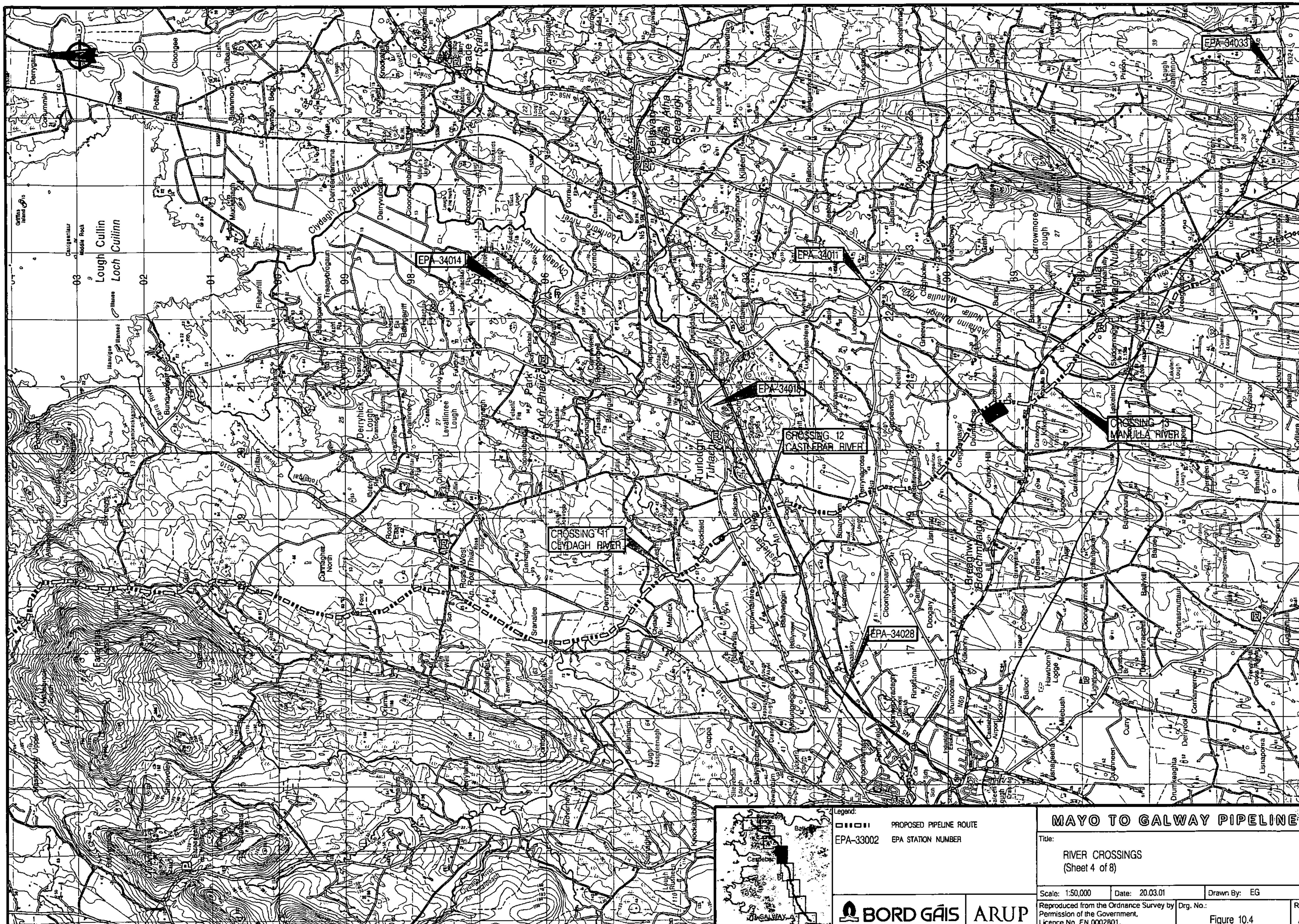
Title:

RIVER CROSSINGS
(Sheet 2 of 8)

Scale: 1:50,000	Date: 20.03.01	Drawn By: EG	
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Drg. No.:	Figure 10.2	Rev. A

BORD GÁIS | ARUP


CROSSING 8
CASTLEHILL RIVER
CROSSING 9
LECARROW RIVER
CROSSING 10
ADDERGOOLE RIVER
EPA-34039
EPA-34037
Lough Conn
Loch Con
LOUGH CONN
Loch Con
Nephin
Neifinn
Lahardaun
Leathardán
Castlehill
Caorthannán
Bofeenaun
Both Faonáin
Levally Lough
Birreencorragh
Knockaffertagh
Legend:
PROPOSED PIPELINE ROUTE
EPA-33002 EPA STATION NUMBER
MAYO TO GALWAY PIPELINE
Title:
RIVER CROSSINGS
(Sheet 3 of 8)
Scale: 1:50,000
Date: 20.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 10.3
Rev.
A

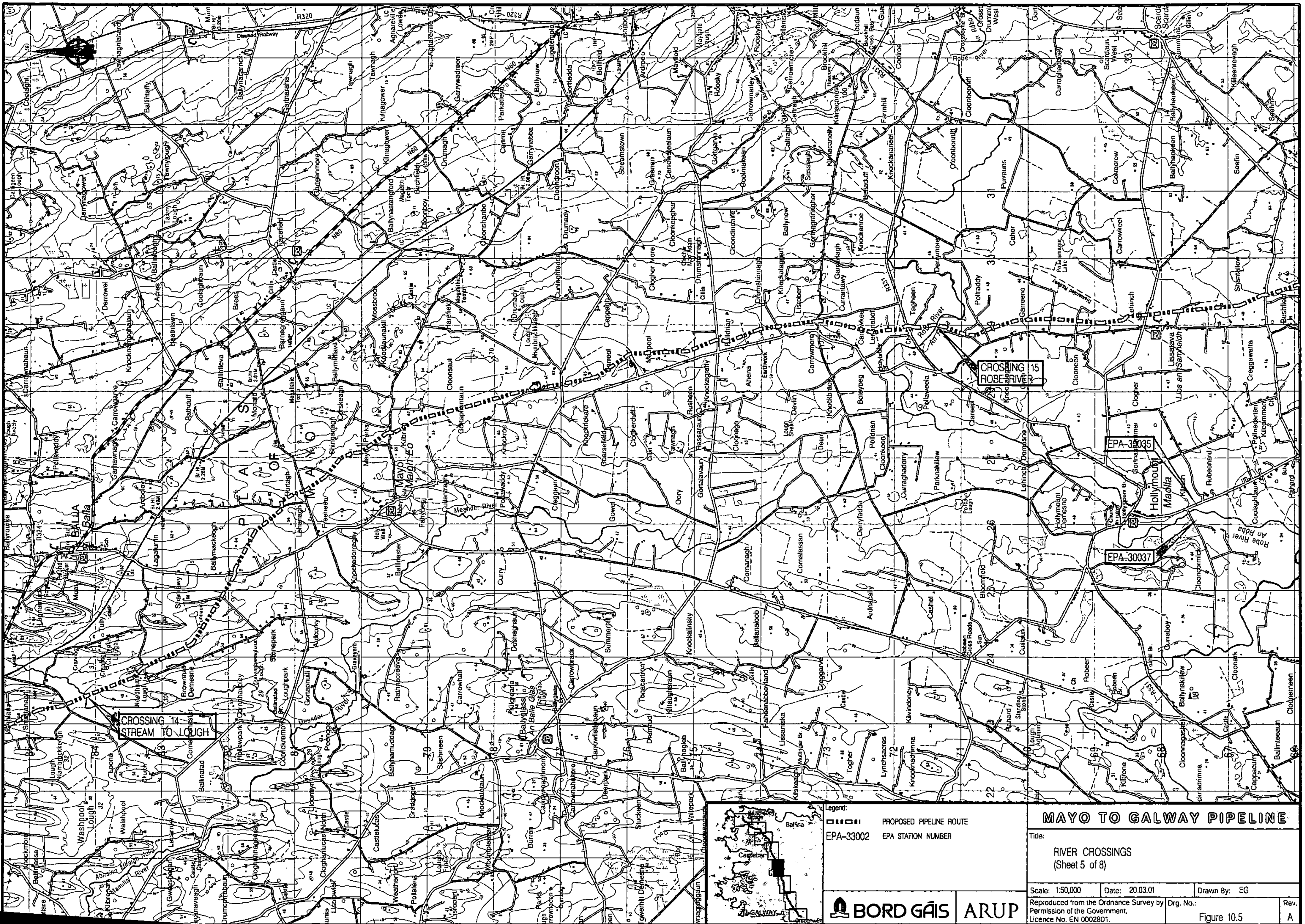


MAYO TO GALWAY PIPELINE

Title:

RIVER CROSSINGS
(Sheet 4 of 8)

Scale: 1:50,000	Date: 20.03.01	Drawn By: EG	
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Drg. No.:	Figure 10.4	Rev. A



Legend:

PROPOSED PIPELINE ROUTE

EPA-33002 EPA STATION NUMBER

MAYO TO GALWAY PIPELINE

Title:

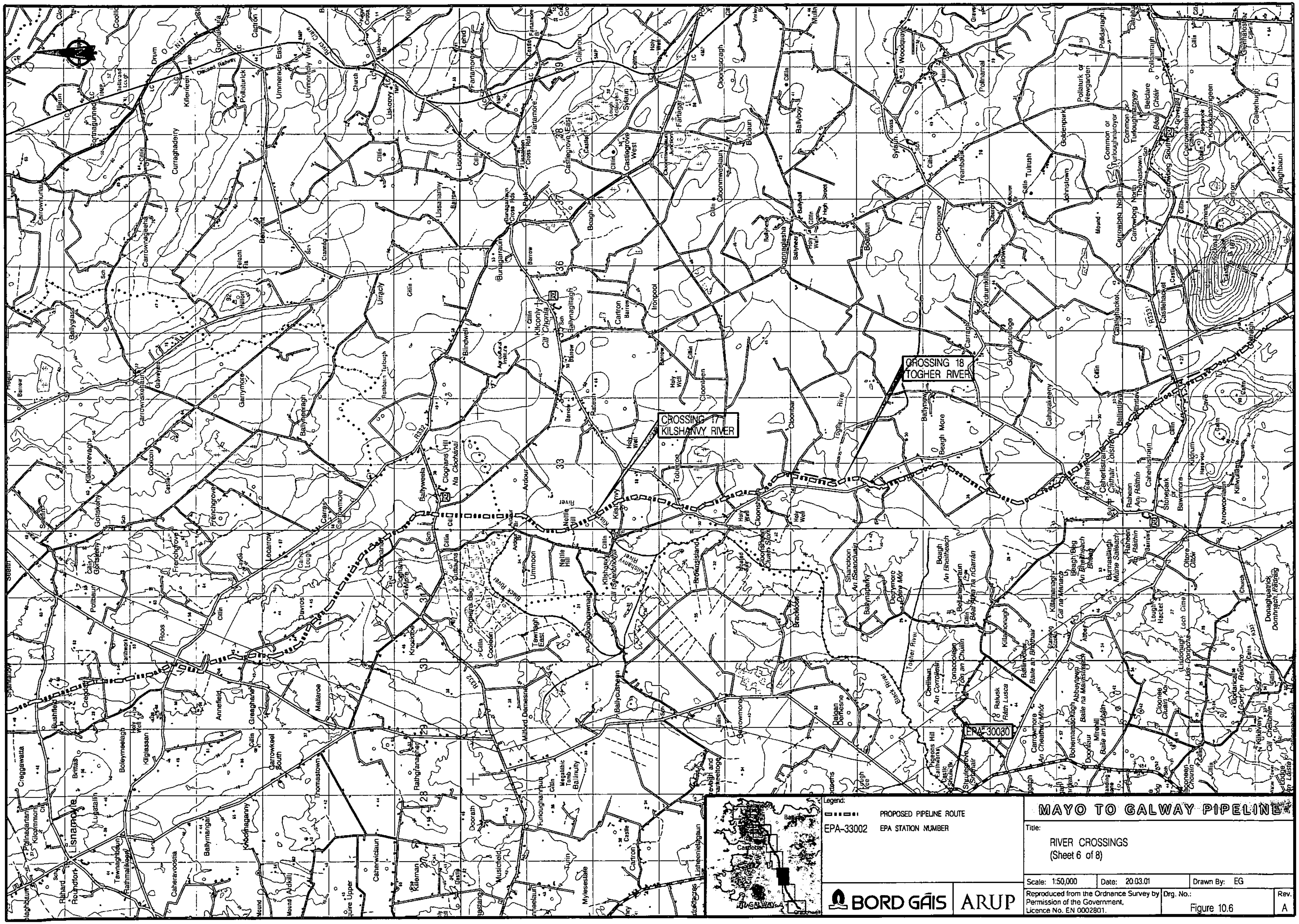
RIVER CROSSINGS
(Sheet 5 of 8)

