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

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Summary Statistics at Selected Gauging Stations
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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 12km² 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.

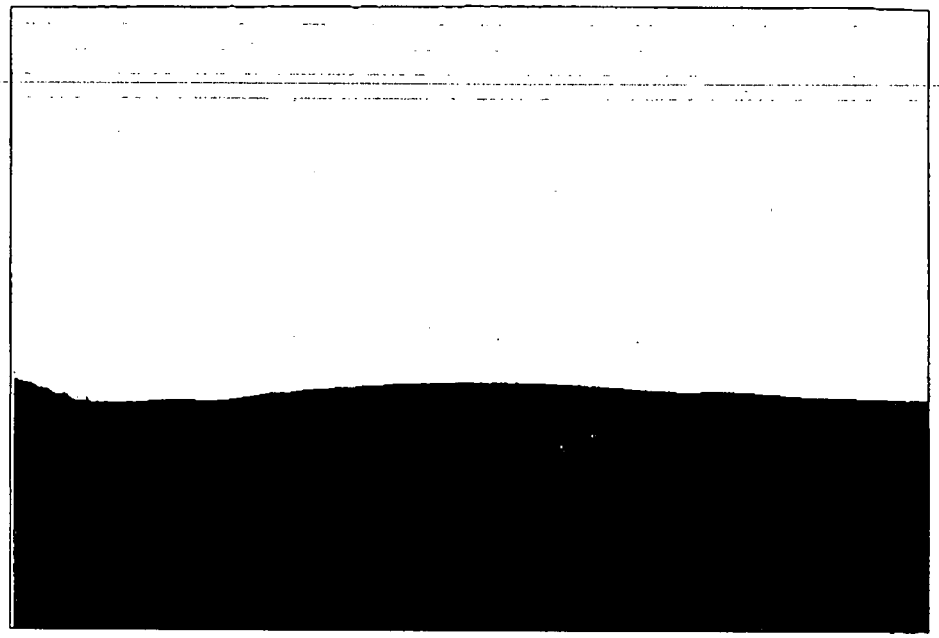


Plate 15.1: Upland Moorland - open and expansive landscape with long distance views available across flat to gently undulating peat bog.

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.

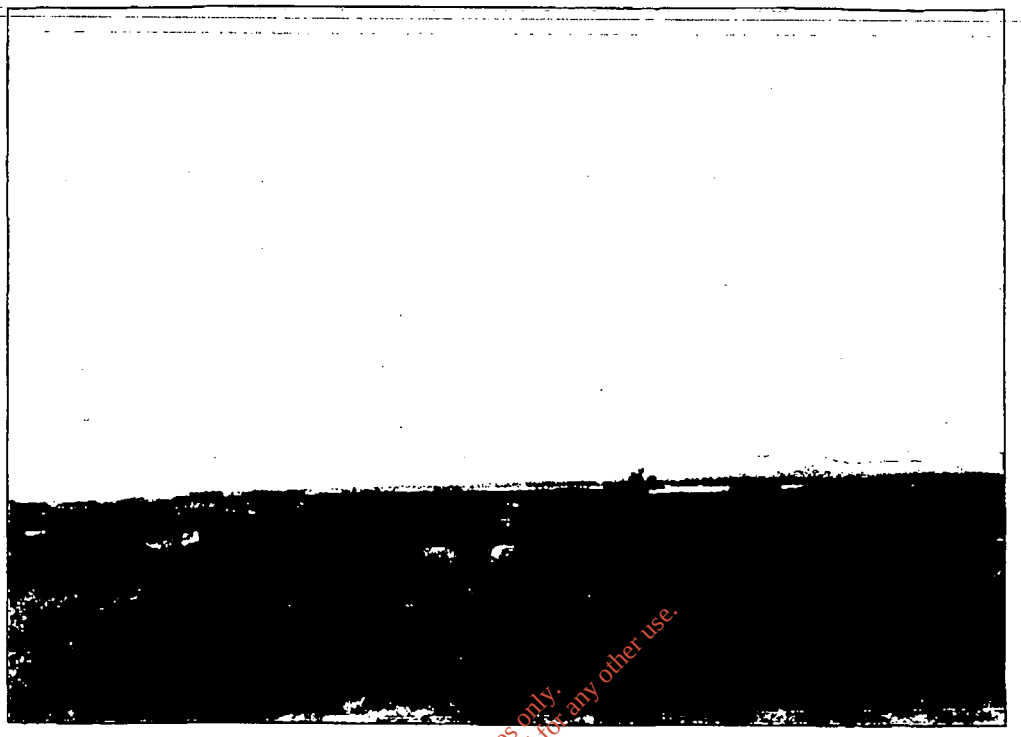
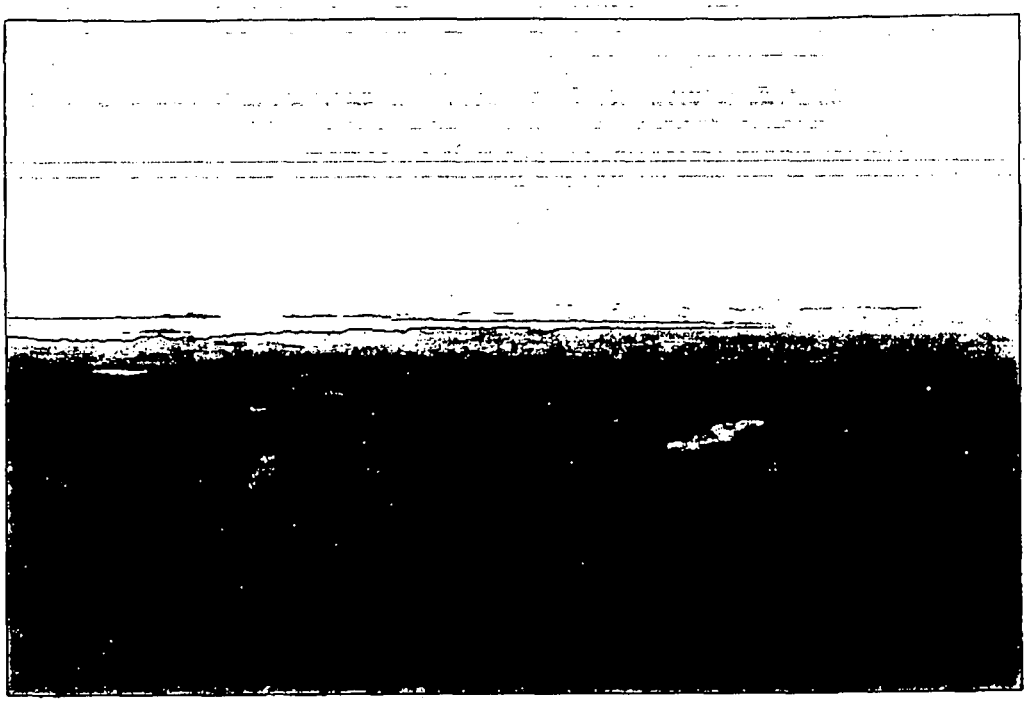