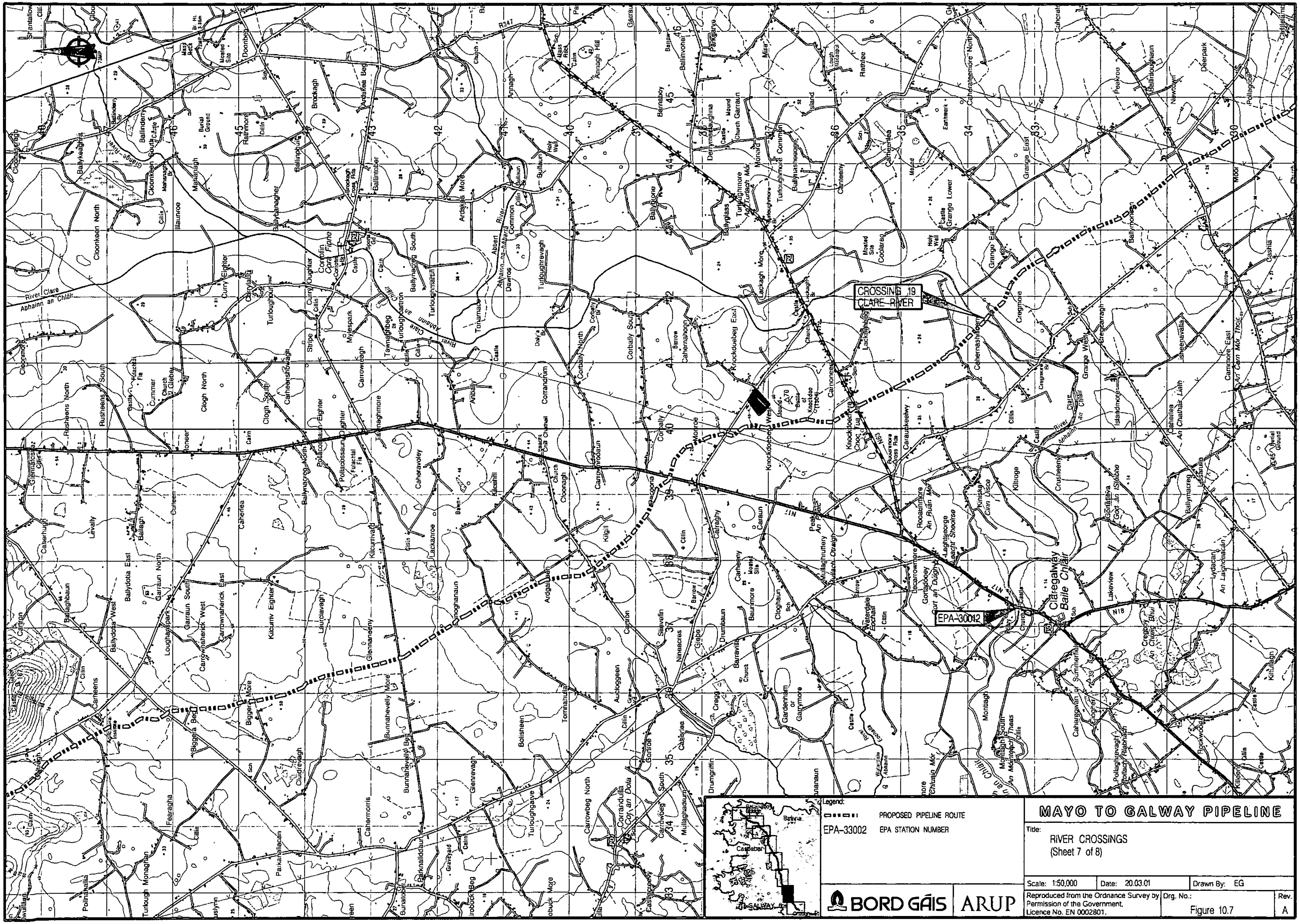
Scale: 1:50,000	Date: 20.03.01	Drawn By: EG

BORD GÁIS | ARUP

Drg. No.: Figure 10.5

Rev. A


CROSSING 18
TOGHER RIVER
CROSSING 17
KILSHANVY RIVER
EPA-30030
Legend:
PROPOSED PIPELINE ROUTE
EPA-33002 EPA STATION NUMBER
MAYO TO GALWAY PIPELINE
Title:
RIVER CROSSINGS
(Sheet 6 of 8)
Scale: 1:50,000
Date: 20.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.: Figure 10.6
Rev. A
BORD GÁIS
ARUP



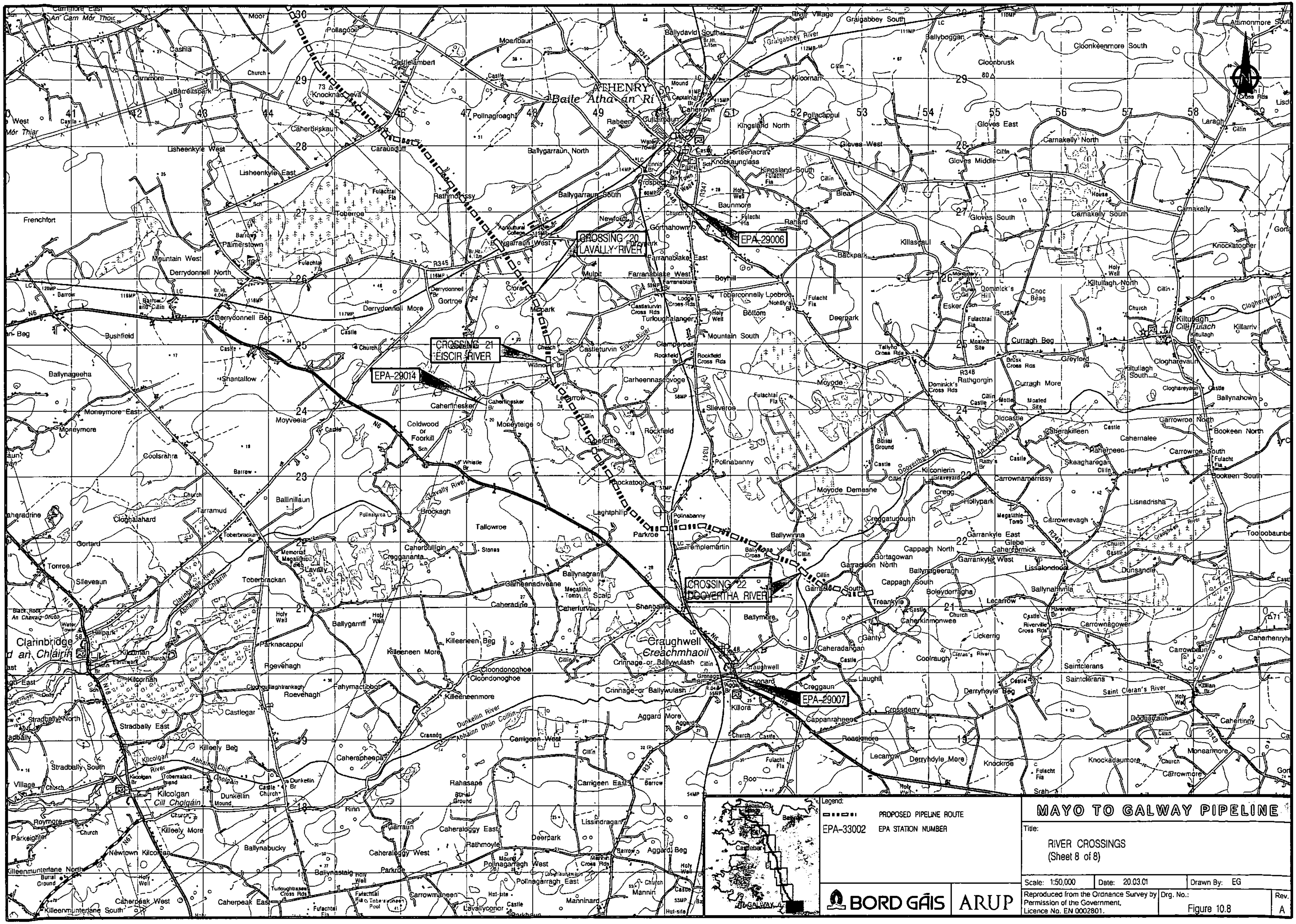
MAYO TO GALWAY PIPELINE

Title:
RIVER CROSSINGS
(Sheet 7 of 8)

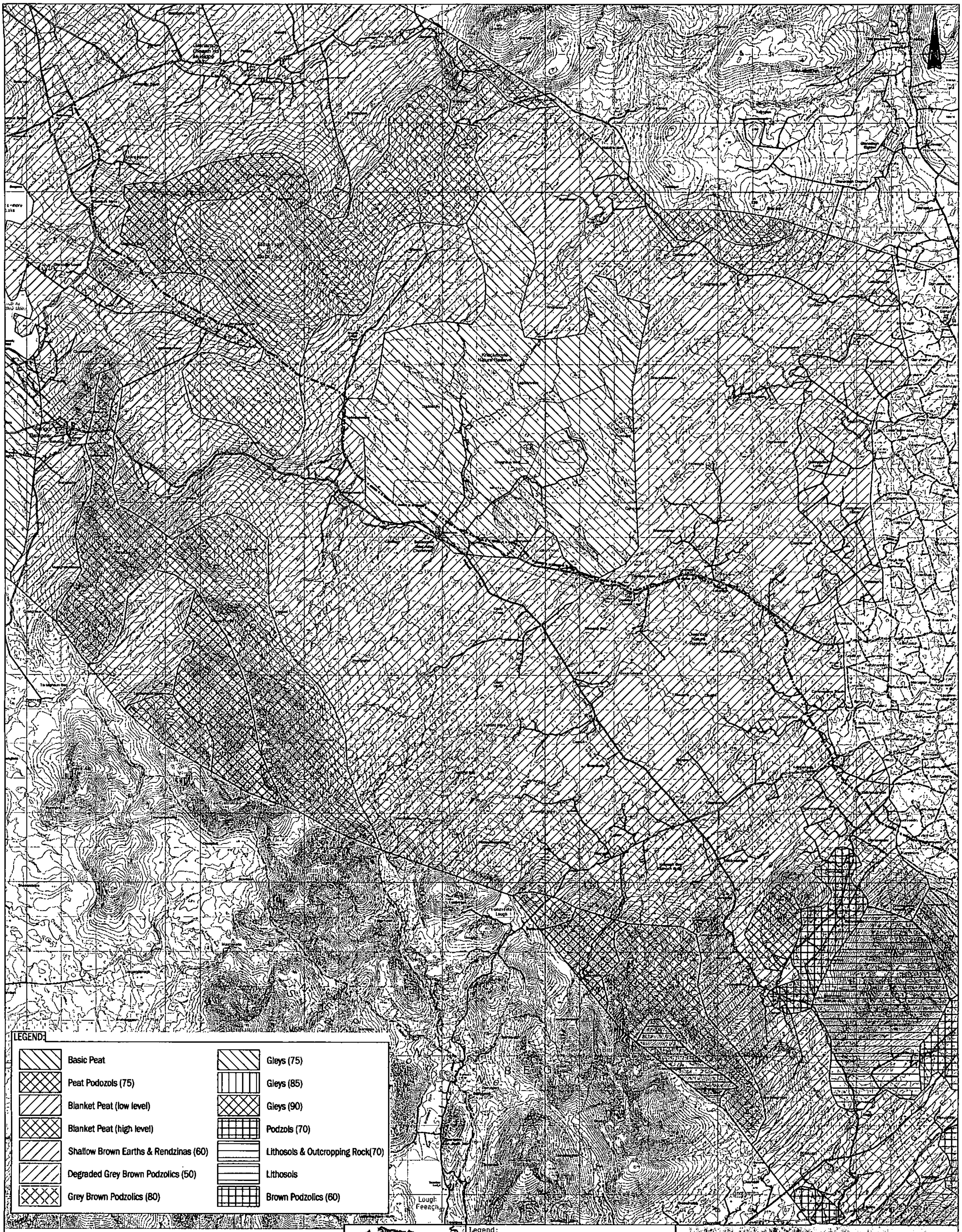
Scale: 1:50,000	Date: 20.03.01	Drawn By: EG

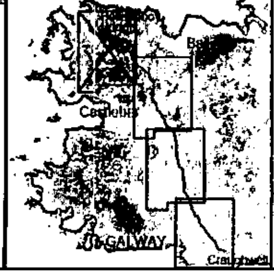
BORD GÁIS | ARUP

Drg. No.: Figure 10.7 | Rev. A



CROSSING 20
LAVALLY RIVER
CROSSING 21
EISCIR RIVER
CROSSING 22
DOOYERTHA RIVER
EPA-29006
EPA-29014
EPA-29007
ATHENRY
Baile Átha an Rí
Craughwell
Creachmhaoil
Clarinbridge
Kilcolgan
Cill Cholgáin
Legend:
PROPOSED PIPELINE ROUTE
EPA-33002
EPA STATION NUMBER
MAYO TO GALWAY PIPELINE
Title:
RIVER CROSSINGS
(Sheet 8 of 8)
Scale: 1:50,000
Date: 20.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.
Drg. No.:
Figure 10.8
Rev.
A
BORD GÁIS
ARUP





Legend:

PROPOSED PIPELINE ROUTE

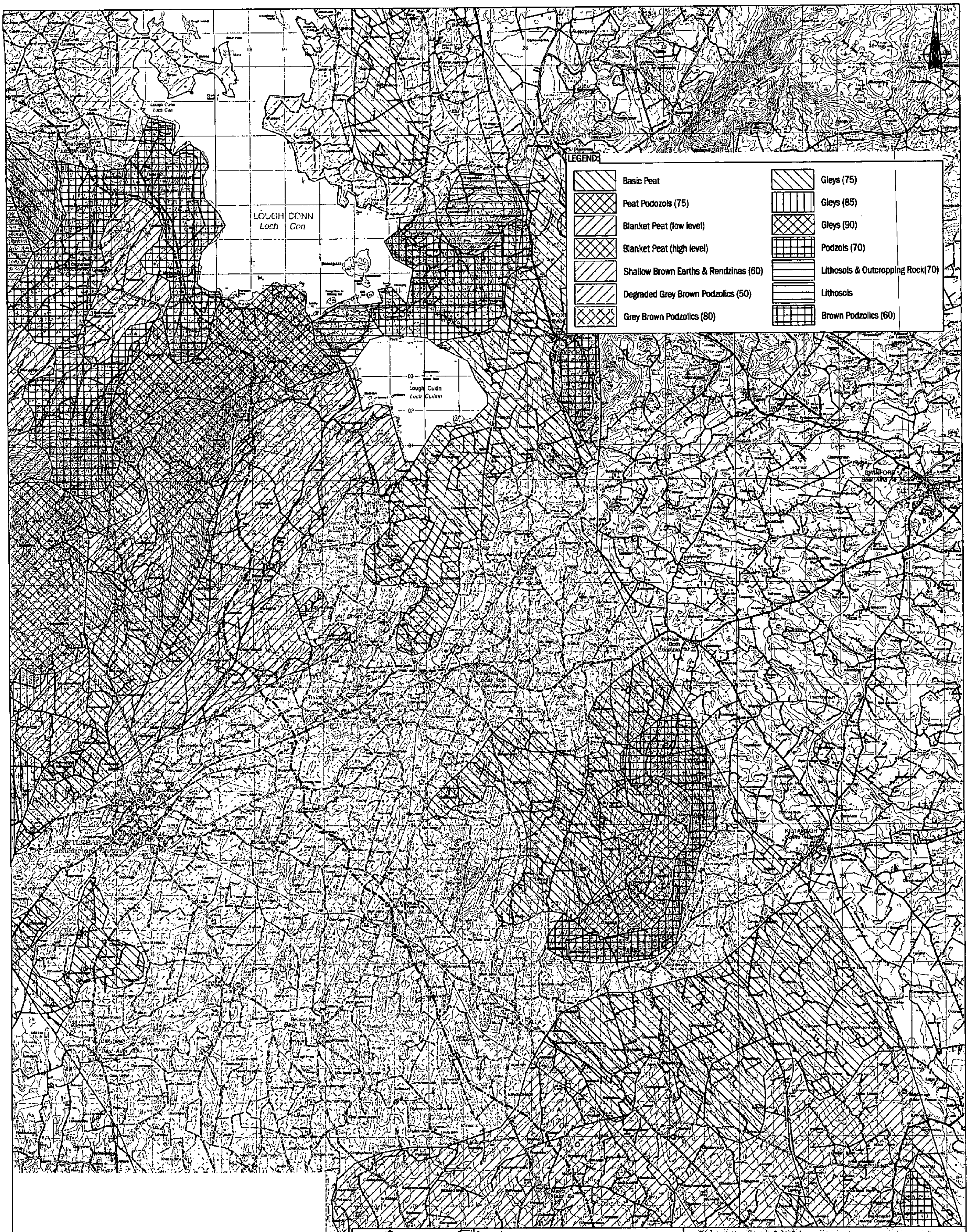
BORD GÁIS | ARUP

MAYO TO GALWAY PIPELINE

Title:

SOILS MAP
(Sheet 1 of 4)

Scale: 1:100,000	Date: 25.03.01	Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.	Drg. No.: Figure 11.5	Rev. A



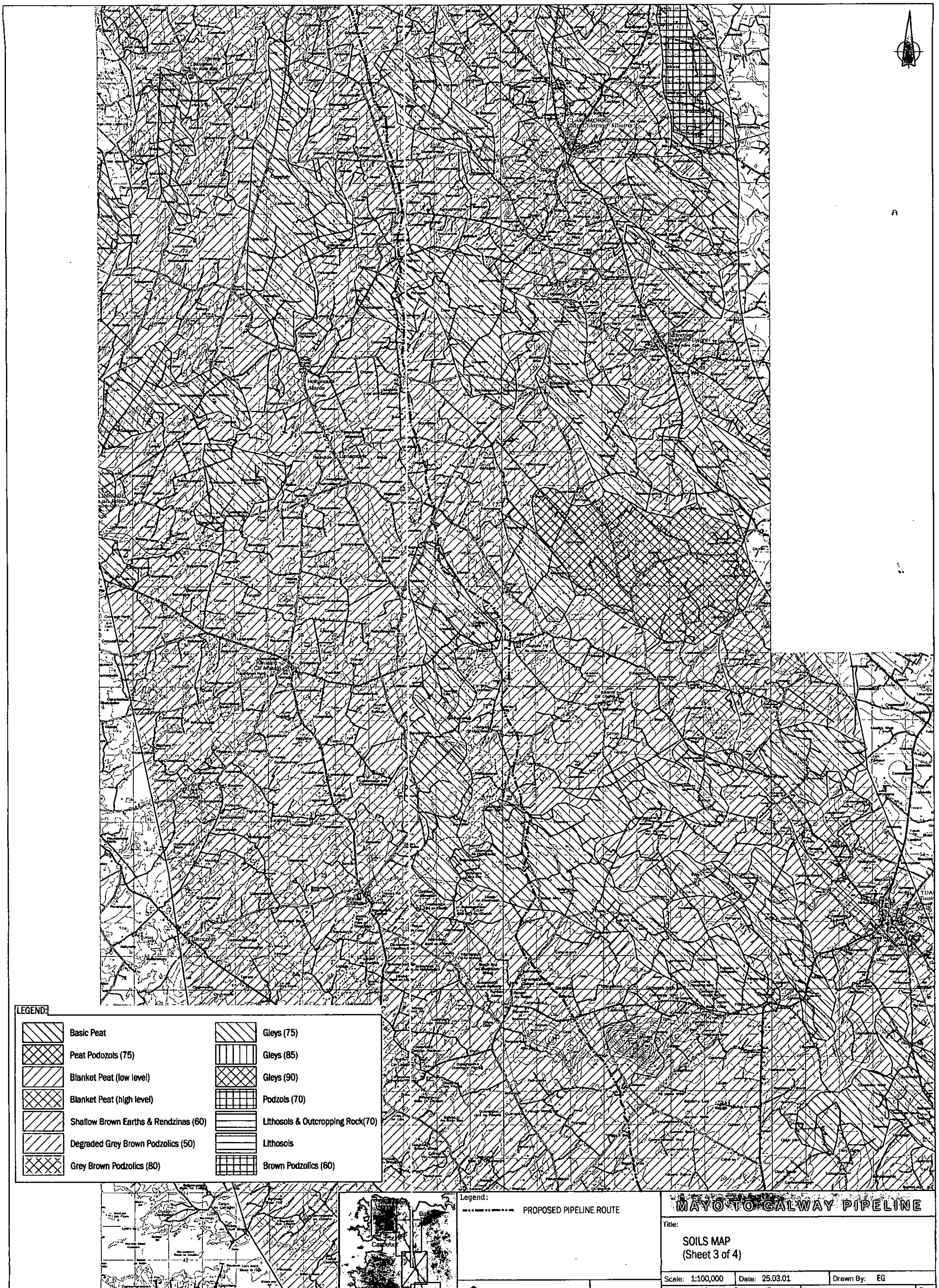
Legend:
PROPOSED PIPELINE ROUTE

MAYO TO GALWAY PIPELINE

Title:
SOILS MAP
(Sheet 2 of 4)

Scale: 1:100,000	Date: 25.03.01	Drawn By: EG	
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Drg. No.:	Figure 11.6	Rev. A

BORD GÁIS ARUP



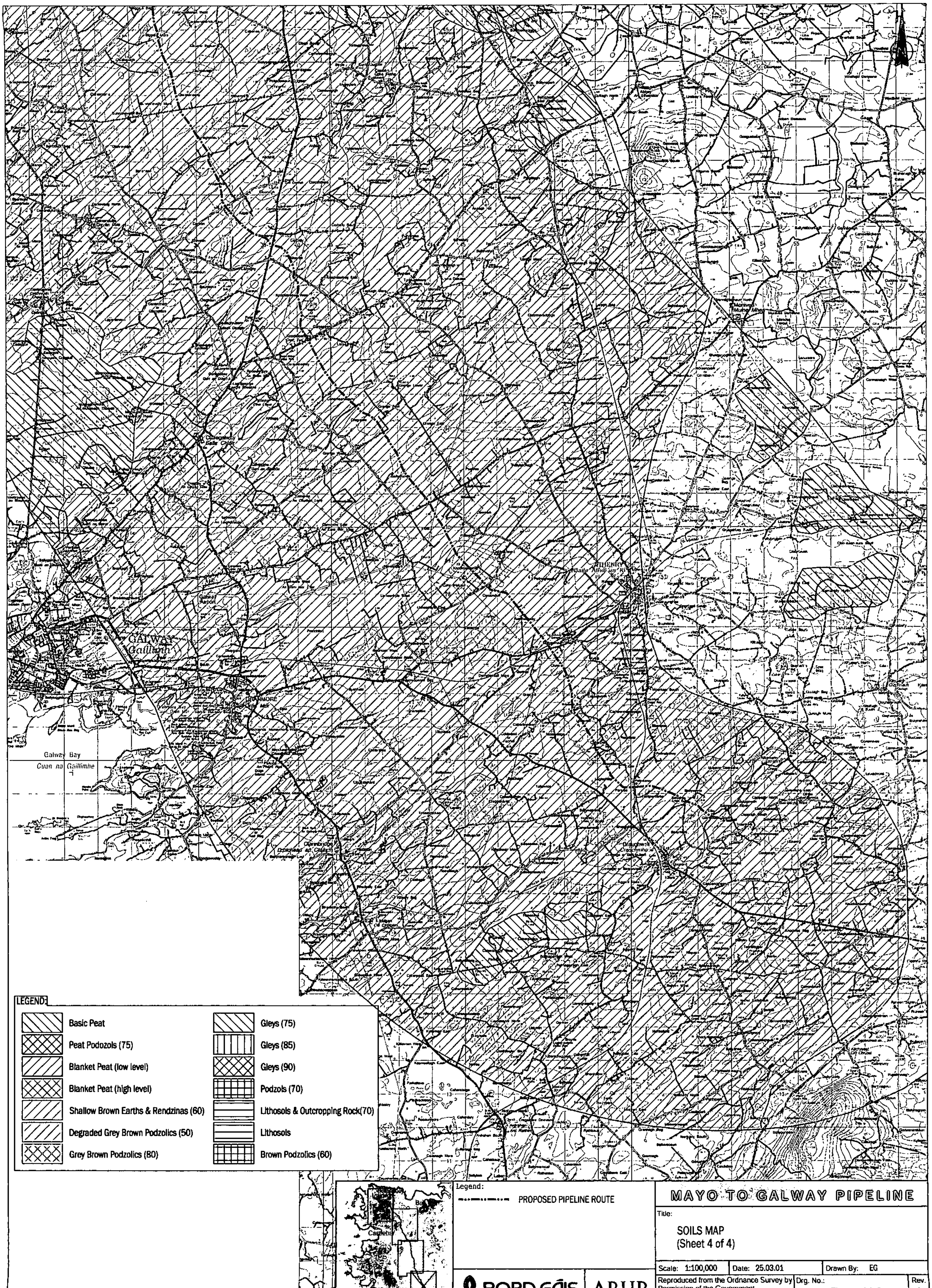
Legend:
PROPOSED PIPELINE ROUTE

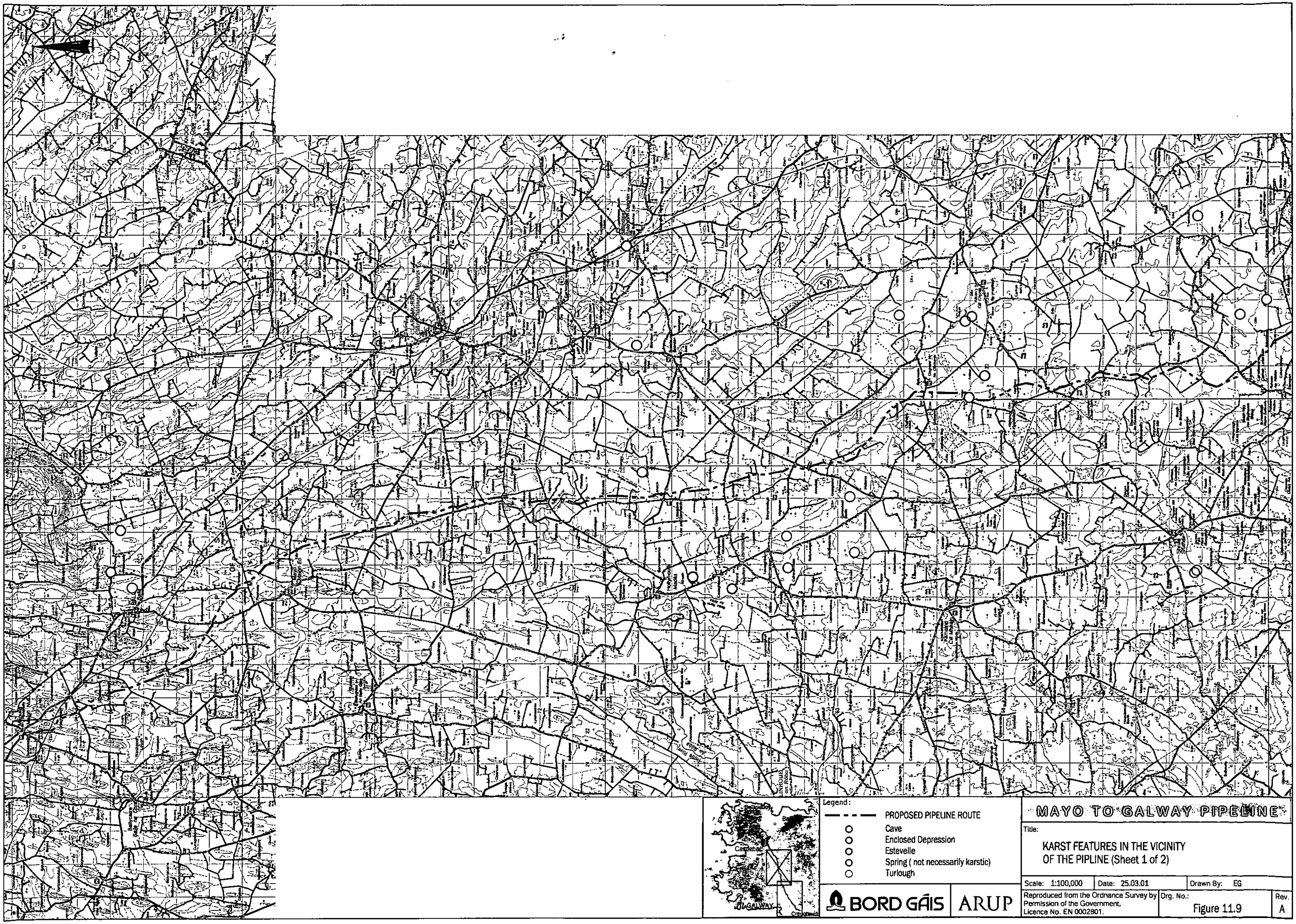
BORD GÁIS | ARUP

MAYO TO GALWAY PIPELINE

Title:
SOILS MAP
(Sheet 3 of 4)

Scale: 1:100,000	Date: 25.03.01	Drawn By: EG	
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Drg. No.: Figure 11.7		Rev. A


GALWAY
Gaillimh
Galway Bay
Cuan na Gaillimhe
ATHENRY
Baile Átha an Rí
LEGEND:
Basic Peat
Peat Podozols (75)
Blanket Peat (low level)
Blanket Peat (high level)
Shallow Brown Earths & Rendzinas (60)
Degraded Grey Brown Podzolics (50)
Grey Brown Podzolics (80)
Gleys (75)
Gleys (85)
Gleys (90)
Podzols (70)
Lithosols & Outcropping Rock(70)
Lithosols
Brown Podzolics (60)
Legend:
PROPOSED PIPELINE ROUTE
MAYO TO GALWAY PIPELINE
Title:
SOILS MAP
(Sheet 4 of 4)
Scale: 1:100,000
Date: 25.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 11.8
Rev.
A
BORD GÁIS
ARUP



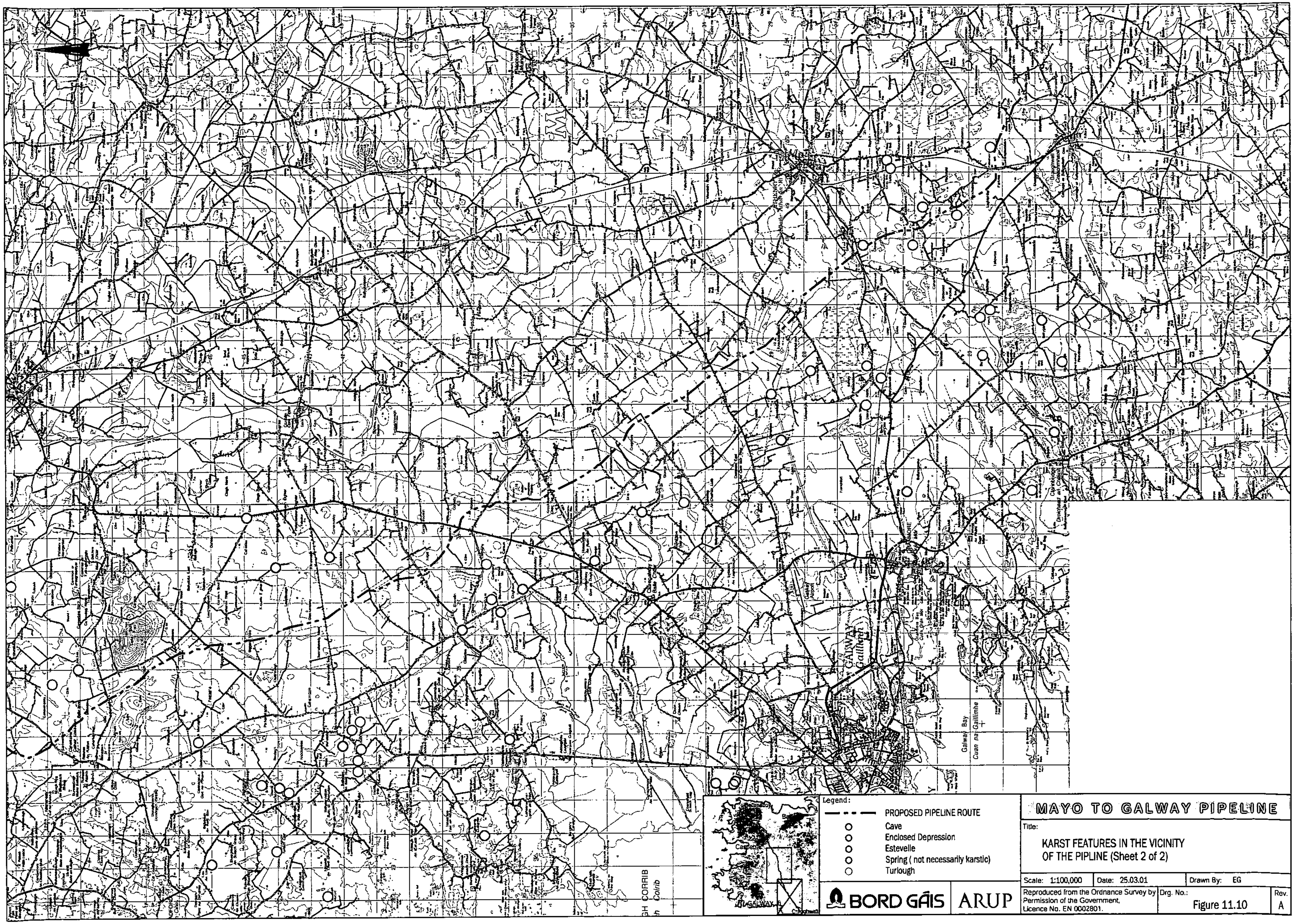
MAYO TO GALWAY PIPELINE

Title:

KARST FEATURES IN THE VICINITY OF THE PIPLINE (Sheet 1 of 2)

Scale: 1:100,000	Date: 25.03.01	Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Org. No.: Figure 11.9	Rev. A

BORD GÁIS | ARUP



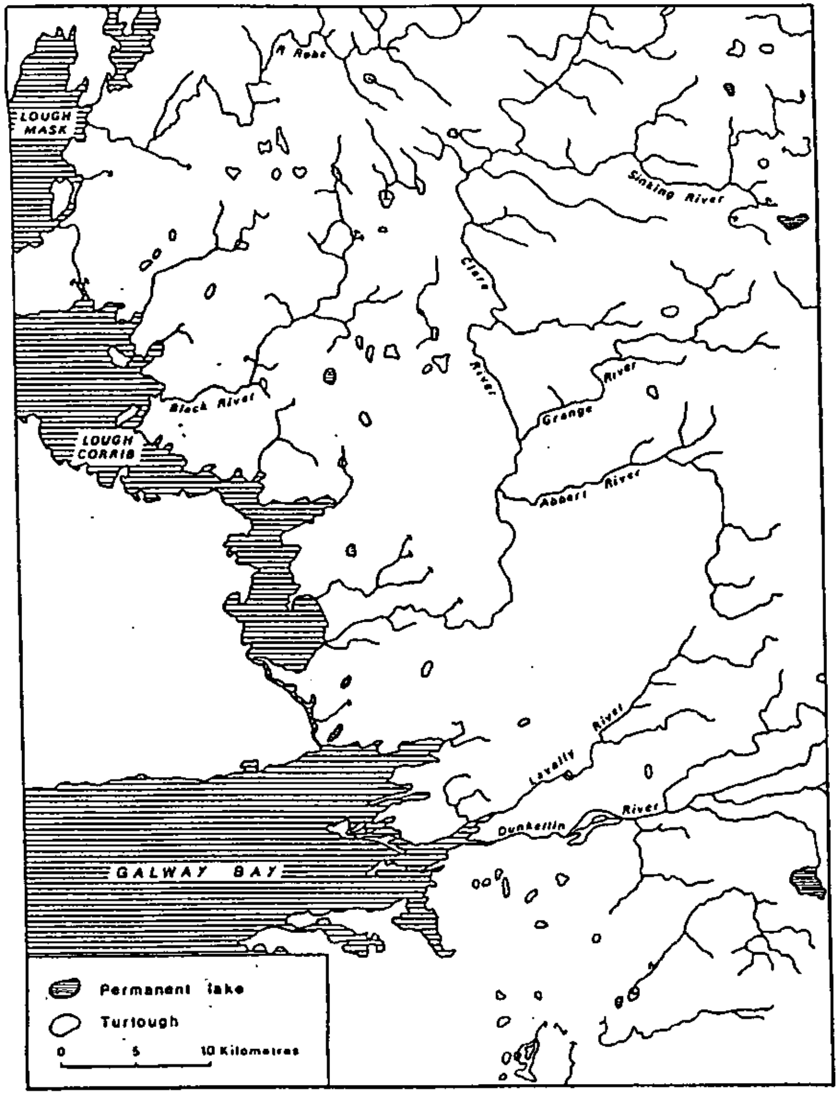
MAYO TO GALWAY PIPELINE

Title:

KARST FEATURES IN THE VICINITY OF THE PIPLINE (Sheet 2 of 2)

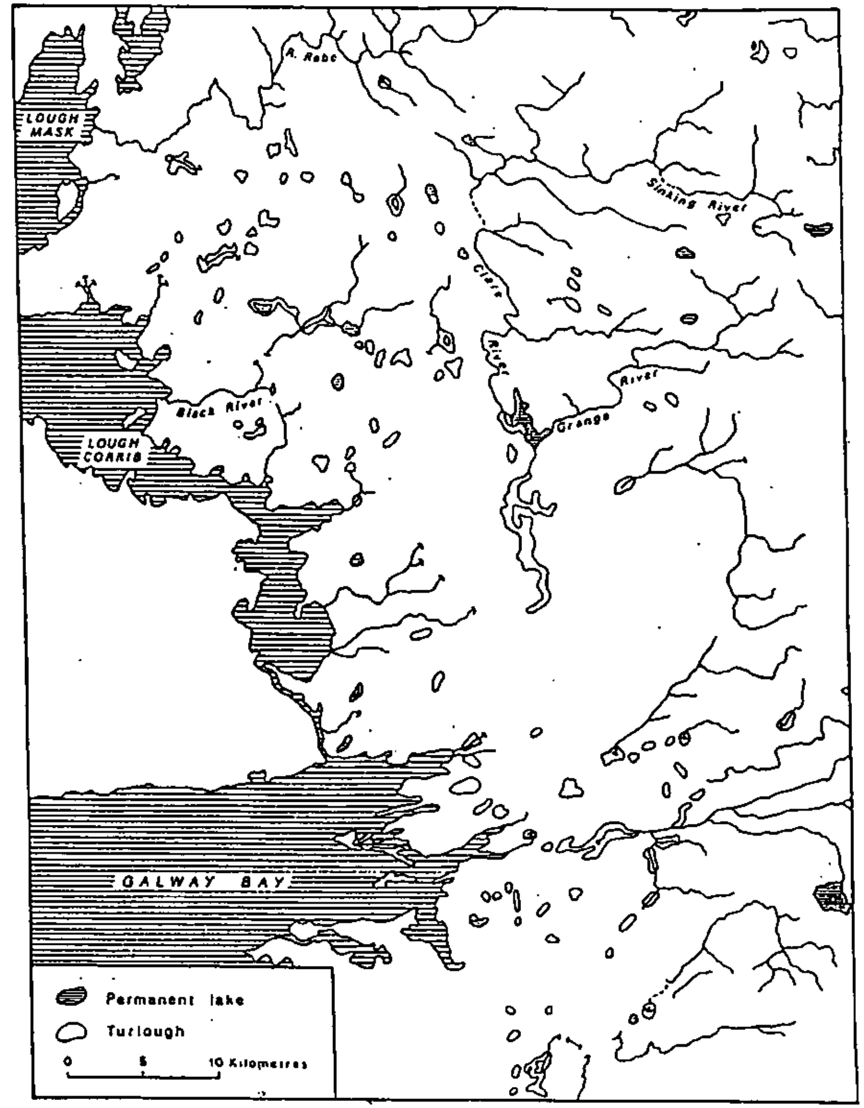
Scale: 1:100,000	Date: 25.03.01	Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Drg. No.: Figure 11.10	Rev. A

BORD GÁIS | ARUP



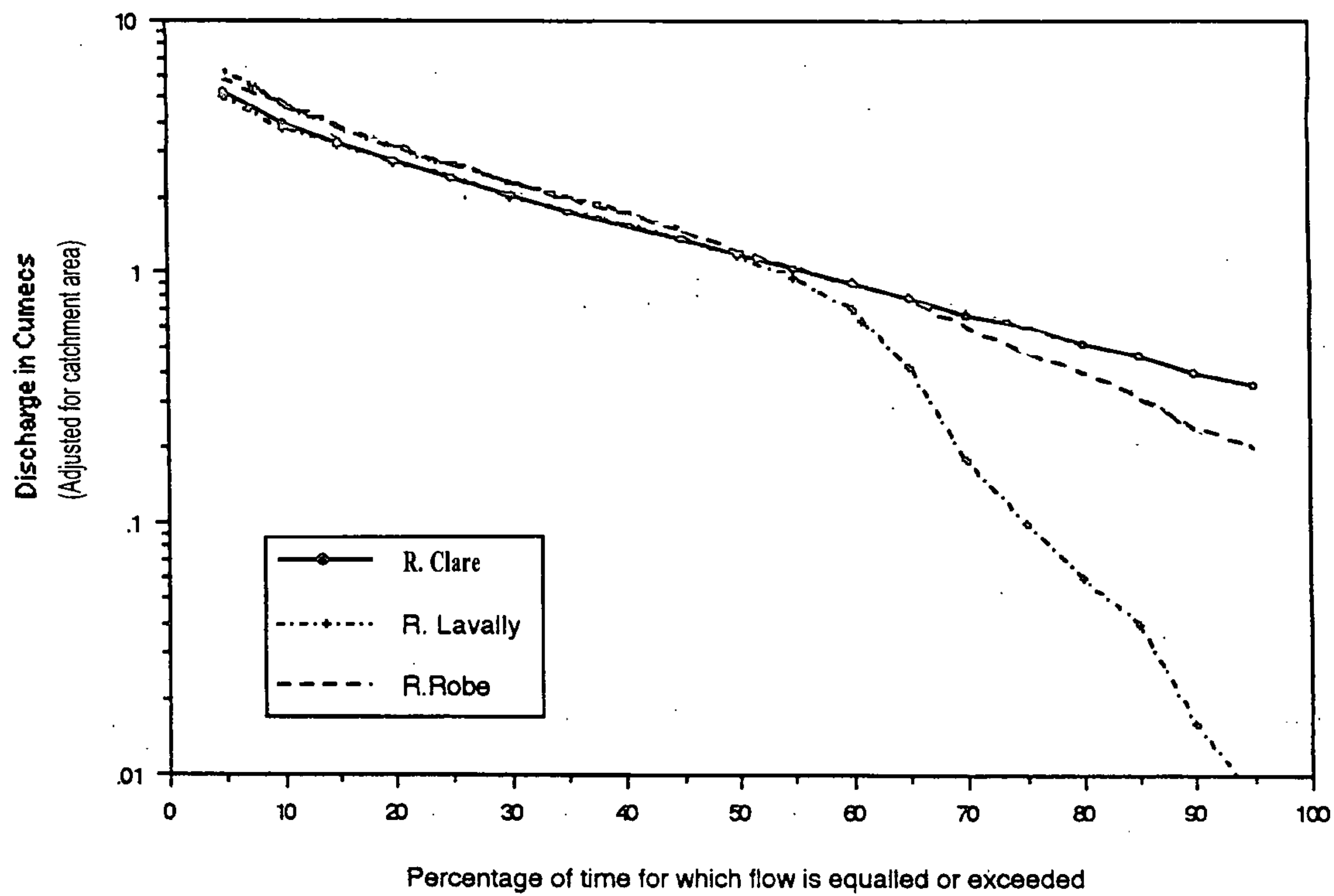
Present Day Surface Drainage

Taken from Drew & Daly (1993)



Pre-arterial Drainage

BORD GÁIS	MAYO TO GALWAY PIPELINE		
	Title: PRESENT & FORMER DRAINAGE PATTERNS IN NORTH-EAST GALWAY		
ARUP	Scale: N.T.S.	Date: 25.04.01	Drawn By: EG
	Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Drg. No.: Figure 13.1	Rev. A

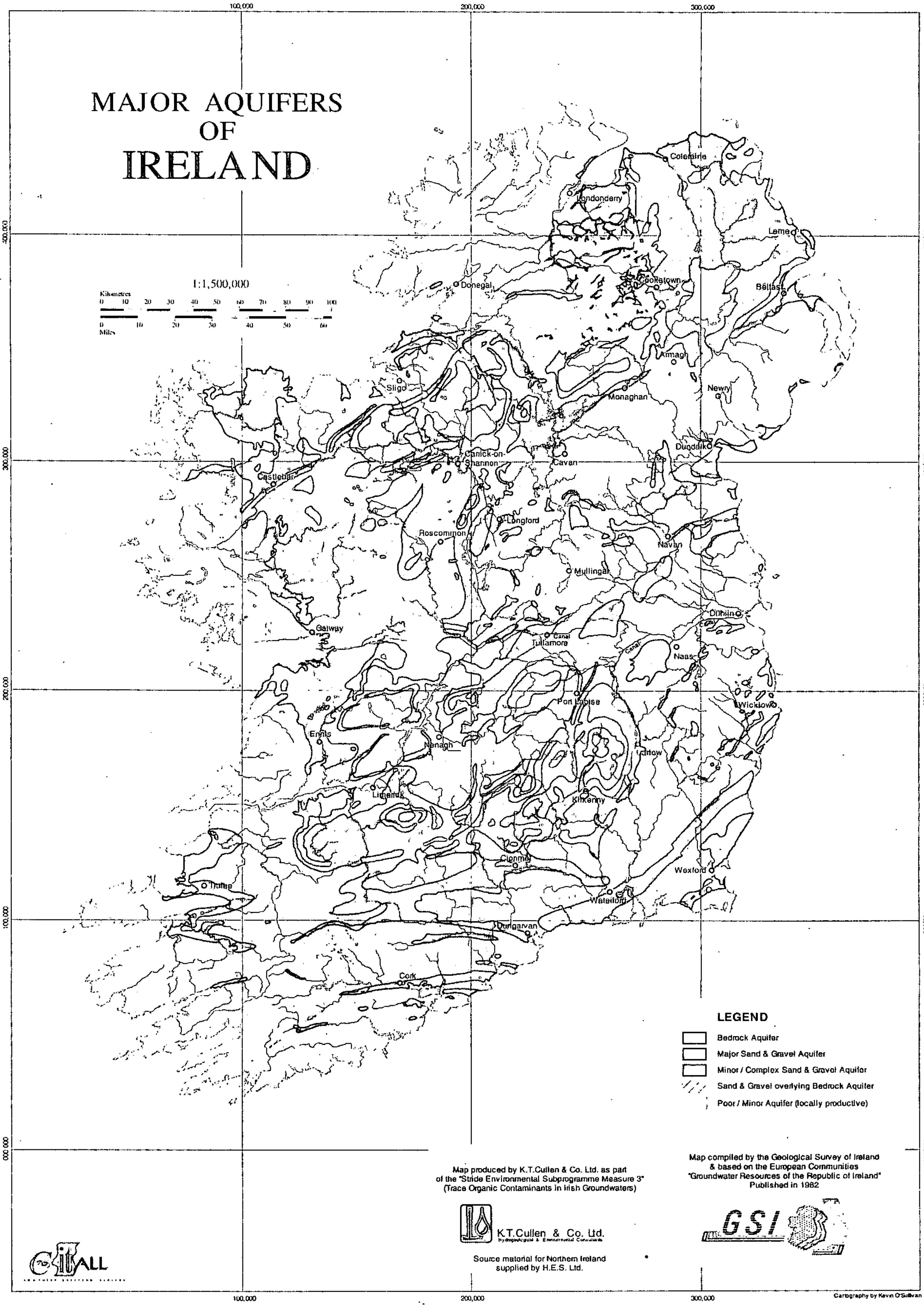


Modified from Drew & Daly (1993)

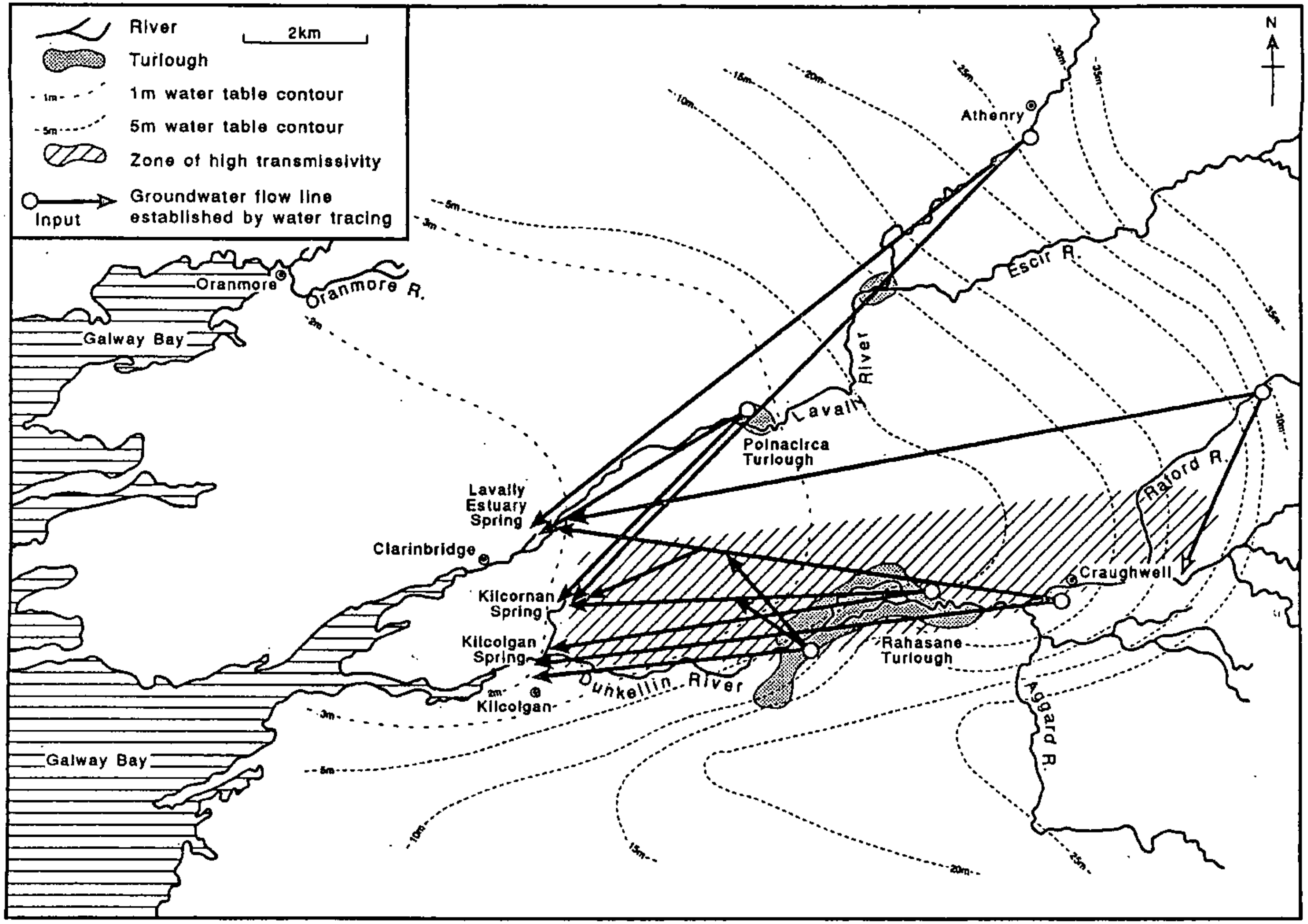
BORD GÁIS

ARUP

MAYO TO GALWAY PIPELINE			
Title: DISCHARGE VERSUS EXCEEDANCE DURATION FOR THREE NAMED RIVERS CROSSED BY PIPELINE			
Scale: N.T.S.	Date: 25.04.01	Drawn By: EG	
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Drg. No.: Figure 13.2		Rev: A

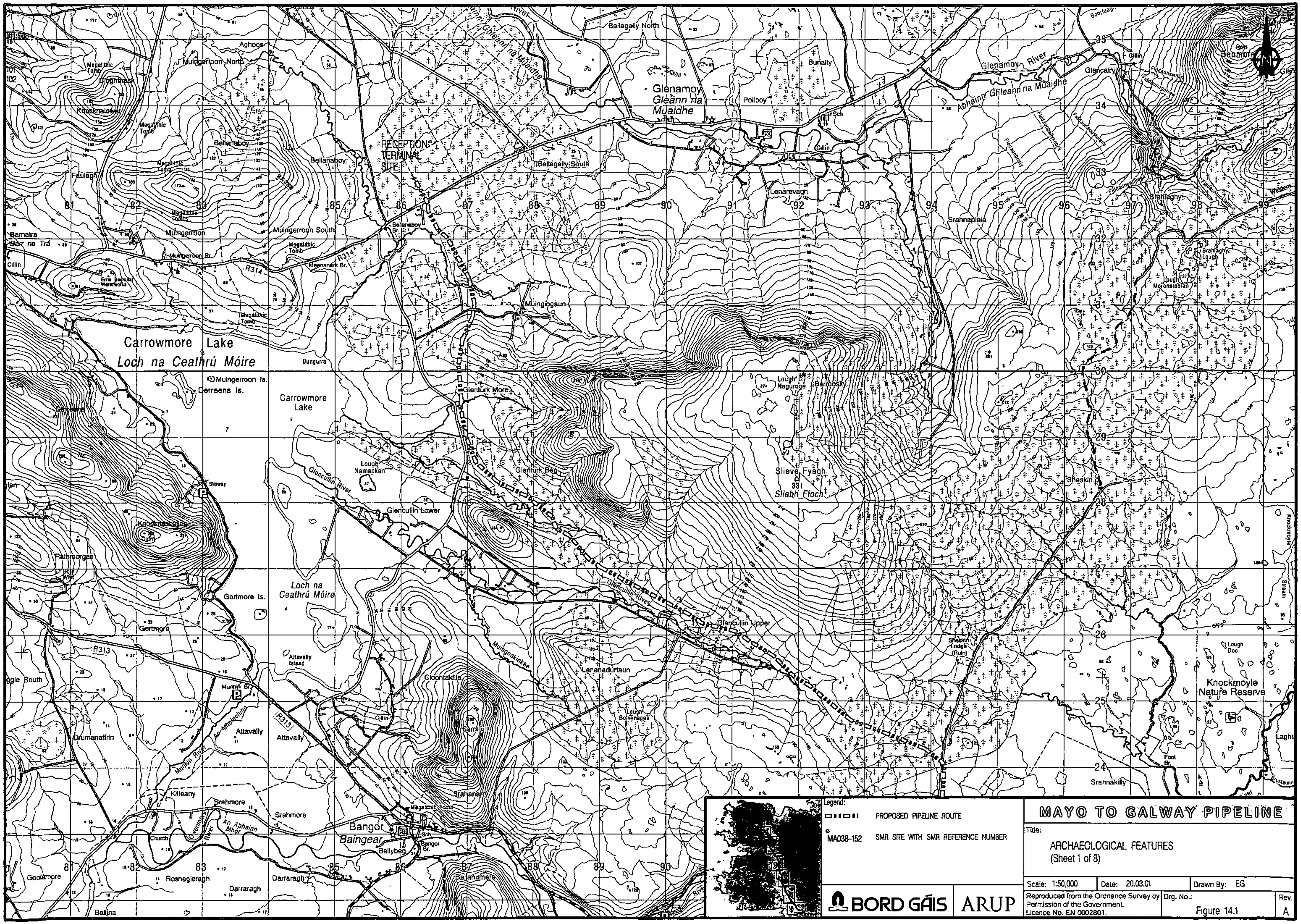


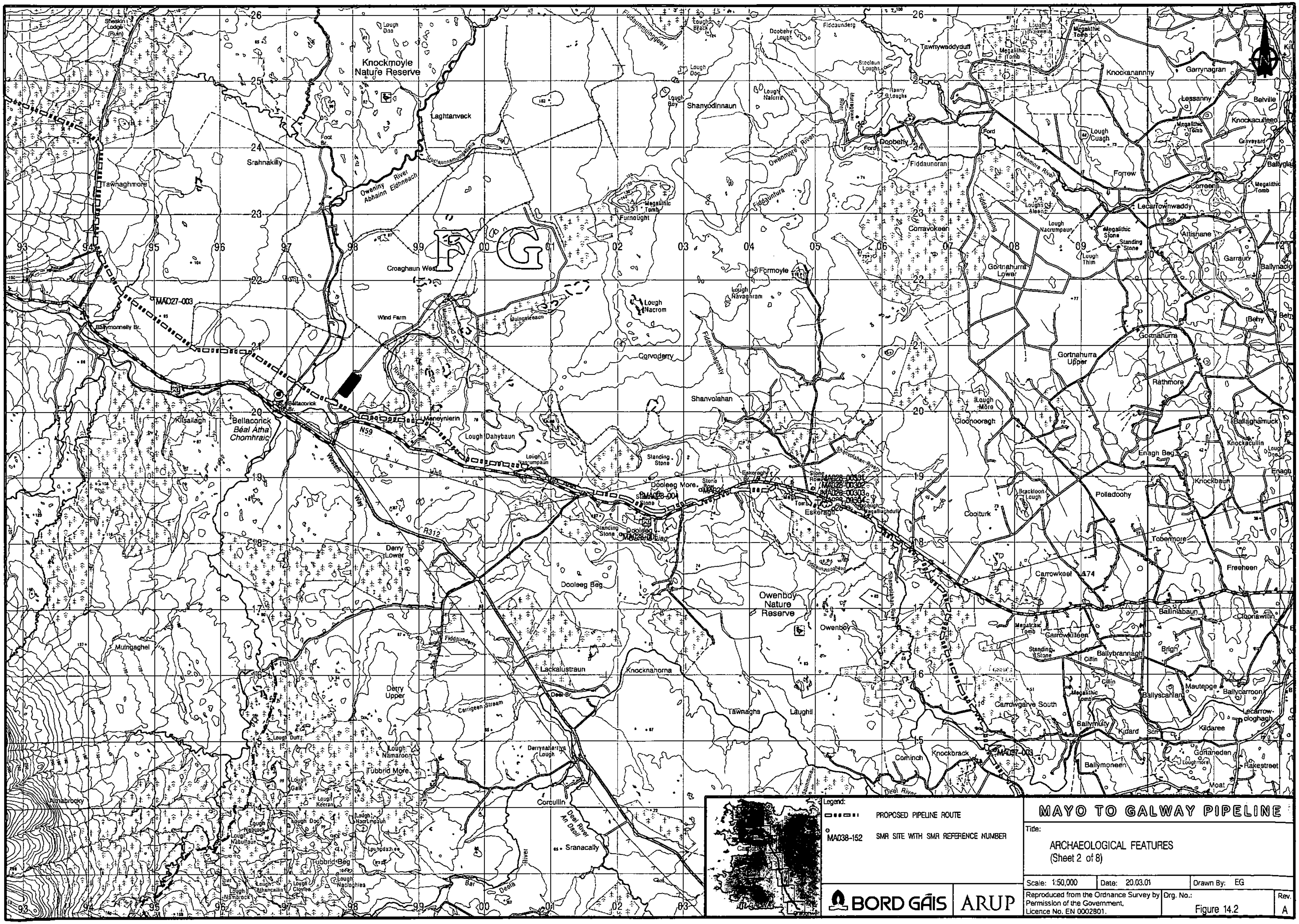
BORD GÁIS	MAYO TO GALWAY PIPELINE
	Title: MAJOR AQUIFERS OF IRELAND
ARUP	Scale: N.T.S. — Date: 25.04.01 — Drawn By: EG
	Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801. — Drg. No.: Figure 13.3 — Rev. A



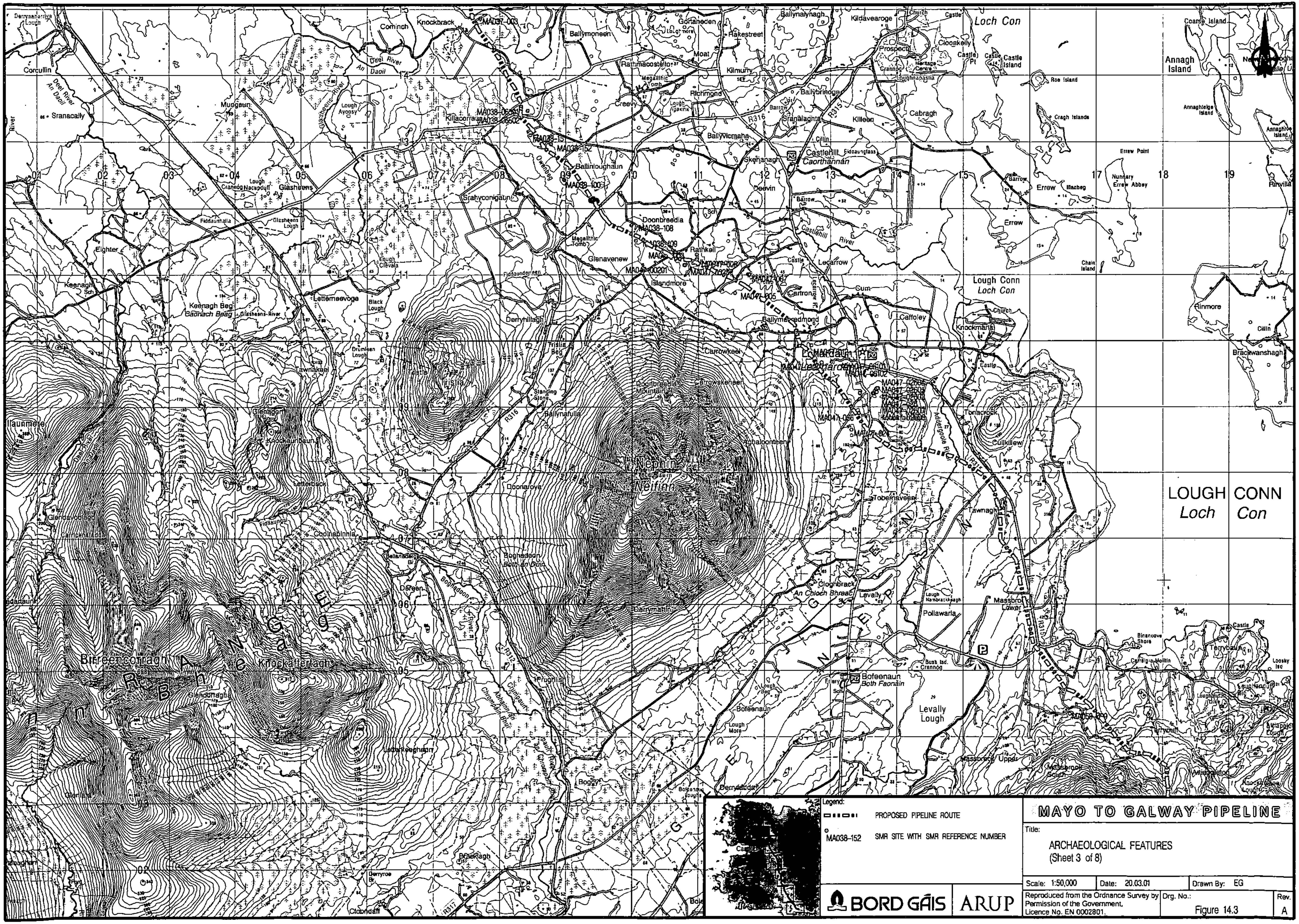
Taken from Drew & Daly (1993)

BORD GÁIS	MAYO TO GALWAY PIPELINE
ARUP	Title: ESTABLISHED GROUNDWATER FLOW PATHS IN DUNKELLIN-LAVALLY CATCHMENT
	Scale: N.T.S. — Date: 25.04.01 — Drawn By: EG
	Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801. — Drg. No.: Figure 13.4 — Rev. A

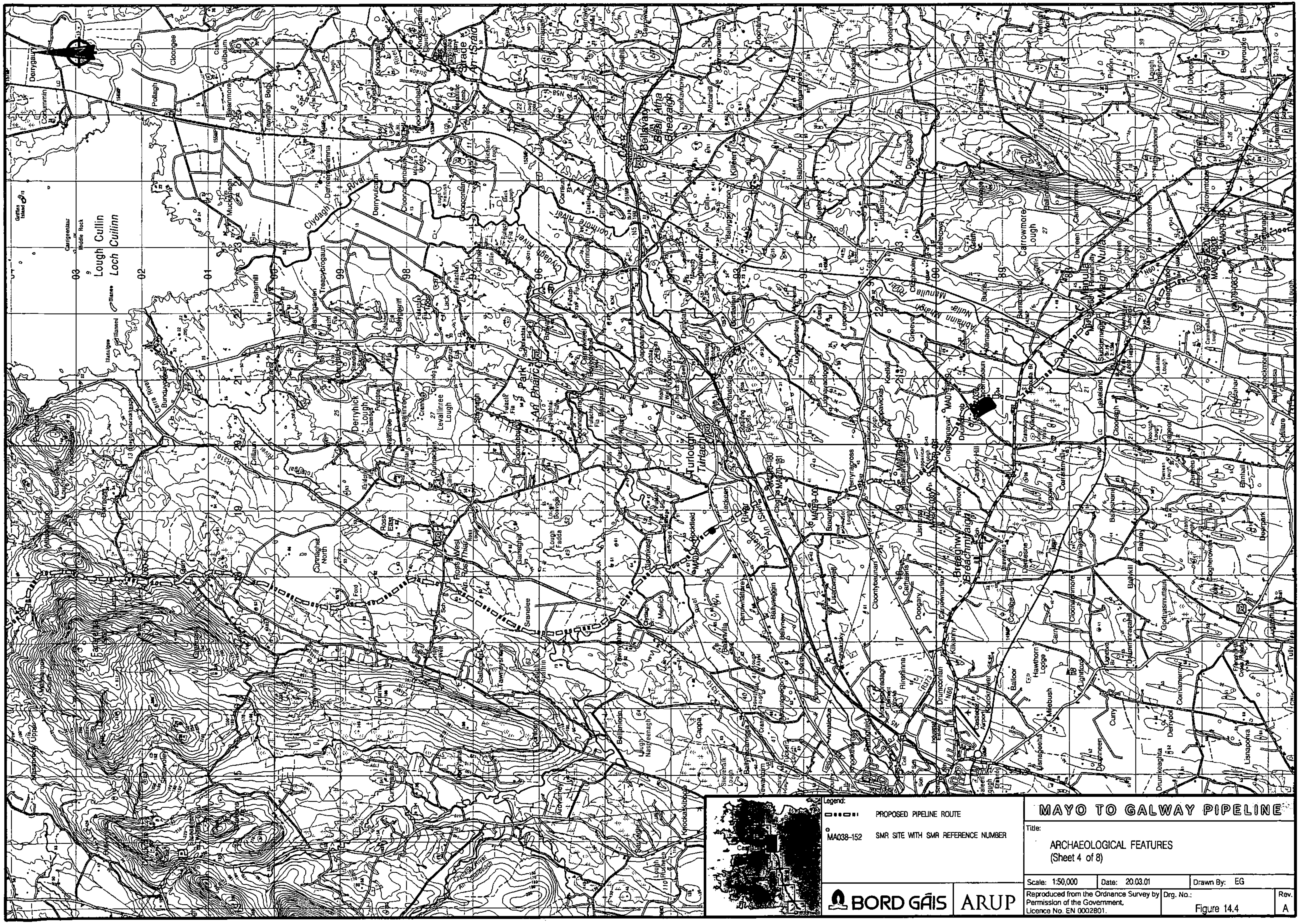

MAYO TO GALWAY PIPELINE
Title:
ARCHAEOLOGICAL FEATURES
(Sheet 1 of 8)
Legend:
PROPOSED PIPELINE ROUTE
MA038-152 SMR SITE WITH SMR REFERENCE NUMBER
Scale: 1:50,000
Date: 20.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.
Drg. No.:
Figure 14.1
Rev.
A
BORD GÁIS
ARUP
RECEPTION TERMINAL SITE
Glenamoy
Gleann na Muaidhe
Carrowmore Lake
Loch na Ceathrú Móire
Bellanaboy
Bellagelly North
Bellagelly South
Muingerroon North
Muingerroon South
Muingerroon
Aghoos
Glencullin River
Glencullin Lower
Glencullin Upper
Glenturk More
Glenturk Beg
Muingingaun
Slieve Fyagh
Sliabh Fíoch
Lough Nagirode
Barroosky
Lenarevagh
Sheskin
Sheskin Lodge (Ruin)
Knockmoyle Nature Reserve
Lough Doo
Srahnakilly
Srahnaplaia
Glencalry
Benmore
Bunalty
Pollboy
Lough Namackan
Derreens Is.
Muingerroon Is.
Gortmore Is.
Gortmore
Rathmorgan
Attavally
Attavally Island
Cloontakilla
Sarraun
Srahanary
Lenanadurtaun
Lough Bolinyagan
Bangor
Baingear
Bellanumera
Ballybeg
Srahmore
Kilteany
Drumanaffrin
Rosnagieragh
Darraragh
Goolamore
Ballina
Bunnahowen
Muingnakinkee
Knockmoyle
Megalithic Tomb
Knocknalower
Faulagh
Barnatra
Barr na Trá
R313
R314



Knockmoyle Nature Reserve
Laghtanvack
Srahnakilly
Tawnaghmore
Oweniny River
Abhainn Eidhneach
Croaghaun West
Wind Farm
MAD27-003
Ballymonnelly Br.
Bellacorick
Béal Átha Chomhraic
Kilsallagh
Maneynierin
Lough Dahybaun
N59
R312
Western Way
Corvoderry
Shanvolahan
Lough Nacrom
Formoyle
Furnought
Megalithic Tomb
Shanvodinnaun
Owenmore River
Doobehy
Fiddaunoran
Corravokeen
Gortnahurra Lower
Gortnahurra Upper
Rathmore
Lough More
Cloonooragh
Standing Stone
Dooleeg More
Eskeragh
Dooleeg Beg
Owenboy Nature Reserve
Owenboy
Coolturk
Polladoohy
Carrowkeel
Tobermore
Freeheen
Ballinlabaun
Carrowkilleen
Ballybrannagh
Carrowgarve South
Knockbrack
Corrinch
Lackalustraun
Knocknahorna
Tawnaghs
Laughil
Derry Lower
Derry Upper
Muingaghel
Tubbrid More
Tubbrid Beg
Corcullin
Deel River
Sranacally
Knockananny
Garrynagran
Lessanny
Belville
Knockaculleen
Forrew
Lecarrownwaddy
Corrneens
Altishane
Garrauty
Ballynacloy
Behy
Ballaghamuck
Knockacullin
Enagh Beg
Knockbaun
Brackloon Lough
Brign
Ballyscanlan
Mautenoe
Ballycarroon
Kildaree
Lecarrowcloghagh
Gortaneden
Rakestreet
Moat
Ballymoneen
Ballymulty
Kidard
Cloonawillin
Alnabrocky
Legend:
PROPOSED PIPELINE ROUTE
MA038-152 SMR SITE WITH SMR REFERENCE NUMBER
MAYO TO GALWAY PIPELINE
Title:
ARCHAEOLOGICAL FEATURES
(Sheet 2 of 8)
Scale: 1:50,000
Date: 20.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.
Drg. No.:
Figure 14.2
Rev. A
BORD GÁIS
ARUP



LOUGH CONN
Loch Con
Lough Conn
Loch Con
Nephin
Neifinn
Levally Lough
Castlehill
Caorthannán
Lahardaun
Legend:
PROPOSED PIPELINE ROUTE
MA038-152
SMR SITE WITH SMR REFERENCE NUMBER
MAYO TO GALWAY PIPELINE
Title:
ARCHAEOLOGICAL FEATURES
(Sheet 3 of 8)
Scale: 1:50,000
Date: 20.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.
Drg. No.:
Figure 14.3
Rev.
A



Legend:

PROPOSED PIPELINE ROUTE

MA038-152 SMR SITE WITH SMR REFERENCE NUMBER

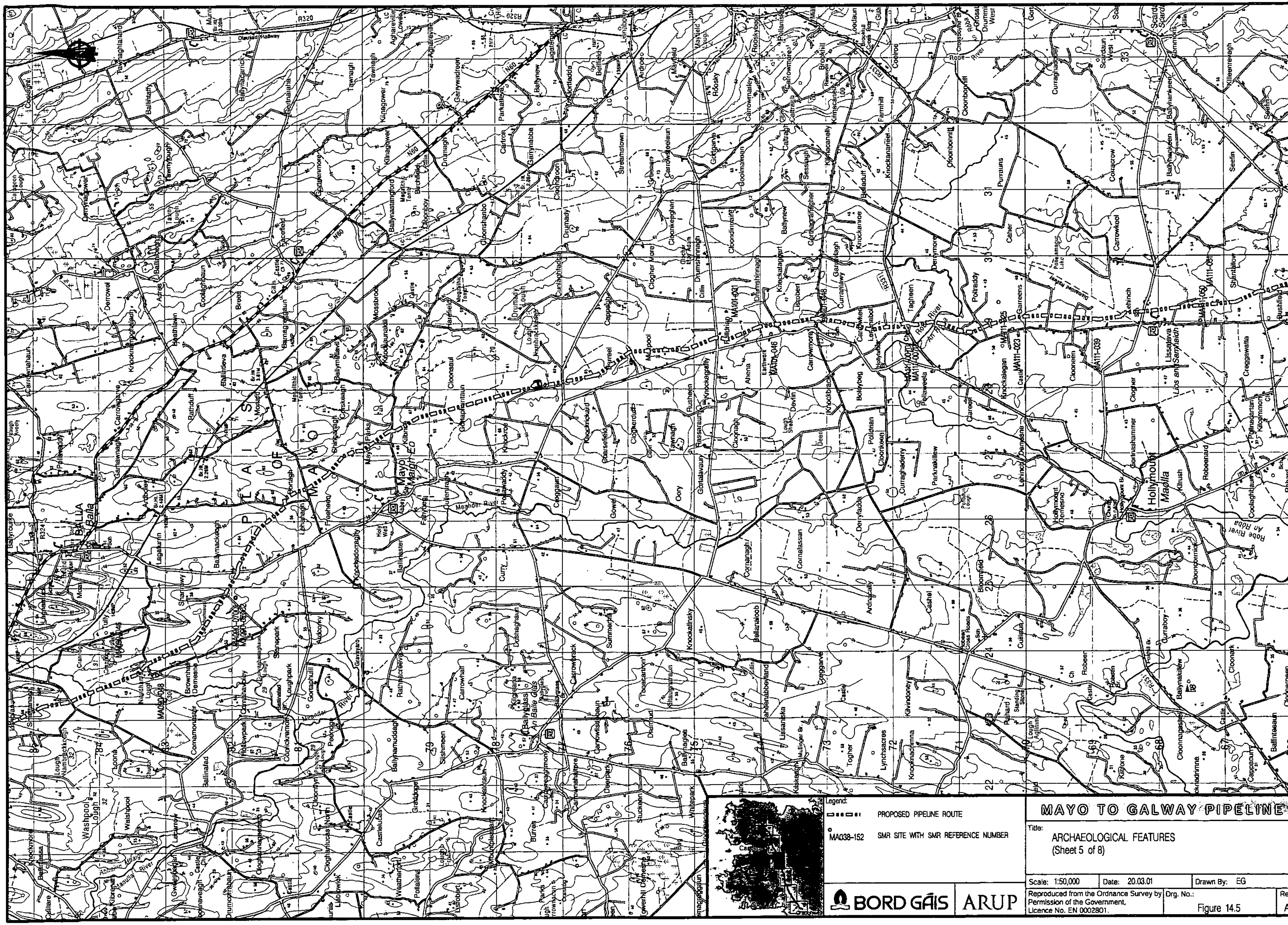
BORD GÁIS | ARUP

MAYO TO GALWAY PIPELINE

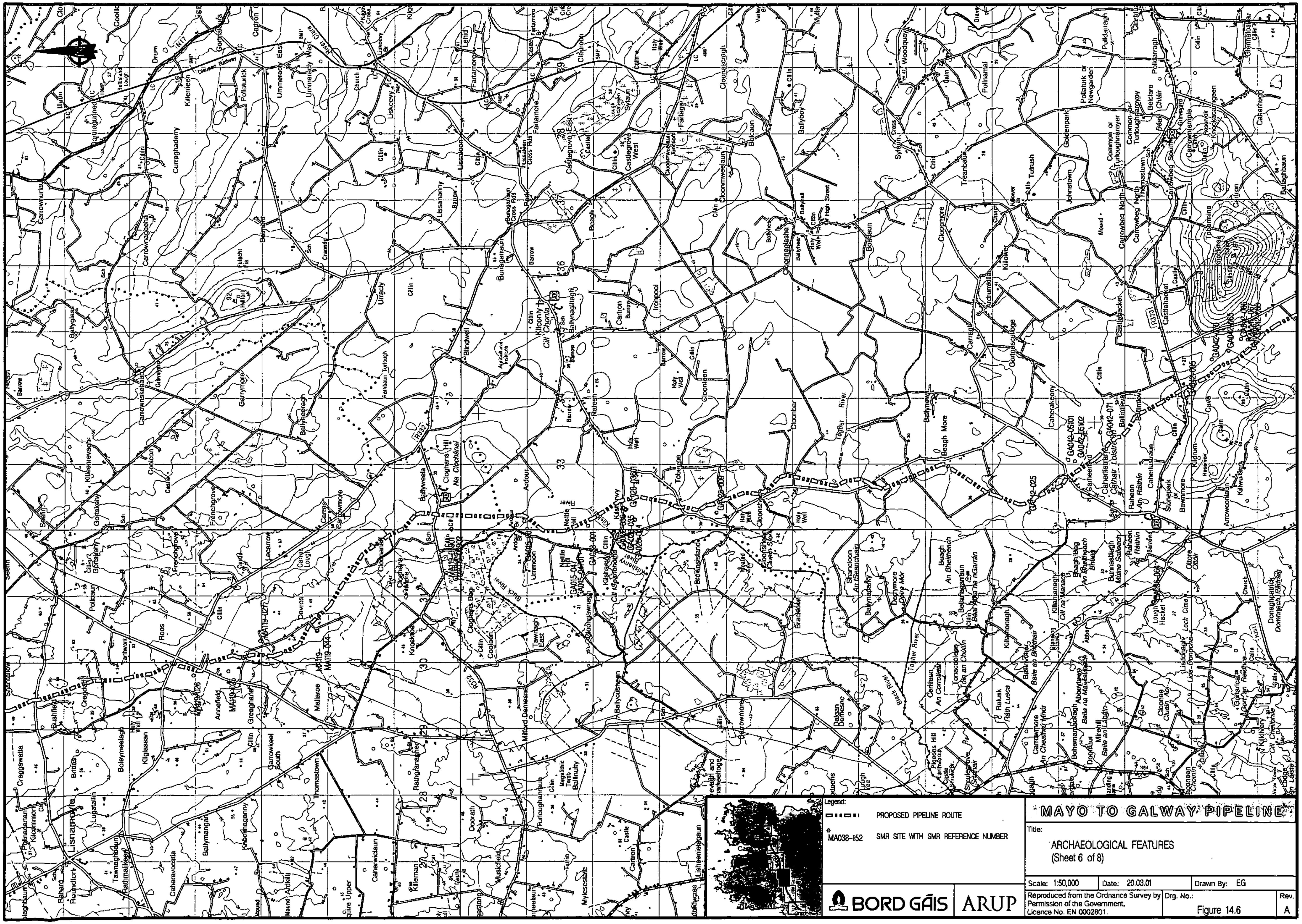
Title:

ARCHAEOLOGICAL FEATURES
(Sheet 4 of 8)

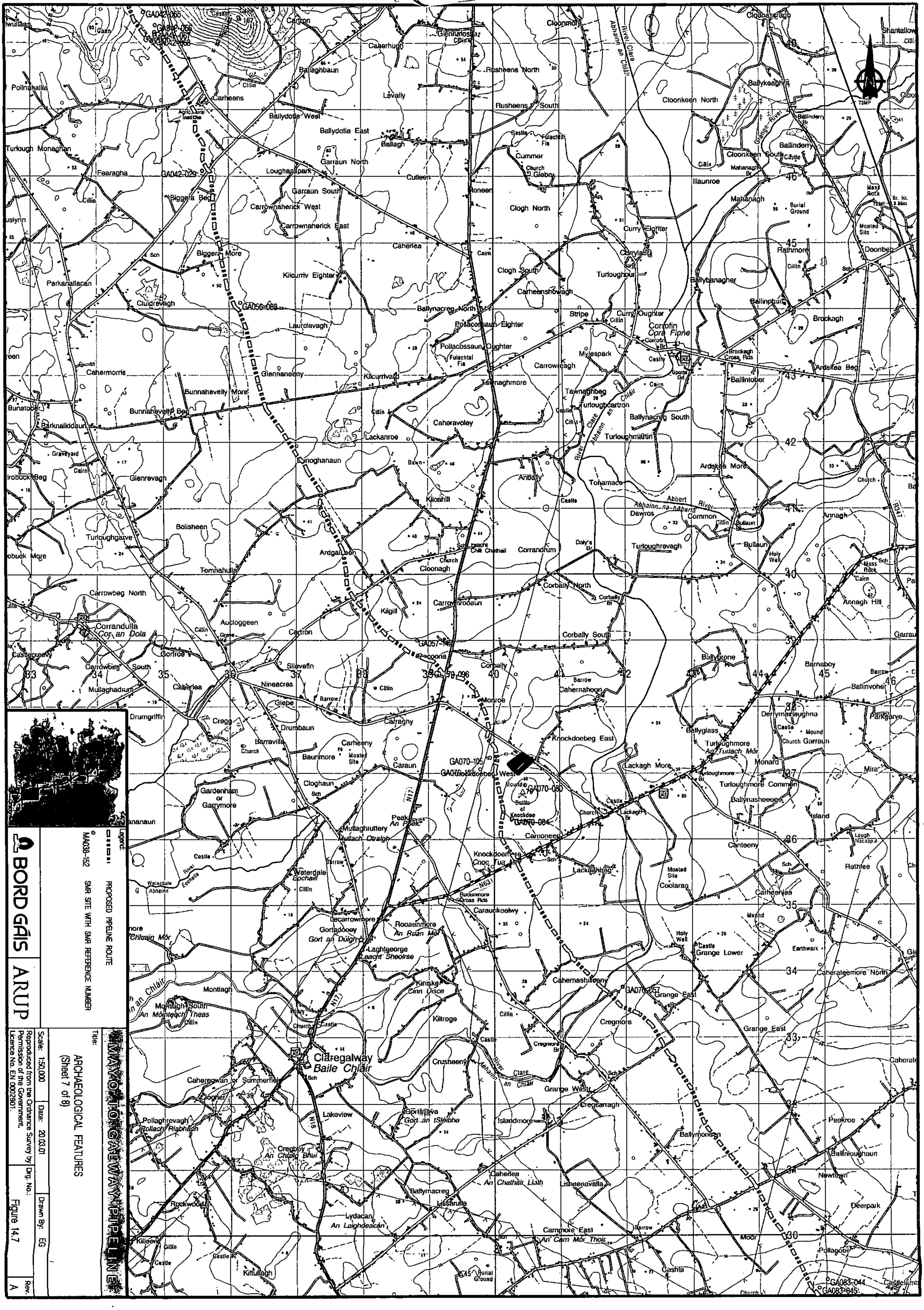
Scale: 1:50,000	Date: 20.03.01	Drawn By: EG	
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.	Drg. No.:	Figure 14.4	Rev. A



Legend:
PROPOSED PIPELINE ROUTE
MA038-152 SMR SITE WITH SMR REFERENCE NUMBER
MAYO TO GALWAY PIPELINE
Title:
ARCHAEOLOGICAL FEATURES
(Sheet 5 of 8)
Scale: 1:50,000
Date: 20.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 14.5
Rev.
A



Legend:
PROPOSED PIPELINE ROUTE
MA038-152 SMR SITE WITH SMR REFERENCE NUMBER
BORD GÁIS
ARUP
MAYO TO GALWAY PIPELINE
Title:
ARCHAEOLOGICAL FEATURES
(Sheet 6 of 8)
Scale: 1:50,000
Date: 20.03.01
Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 14.6
Rev.
A



Legend:

PROPOSED PIPELINE ROUTE

MA038-152 SMR SITE WITH SMR REFERENCE NUMBER

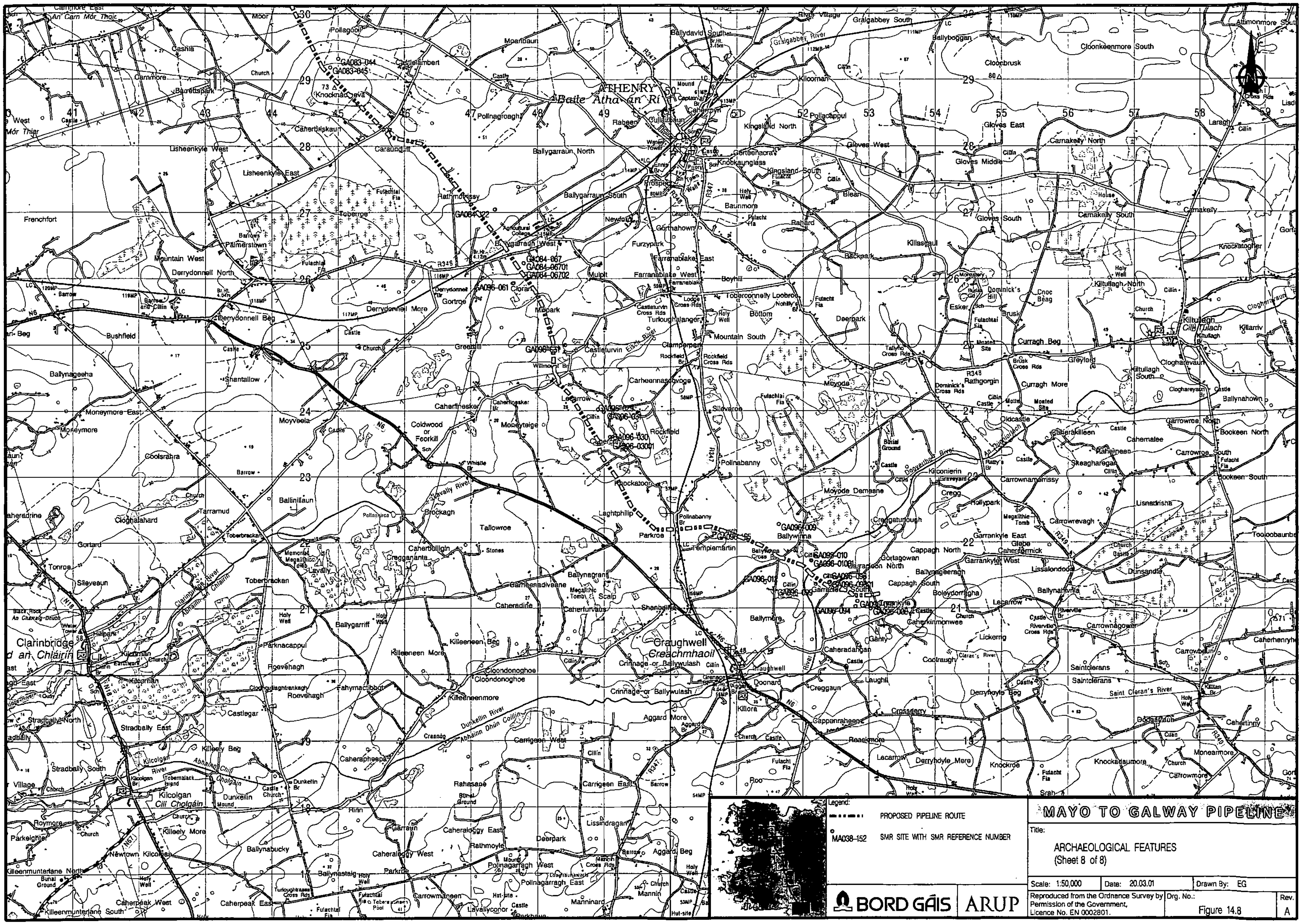
BORD GÁIS | ARUP

Title:

MAYO TO GALWAY PIPELINE

ARCHAEOLOGICAL FEATURES
(Sheet 7 of 8)

Scale: 1:50,000	Date: 20.03.01	Drawn By: EG
Reproduced from the Ordnance Survey by Permission of the Government. Licence No. EN 0002801.	Drg. No.: Figure 14.7	Rev. A


Legend:
PROPOSED PIPELINE ROUTE
MA038-152 SMR SITE WITH SMR REFERENCE NUMBER
MAYO TO GALWAY PIPELINE
Title:
ARCHAEOLOGICAL FEATURES
(Sheet 8 of 8)
Scale: 1:50,000
Date: 20.03.01
Drawn By: EG
BORD GÁIS
ARUP
Reproduced from the Ordnance Survey by Permission of the Government, Licence No. EN 0002801.
Drg. No.:
Figure 14.8
Rev.
A
ATHENRY
Baile Átha an Rí
Graughwell
Creachmhaoil
Clarinbridge
Kilcolgan
Cill Cholgáin