Plate 15.3: Wet Pasture - view across undulating unimproved, poorly drained pastoral fields featuring large tracts of rushes. Hedgerows, trees and gorse and willow scrub combine to give a well-vegetated enclosed feel to the landscape.

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

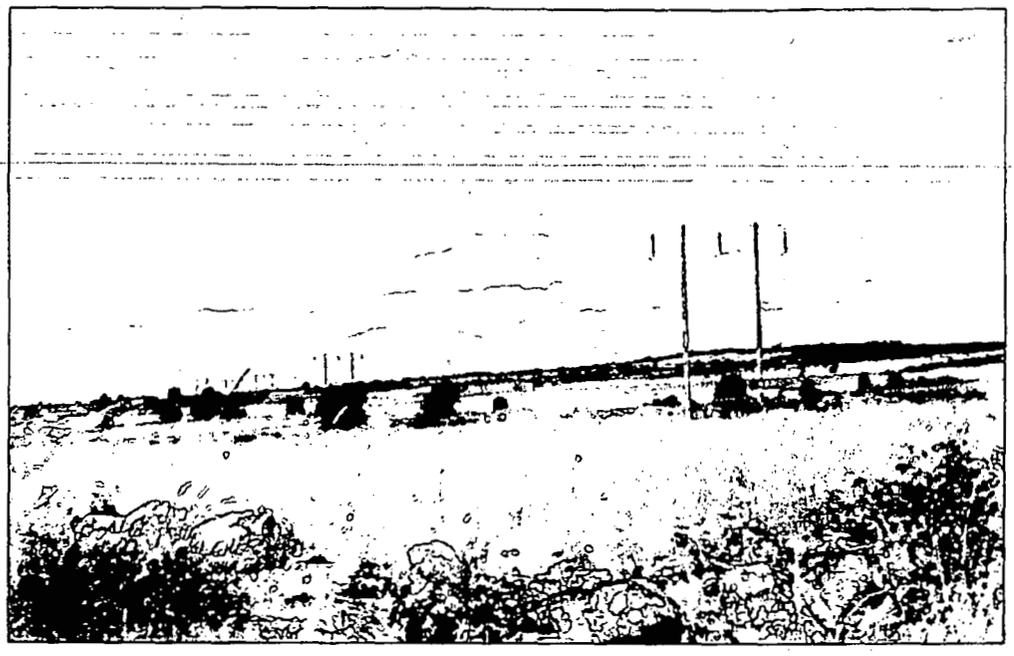


Plate 15.7: Minor Ridge and Valley - views across broad flat valleys featuring pastoral fields defined by dry stone walls.

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 BGE 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 delivery to storage depots	Cork	Galway	1400	28			10													
	Galway	Knockdoe	2800	56		10														
	Knockdoe	Turlough	1866	38	10	10			10											
	Castlebar	Bellacorick	933	19				10				10	10							
Machinery delivery to compound	Galway	Knockdoe	48	5		2														
	Knockdoe	Turlough	32	3	2	2			2											
	Castlebar	Bellacorick	16	2				2				2	2							
Sand and gravel	Bunnahowen	Bellanaboy Bridge	5000	65-32											13-26					
	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 slabs	Castlebar	North	10	10				1			1				1					
	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 $L_{Aeq,1hour}$ dB_A	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 BGE'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, BGE 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 geniculatus* - 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: