EIS 277

BORD GAIS EIREANN

GAS INTERCONNECTOR PROJECT

SUBSEA

ENVIRONMENTAL STATEMENT

ON BEHALF OF THE PROJECT MANAGEMENT TEAM

By

MCS International / ICIT

detail. Shellfish, plankton, seabirds and marine mammals are also examined. The main conclusions are that the areas traversed by the pipeline are representative of the Irish Sea and therefore any area directly affected by the pipeline will not be unique and as such is not likely to be subject to special considerations of conservation value.

Other sea users in the area of the development are also examined. The Irish Sea is a very heavily fished area and consequently is of major importance when considering interactions. The Brighouse Bay landfall and approaches are heavily fished for scallops and queenies by fishermen from Kirkcudbright and the Isle of Man fleet relies on the shellfish beds to the north west of the island. Between the Isle of Man and Ireland are the largest *Nephrops* grounds in the Irish Sea area. *Nephrops* are the single most important fishery in the region with heavy reliance from Irish and Northern Irish fleets.

The Irish Sea is also used for military and naval exercises. The pipeline passes through a submarine exercise area. The other major user which must be considered is the shipping industry. The Irish Sea is a busy water way with regular traffic passing from the St George's Channel north and passing over the route of the pipeline. Recreation, cables, and waste dumping are not significantly important in the vicinity of the pipeline.

4 INTERACTIONS BETWEEN THE DEVELOPMENT AND THE ENVIRONMENT

The environmental impact is likely to be short term and very localized over the length of the sub-sea pipeline. Pre-lay dredging and pipelaying are likely to give rise to negligible impacts in that they will affect localized areas over a short time period in a way that is similar in effect to small random changes in the sea life population due to environmental vagaries. These phases will have no discernible effect on the sea life population as a whole. The temporary loss of access to fishing grounds and/or the disturbance of shellfish during these phases will have only a minor impact in that they will affect localized areas over a short time period but will not affect the integrity of the sea life population itself. Such an impact does not affect the long-term well being of those utilising the resource. It is expected that 6m each side of the pipe will be affected by any rockdumping. However, steps have been taken to ensure that rock dumping will be kept to an absolute minimum.

scour hence the potential for freespanning due to scour processes is considered low.

6. ENVIRONMENTALLY SENSITIVE APPROACHES

- Timing is important in reducing impacts. Ideally operations should be confined to times when fishing activity is low and outside the breeding/ spawning season for birds and mammals. (Section 3.3.1). The best time for operations in the shellfish beds would be April, May or June.

- Early and constructive liaison with the fishing organizations is vital to minimize conflict. The use of a fishing representative on the lay-barge is recommended to oversee good practice and liaise with fishing vessels. (Section 5.7).

- Careful controls on debris removal should be implemented including inventory control and communication with all workers to ensure compliance. (Section 5.7).

- Rockdumping should be minimized and this point is recognised in the design since rockdumping will only be utilised as a limited contingency operation in the event of failure to achieve adequate trenching. Trenching is the most user-friendly approach to reducing interactions with the fishing industry.

- Careful consideration should be given to the discharge of hydrostatic test water by carrying out dispersion studies. (Section 5.4).

- Exclusion zones should be kept to a minimum. However, a voluntary exclusion zone for project vessels around Lambay Island should be considered to reduce disturbance to the bird colonies. (Section 5.5).

- Regular monitoring and maintenance must be undertaken to ensure future integrity of the pipeline. (Section 7.2).

- Formal consideration should be given to abandonment options noting that circumstances, costs and technology could change within the project lifetime. (Section 5.8).

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EXECUTIVE SUMMARY

1. INTRODUCTION

Bord Gais Eireann, The Irish Gas Board, propose to install and operate a 24" diameter steel pipeline carrying natural gas from Brighouse Bay near Kirkcudbright in Scotland to Loughshinny Bay north of Dublin. Bord Gais Eireann have made a commitment to carry out a full Environmental Impact Assessment (EIA) in accordance with EEC directive 85/337/EEC. The EIA examines the potential interactions between the development and the environment, identifies where impacts may occur and indicates the implications and the possible mitigative measures that could be associated with the pipeline.

This assessment of the sub-sea impacts has been carried out jointly by MCS International and the Institute of Offshore Engineering of Heriot-Watt University. It was undertaken during the design phase of the project from August 1991 until March 1992. This report represents the findings of the assessment.

2. THE DEVELOPMENT

It is proposed that the gas pipeline will be installed by barge between February and July 1993 with work on the landfalls commencing in November 1992. It is expected that precommissioning will be carried out in August 1993. The pipeline will be post lay trenched where possible throughout the length of the pipeline to ensure structural stability and to avoid damage to the integrity of the pipe. A limited amount of rockdumping will be carried out if trenching is not possible where hard outcrops of rock are encountered.

3. THE ENVIRONMENT

Section 3 of this EIA examines the physical and biological environment through which the pipeline traverses. The benthic community structure including the major demersal and pelagic species, spawning and nursery grounds that are present in the vicinity of the development are documented in

detail. Shellfish, plankton, seabirds and marine mammals are also examined. The main conclusions are that the areas traversed by the pipeline are representative of the Irish Sea and therefore any area directly affected by the pipeline will not be unique and as such is not likely to be subject to special considerations of conservation value.

Other sea users in the area of the development are also examined. The Irish Sea is a very heavily fished area and consequently is of major importance when considering interactions. The Brighouse Bay landfall and approaches are heavily fished for scallops and queenies by fishermen from Kirkcudbright and the Isle of Man fleet relies on the shellfish beds to the north west of the island. Between the Isle of Man and Ireland are the largest *Nephrops* grounds in the Irish Sea area. *Nephrops* are the single most important fishery in the region with heavy reliance from Irish and Northern Irish fleets.

The Irish Sea is also used for military and naval exercises. The pipeline passes through a submarine exercise area. The other major user which must be considered is the shipping industry. The Irish Sea is a busy water way with regular traffic passing from the St George's Channel north and passing over the route of the pipeline. Recreation, cables, and waste dumping are not significantly important in the vicinity of the pipeline.

4 INTERACTIONS BETWEEN THE DEVELOPMENT AND THE ENVIRONMENT

The environmental impact is likely to be short term and very localized over the length of the sub-sea pipeline. Pre-lay dredging and pipelaying are likely to give rise to negligible impacts in that they will affect localized areas over a short time period in a way that is similar in effect to small random changes in the sea life population due to environmental vagaries. These phases will have no discernible effect on the sea life population as a whole. The temporary loss of access to fishing grounds and/or the disturbance of shellfish during these phases will have only a minor impact in that they will affect localized areas over a short time period but will not affect the integrity of the sea life population itself. Such an impact does not affect the long-term well being of those utilising the resource. It is expected that 6m each side of the pipe will be affected by any rockdumping. However, steps have been taken to ensure that rock dumping will be kept to an absolute minimum.

The following ranked list of potentially deleterious interactions have been extracted from Section 5 of the sub-sea EIA.

(1) **Major impacts** - none anticipated

(2) **Moderate impacts** -none anticipated

(3) **Minor impacts**

Prelay dredging
-smothering of benthos and shellfish
-temporary loss of fishing access

Pipelaying
-temporary loss of fishing access
-delay prior to trenching affecting fishing

Rockdumping
-smothering of benthos and shellfish
-dissipation of rockdump by dredge tines

Precommissioning
-release of hydrostatic test water
-snagging of gear on pipe ends prior to tie-in

Operations
-snagging of gear on debris / entrapment

General
-disturbance of whelping seals, brood rearing and moulting birds by equipment presence and noise
-remobilization of sediment contaminants

The definitions of impact magnitude are defined in Section 5.11 of the text. It should be noted that there are numerous negligible impacts identified within Section 5 which are not listed here.

5. EFFECTS UPON THE DEVELOPMENT

The most important impact that the environment could have on the development is that scouring of the seabed could cause freespanning. However, the pipeline will be trenched to 1m cover, in areas susceptible to

scour hence the potential for freespanning due to scour processes is considered low.

6. ENVIRONMENTALLY SENSITIVE APPROACHES

- Timing is important in reducing impacts. Ideally operations should be confined to times when fishing activity is low and outside the breeding/ spawning season for birds and mammals. (Section 3.3.1). The best time for operations in the shellfish beds would be April, May or June.

- Early and constructive liaison with the fishing organizations is vital to minimize conflict. The use of a fishing representative on the lay-barge is recommended to oversee good practice and liaise with fishing vessels. (Section 5.7).

- Careful controls on debris removal should be implemented including inventory control and communication with all workers to ensure compliance. (Section 5.7).

- Rockdumping should be minimized and this point is recognised in the design since rockdumping will only be utilised as a limited contingency operation in the event of failure to achieve adequate trenching. Trenching is the most user-friendly approach to reducing interactions with the fishing industry.

- Careful consideration should be given to the discharge of hydrostatic test water by carrying out dispersion studies. (Section 5.4).

- Exclusion zones should be kept to a minimum. However, a voluntary exclusion zone for project vessels around Lambay Island should be considered to reduce disturbance to the bird colonies. (Section 5.5).

- Regular monitoring and maintenance must be undertaken to ensure future integrity of the pipeline. (Section 7.2).

- Formal consideration should be given to abandonment options noting that circumstances, costs and technology could change within the project lifetime. (Section 5.8).

7. CONCLUSION

The sub-sea phase of the project could have a detrimental impact on the local fishing industries by removing small and localized areas from the potential fishable area. However, it is considered that the areas are small and overall impact should be negligible. The potential for serious gear snagging of fishing gear on the proposed pipeline is considered negligible since the pipeline will be trenched along the length of the route.

Overall the anticipated impact on the environment is considered to be negligible.

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1. INTRODUCTION

1.1 THE GAS INTERCONNECTOR PROJECT

Bord Gais Eireann (BGE) propose to install and operate a pipeline from Brighouse Bay, on the south west coast of Scotland, to Loughshinny, north of Dublin. The purpose of this pipeline is to transport natural gas from the UK to the Irish national gas grid system. At present the singular source of natural gas in Ireland is from the Kinsale Head gas field. Natural gas is a valued source of energy in Ireland used by both industrial and domestic users. It is estimated that the reserves of natural gas from Kinsale will be substantially depleted by about 1999, hence BGE are now planning to provide alternative sources of natural gas from the UK by means of the interconnector pipeline.

This environmental impact statement assesses the effects of installing and operating the subsea pipeline between Brighouse Bay and Loughshinny.

1.2 THE ROLE OF THE EIA PROCESS

The primary aim of Environmental Impact Assessment is to identify potential interactions between the project, the environment and other resource users. By identifying the potential interactions at an early stage negative impacts can be offset by integration of good environmental practice into the design, construction and operational phases of any project.

The process was formally applied in European practice by EC Directive 85/337/EEC (Assessment of the Effects of Certain Public and Private Projects on the Environment). This came into force in the UK in 1988 under the Town and Country Planning (Assessment of Environmental Effects) Regulations and Environmental Assessment (Scotland) Regulations and on 1 February 1990 in Eire under the European Communities (Environmental Impact Assessment) Regulations 1989 and the Local Government (Planning and Development) Regulations, 1990 (S.I. No. 25 of 1990).

The EC Directive notes two scales of project; Annex I where EIAs are compulsory and Annex II where such assessments are at the discretion of the individual state where it is considered such projects could have significant effects on the environment. Sub-sea oil and gas pipelines are listed under the

optional Annex II. The UK Department of the Environment uses three broad criteria to define "Significant". These are:

1 major projects which are of more than local importance.
2 smaller projects proposed for particularly sensitive locations.
3 projects with unusually complex and potentially adverse environmental effects

where expert and detailed analysis of these effects would be desirable and would not be carried out under normal planning procedures.

The scale and international importance of the Irish Sea Gas Interconnector Project would suggest that an EIA would be required. However, as well as meeting international regulations, an EIA offers other benefits to the developer:

1 The EIA process also aids the authorization process required for any pipeline project by presenting relevent information in a structured way, thereby helping the decision-making process.

2 If incorporated at an early stage of the design process, the EIA allows the developer to take a systematic look at any potential environmental problems and incorporate any relevant changes that could prevent last minute design changes brought on by pressure from authorities, or even more expensive remedial measures after installation.

3 The EIA is also useful for presenting an independent, professional consideration of the project for dissemination to the public and interested parties. Any problems encountered are put into perspective and allow early and complete discussion of the proposed development to take place.

1.3 THE GAS INTERCONNECTOR SUBSEA EIS

MCS International were commissioned by BGE to assess the environmental impacts of the subsea aspects of the proposed interconnector project from Mean Low Water Spring at Brighouse Bay to Mean Low Water Spring at Loughshinny. MCS International undertook this work in association with the International Centre for Island Technology, Heriot-Watt University, Scotland.

1.4 STRUCTURE OF THE EIS

The structure of this EIS is presented below:

1. A description of the proposed development.

2. A description of environmental conditions in the project area.

3. A description of sea use in the project area.

4. Identification of potential interactions between the project, other users and the environment.

5. Assessment of the scale of the interactions.

6. Assessment of the significance of the interactions.

7. Recommendations for environmental management of the project.

1.5 SOURCES OF INFORMATION

This report should be seen as providing an assessment of the project within the constraints of available data; the majority of the data was compiled from published sources and responses from interested parties. However, not all approached parties have responded within the EIA timescale and consequently their views cannot be incorporated. The views of all those who responded within the EIA timescale have been considered.

2 THE DEVELOPMENT

2.1 THE PIPELINE

The proposed pipeline has been designed to transport natural gas at a maximum operating pressure of 148 bar g. This will allow a flow rate of 600 MMCFD to be achieved. The maximum depth of the pipeline under the sea will be 110m, with maximum design current speeds reaching 1.3m/s and waves having a maximum height of 19.22m and an associated period of 13 sec. The details of the pipeline necessary to operate as set out above are: a steel pipe with internal diameter of 24 inches; pipe wall thickness of 15.9mm and a reinforced concrete protective coating ranging from 60mm to 75mm.

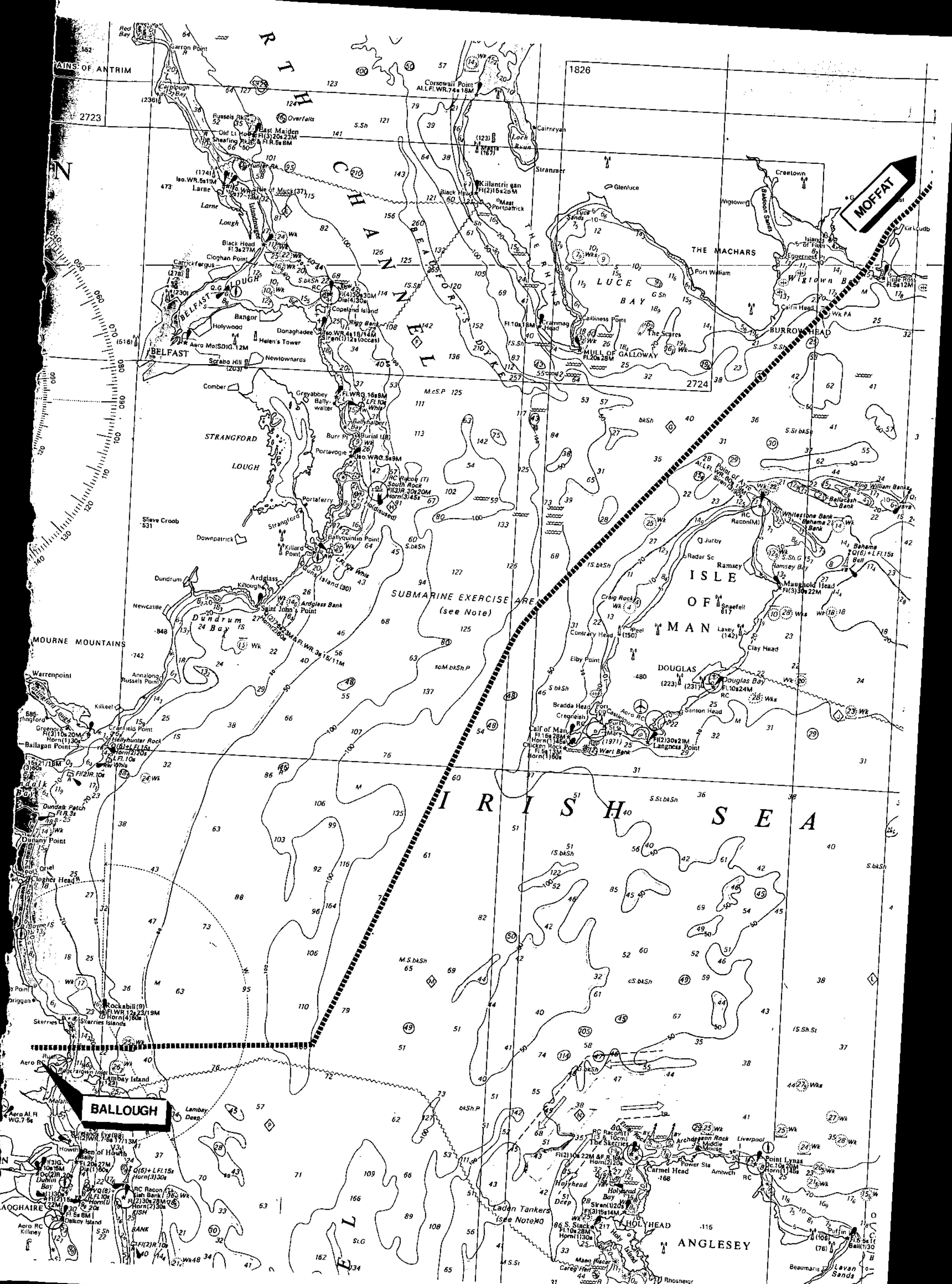
2.2 ROUTE PREPARATION

The proposed route for the pipeline between Brighouse Bay and Loughshinny is shown in Figure 1 A detailed survey of this route has been carried out. This survey has been used to carry out a pipeline freespan analysis and the results from this analysis have identified specific areas of the seabed which require preparatory work before the pipeline can be laid. This operation is called pre-sweeping and it's purpose is to remove sand waves and other dredgable high spots from the pipeline alignment which will avoid formation of freespans.

Pre-sweeping is performed by mobilising and operating a dredger, (generally a trailer hopper suction dredger), which will reduce locations of high elevations leaving the route with acceptable gradients for pipelaying.

2.3 PIPELAYING

Offshore pipelines in European waters are generally constructed by conventional S-laying using a laybarge. The laybarge is continuously anchored to the seabed and moves forward by shifting the anchor positions. This allows the pipeline to be kept in tension and avoids buckling. The pipeline is lowered over the stern of the laybarge onto the seabed over a pipe support ramp called a stringer.



MOFFAT
BALLOUGH
IRISH SEA
ISLE OF MAN
NORTH CHANNEL
BEAUFORT'S DYKE
LUCE BAY
THE MACHARS
THE RHINS
STRANGFORD LOUGH
BELFAST
BELFAST LOUGH
Larne
Stranraer
Portpatrick
MULL OF GALLOWAY
BURROW HEAD
Wigtown Bay
Creetown
Glenluce
Port William
Cairnryan
Loch Ryan
Corsewall Point
Killantringan
Black Head
Copeland Island
Donaghadee
Bangor
Holywood
Newtownards
Comber
Greyabbey
Ballywalter
Portavogie
Portaferry
Strangford
Downpatrick
Ardglass
Saint John's Point
Dundrum Bay
Newcastle
MOURNE MOUNTAINS
Annalong
Kilkeel
Warrenpoint
Greenore
Cranfield Point
Dundalk Bay
Dunany Point
Clogher Head
Skerries
Skerries Islands
Rockabill
Rush
Lambay Island
Malahide
Howth
Ben of Howth
Dublin Bay
Dalkey Island
Killiney
KISH BANK
SUBMARINE EXERCISE AREA (see Note)
Laden Tankers (see Note)
Point of Ayre
Jurby
Ramsey
Ramsey Bay
Maughold Head
Snaefell
Peel
Contrary Head
Laxey
Clay Head
DOUGLAS
Douglas Bay
Elby Point
Bradda Head
Port Erin
Calf of Man
Chicken Rock
Castletown
Langness Point
Santon Head
King William Banks
Ballacash Bank
Whitestone Bank
Bahama Bank
The Skerries
Holyhead
HOLYHEAD
ANGLESEY
Holy Island
Carmel Head
Amlwch
Point Lynas
Middle Mouse
Rhosneigr
Puffin
Beaumaris
Lavan Sands
Bangor
S. Stack
Liverpool
1826
2723
2724

The pipelay operation commences with mobilisation of the laybarge to the site. It is proposed that the laybarge will set up initially at Brighouse Bay where it will commence operations with the landfall shore pull. Once the pipeline has reached the shore, the laybarge begins to lay pipe along the route alignment. The laybarge carries a supply of pipe lengths, or joints, sufficient for two or three days pipelaying. The stocks are continually replenished by pipe haul vessels which carry pipe from a nearby source,- either a dockside or a larger bulk pipe carrier. Once the pipe joints are loaded onto the lay vessel, they may be double jointed. This optional activity involves welding two joints of pipe together such that the pair of pipe joints are then handled as a single unit. A lay tolerance of +/- 15 metres has been specified for this project, although an accuracy of +/- 10 metres is commonly achieved during such operations. Immediately after a section of the pipe has been laid, an as-laid survey is performed to confirm that the pipe is undamaged and laid within the specified tolerance limits.

On completion of the lay operation, the precise end chainage position of the pipeline is determined by the on-board computer. At this point a lay down head is welded to the end of the pipeline. The laybarge then proceeds to carry out the shore pull at the Loughshinny landfall, where the pipe is laid out to the tie-in location adjacent to the lay down head on the previously installed section.

2.4 TRENCHING AND PROTECTION

On completion of the pipelay operations a pipeline trenching spread will be mobilised to trench the pipeline.

The selection of trenching equipment is directly related to the depth of trench specified and the particular soil conditions existing on the route.

Careful scheduling of the trenching operation will be required to ensure that at no time is the trenching spread on standby, awaiting completion of pipelay. For the contingency condition where a hard seabed prohibits trenching, or where discrete freespan correction is necessary, a rockdumping spread will be mobilised. Suitably graded rock will be placed over the pipeline in these sections to reduce pipeline spanning and/or provide additional in-place stability. Rockdumping will be kept to a minimum and will be used only

when bedrock or other hard seabed conditions are encountered at or near the surface of the seabed.

2.5 ON SITE WELDING

Single or double pipe joints are fed into the firing line where the joints are welded into the pipeline prior to laying over the stern. The firing line consists of up to eight welding stations (four for double joints) where progressive layers of the butt weld are deposited.

The first station threads the buckle detector cable and internal line up the clamp control cable through a new pipe joint with the firing line, and hydraulically clamps them together; the root pass weld is then performed. The second station runs the hot pass weld and subsequent stations perform the filler welds and the last welding station caps out the weld. Following completion of the weld, the weld is radiographed using an X-ray source mounted inside the pipe on a remotely controlled chassis, and if required weld repairs are performed. Finally the field joint coating is applied to the weld area and the void between adjacent concrete coatings filled with a suitable infill.

2.6 COMMISSIONING

2.6.1 Tie-in

On completion of the pipelaying operation the two offshore ends of the pipeline will be laid parallel in close proximity on the seabed overlapping by approximately 10m. A welded tie-in will then be made by hyperbaric welding.

Hyperbaric welding requires that initial flooding of the pipeline has been carried out. Divers locate the two pipeline ends on the seabed and move them together using large mechanical pipeline handling frames (PHFs). When flooded, thereby removing any potential pressure differential, it is safe for the divers to cut the laydown heads and prepare the pipe ends for hyperbaric welding. Sealing plugs are installed inside each end and inflated to create a water tight seal 1-2m from each end. The ends are aligned with the PHFs and a hyperbaric chamber installed over the connection point. Water is

pumped from the chamber by filling the chamber with a diving gas mixture at the ambient pressure. Water level is maintained close to the bottom of the chamber and a floor installed under the pipe to allow a dive team to enter and remove their diving equipment prior to carrying out the welding, NDT and coating operations. All sub-sea equipment is then removed and the internal seals removed by pigging the pipeline.

2.6.2 Flooding

The pipeline will be flooded with filtered seawater treated with corrosion inhibitors, oxygen scavengers and a biocide to enable completion of the tie-in activities and then pressure testing of the pipeline.

Flooding will be performed from the landfalls, with the main spread probably located at Brighouse Bay. The flooding spread consists of:

i) water intake pontoon moored a sufficient distance from shore to obtain a constant supply of seawater free of sand and silt at all tidal stages.

ii) suction pump and supply hoses to shore based filtering and break tanks.

iii) chemical injection facilities.

iv) discharge pumps to pump the filtered, treated seawater into the pipeline.

v) temporary pig launcher on the pipeline end.

The filling operation will be performed by launching a train of pigs into the pipeline propelled by treated seawater. The train would typically comprise two cleaning pigs followed by two pigs fitted with gauge plates. They would generally be separated by 500 - 1000m of filtered but not chemically treated seawater. The pig train is then pumped through the pipeline at a rate of 0.5 - 1.0 cumecs. with filtered and chemically treated seawater. This operation typically takes between 3 - 5 days.

2.6.3 Hydrostatic Testing

55,000 tonnes of treated seawater will be needed for hydrostatic testing of pipeline integrity. Test heads are installed on each landfall pipe end and a pressure testing spread is mobilised to perform the operation. The pressure of the pipe is slowly raised until a hoop stress of 90% of the specified minimum yield strength of the pipeline is induced. The pressure is allowed to stabilize then the 24 hour test period is commenced. The pressure is continuously monitored throughout the test period.

Minor variations in the test pressure often occur (these can be due to temperature changes etc.) and, unless these variations can be accounted for, such changes frequently lead to extension of the test period until all parties are satisfied that no leaks exist. The pipeline is then depressurized and a formal pressure test report prepared as evidence of a satisfactorily constructed pipeline.

2.6.4 Treatment Chemicals

The choice of chemicals used in the test seawater is important. The mix typically includes a biocide to remove biofouling organisms, an oxygen scavenger and a corrosion inhibitor. The rate at which these chemicals are added to the water and the specific products used will require detailed discussion with the authorities responsible for approving the eventual discharge of the test water. The very large volume of treated water required to be discharged could affect marine life in the immediate vicinity of the discharge location.

Aspects to consider include toxicity, persistence and tendency to bioaccumulate.

Although the chemicals to be used have not yet been specified, a typical mix would have the following characteristics:

Oxygen scavenger	the active chemical is typically Ammonium bisulphite such as in Blacksmith OS2. This has a Department of Energy rating of 1 under the Chemical Notification Scheme (CNS). This rating is based on acute toxicity to the brown shrimp Crangon crangon.

Corrosion inhibitor	the active chemical is typically an Amine base such as with Blacksmith CP1300 which is CNS rated as 0.
Biocide	although there are alternatives the most common and best compromise between effectiveness and environmental affect is a biocide based on polymeric biguanide hydrochloride such as in Blacksmith B1200. This has a CNS rating of 2.

The Department of Energy Chemical Notification Scheme has five categories:

DEn Rating	Permitted discharge per installation per year without notification
0	No limit
1	up to 100 tonnes
2	up to 10 tonnes
3	up to 1 tonne
4	No discharge without notification

It is important to note that the permitted discharges above refer to releases per year rather than per release. The relevance to the single, point discharge of the hydrostatic test must therefore be closely considered.

The Paris Commission are examining alternatives to the CNS scheme to implement a single international system to control the discharge and use of chemicals in the North Sea particularly. This will more than likely have knock on effects for the rest of the UK and Irish Continental Shelf.

In independent toxicity trials running alongside the Paris Commission, trials using the calanoid copepod Acartia tonsa and the Pacific oyster *Crassostrea gigas*, in addition to the brown shrimp *Crangon crangon*, the polymeric biguanide hydrochloride based biocide is suggested as having the best combined performance (i.e. second lowest acute toxicity and second best antimicrobial performance out of six tested formulations). (Whale and Whitham 1991).

2.6.5 Dewatering and Precommissioning

The precommissioning will comprise bulk dewatering followed by drying operations to remove residual water. Bulk dewatering is achieved by propelling pigs through the pipeline with compressed air. Up to 30 bar pressure will be needed to overcome the hydrostatic head in addition to the frictional head of the water and pigs. When successive pigs fail to sweep appreciable quantities of water from the pipeline then bulk dewatering is considered complete and drying operations can be commenced.

The discharge rate will range between 0.15 - 0.3 Cu metres/sec with a maximum rate of 0.6 Cu metres/sec.

This means the dewatering will take between 50 and 100 hours. It is also anticipated that the dewatering discharge will take place at the Loughshinny terminal.

Methanol swabbing is frequently applied on gas pipelines and is the selected method for final treatment of the pipeline prior to introduction of gas. A methanol swabbing train complete with nitrogen buffers is propelled through the pipeline with natural gas to dilute the remaining water with methanol sufficiently to ensure that gas hydrates cannot form when the line is gased up.

2.7 OPERATIONS

The pipeline can operate at 148 bar g (14.8 MPa) and will transport natural gas at a flow rate of up to 600 MMCFD (17.0 MMSCMD).

In the event of an emergency a shutdown will be implemented. This shutdown procedure will be based on measurements of pressure and rates of change of pressure at each end of the pipeline. In addition leak detection will be carried out by comparing time integrated inlet and outlet flow rates to provide a system mass balance.

The pipeline condition will be monitored by ROV equipped with TV/video on a regular basis. Maintenance operations will be introduced when required. With the marine stretch of the project consisting of a 24" steel pipeline covered with concrete coating, it is anticipated that maintenance, if and when

required, will primarily focus on prevention of freespans and replenishment of rockdump material.

2.8 DECOMMISSIONING

The Works Authorisation, granted under the Petroleum and Submarine Pipelines Act 1975 will contain a schedule setting out the measures required for abandonment of the pipeline. Abandonment can be interpreted as ceasing to use with the intent not to re-use, rather than ceasing to own. Under the Act the Secretary of State is given the power to "at any time thereafter, and on more than one occasion", to serve notices on the holder of the authorization specifying work to be carried out "to prevent the pipeline from being or becoming a navigation or fishing hazard or source of pollution". This implies continuing obligations on the holder after final use of the pipeline until such time as the authorization is terminated by mutual consent. (Huntington 1988).

The Petroleum Act 1987 extends the 1975 Act to include those older pipelines that were constructed before the need for works authorization. As such it provides a uniform legal base for all offshore pipelines. However, it is also wider in scope than the 1975 Act and recognizes the high financial costs of offshore abandonment work and attempts to ensure that this cost can be, and is, met by owners of the pipeline. (Huntington 1988).

Any treatment of abandonment is inevitably dominated by financial considerations, but as Huntington points out abandonment costs may be offset against tax liabilities and so it is in the interests of both operators and government to minimize expenditure commensurate with an adequate abandonment scheme.

The options include full removal, partial removal, deep burial or a combination of these. Under the works planning full attention must be given to such options. At this stage no decision has been made as to the abandonment policy. However, BGE recognize that opinion changes in relation to the best approach to such issues and are prepared to fully comply with the regulations in force at the time of abandonment if this were to be a requirement.

3 THE ENVIRONMENT

3.1 PHYSICAL

3.1.1 Bathymetry

A marine survey of the proposed pipeline route was carried out by Seateam U.K. Limited between 16th August 1991 and 11th October 1991. The results of this survey are detailed in a seven volume report written by Seateam for BGE. The bathymetry of the proposed route is summarised in this section.

From the start of the offshore survey around KP 2 the seabed deepens relatively steadily at gradients of around 1:250. It reaches a maximum depth of 110 metres in the vicinity of KP 40 before shoaling again. As the route turns onto a north northeast orientation it parallels the seabed contours for a time.

In the vicinity of KP 62 the bathymetric contours have changed orientation so that they cross the route perpendicularly. The seabed continues to shoal gently to a depth of less than 63 metres around KP 74. After this point the seabed appears to flatten as the route parallels the strike of the northwesterly dipping seabed.

From KP 86 contours again change orientation to strike perpendicular to the route. The seabed topography undulates gently as it again deepens. The seabed dip changes again to a west northwesterly direction between KP 104 and KP 119 giving rise to a flat route profile over this section, with a mean depth of 87 metres L.A.T. The seabed continues to undulate around the 87 metres L.A.T. up to KP 127 where there is a 19 metre riser in the seabed between KP 127 and KP 128.

Between KP 127 and KP 143 the seabed is smooth but undulating with very little change in overall elevation. The only area of note being a sandwave field between KP 137 and KP 143.

There is a substantial change in seabed topography between KP 143 and KP 189. The seabed undulates around a mean depth of approximately 40 metres in a very irregular manner giving rise to some short but very steep gradients.

Furthermore, the route crosses some of the steep slopes parallel to the contours.

As the seabed irregularities die out so a series of sandwaves develop up to KP 193. After KP 193 the seabed shoals gently towards the Scottish coast.

In general the survey agrees well with published bathymetric surveys of this area, such as Irish Sea, Liverpool Bay to Dublin and North Channel, Imray C6. The only area where a discrepancy arises is around KP 127, Imray C6 chart does not show a sufficient level of detail to observe this feature.

3.1.2 Seabed Sediments

The route can be almost divided into two halves based on the sediment type. Muddy deposits prevail at the seabed over the southern half of the route while in contrast the northern section is characterised by granular deposits. Muddy sediments are present at the seabed between KP 2 to KP 12. Rock and Till outcrops punctuate this thin sediment cover between KP 3.7 and KP 5.8 and again between KP 7.8 and KP 12. A smooth sandy clayey seabed persists after KP 12. As the route progresses offshore so the sediments become less sandy to the point where almost pure clays exist from KP 44 to KP 126. Some small quantities of fine gravel may also be present within these clayey soils.

From KP 126 to KP 131.7 there is a transitional zone where a sandy seabed develops with a decreasing clay proportion as the route heads north. The mean seabed grain size continues to increase with shell and gravel deposits between KP 131.7 and KP 137.5 where Tills are in close proximity to the seabed. As the superficial soils thicken over the next 13 km so a seabed veneer of shelly sand develops.

The Till rises at or close to the seabed producing a very irregular topography between KP 150.4 and KP 187.9. The seabed sediments consist of a thin gravely sand veneer with scattered cobbles and boulders. Eroded into these deposits are a series of large linear depressions / furrows.

After KP 187.9 sands develop which seem to become progressively more gravely as the route approaches the shore.

The results of this survey agree very well with the seabed sediments described in the Isle of Man, Sheet 54N 06W, British Geological Survey map. The findings of this survey are also in general agreement with maps of surface sediments of the Irish Sea as presented in the Irish Sea Study Group Report.

3.1.3 Seabed Geology

The shallow geology of this route can be subdivided into basically four areas;

i) The Irish Platform
ii) The Central Basin
iii) The Outer Slope of the Scottish / English Platform
iv) The Scottish / English Platform

i) The Irish Platform - KP 0 - KP 16.5

From KP 2 (the start of the offshore survey) there is approximately 5 metres silt and clayey sand overlying Till and / or Bedrock. This cover thins rapidly between KP 4 to KP 6 and KP 7.9 to KP 11.5. There is a cover of approximately 2 metres of soft clay which is thought to rest directly onto till.

ii) The Central Basin KP 16.5 - KP 97.7

This area is dominated by a thick sequence of acoustically well layered clays, often over 20 metres thick. The base when visible is usually an irregular erosion surface, however, more frequently than not this base is obscured by substantial masking, particularly between KP 30.6 to KP 40.8, where gas occurs up to the seabed. Further masking with plumes occur after KP 40.8 up to KP 79.6 and again from KP 86.2 to KP 94.8.

The soils themselves are particularly uniform very soft clays and slightly sandy clays with shear strengths consistently between 10 KPa and 16 KPa at 2 metres depth.

Soils of this type which are poorly compacted found within the North Sea commonly contain low concentration of biogenic gas, predominantly methane.

Recomputed Co-Tidal Chart for Proposed Pipeline

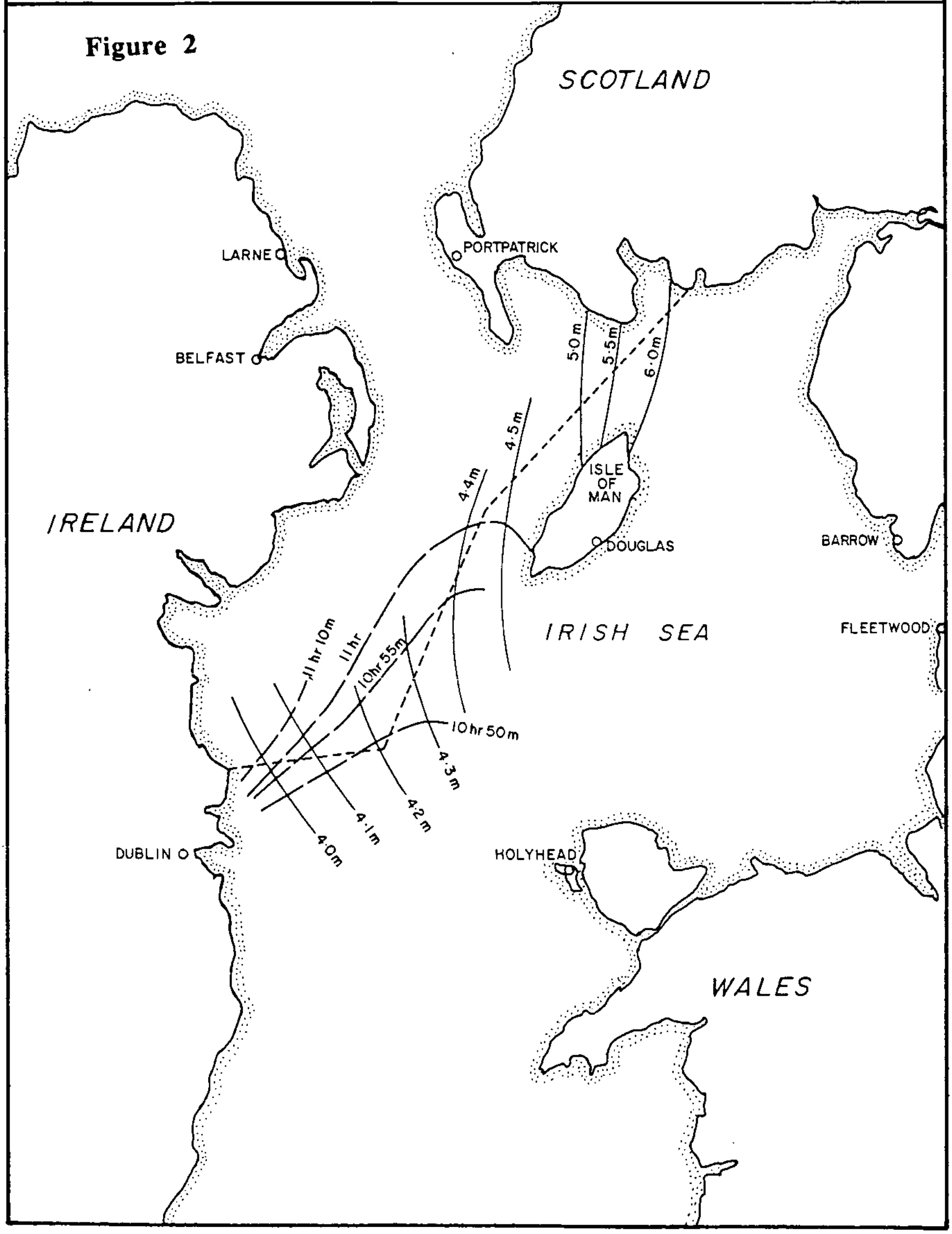


Figure 2

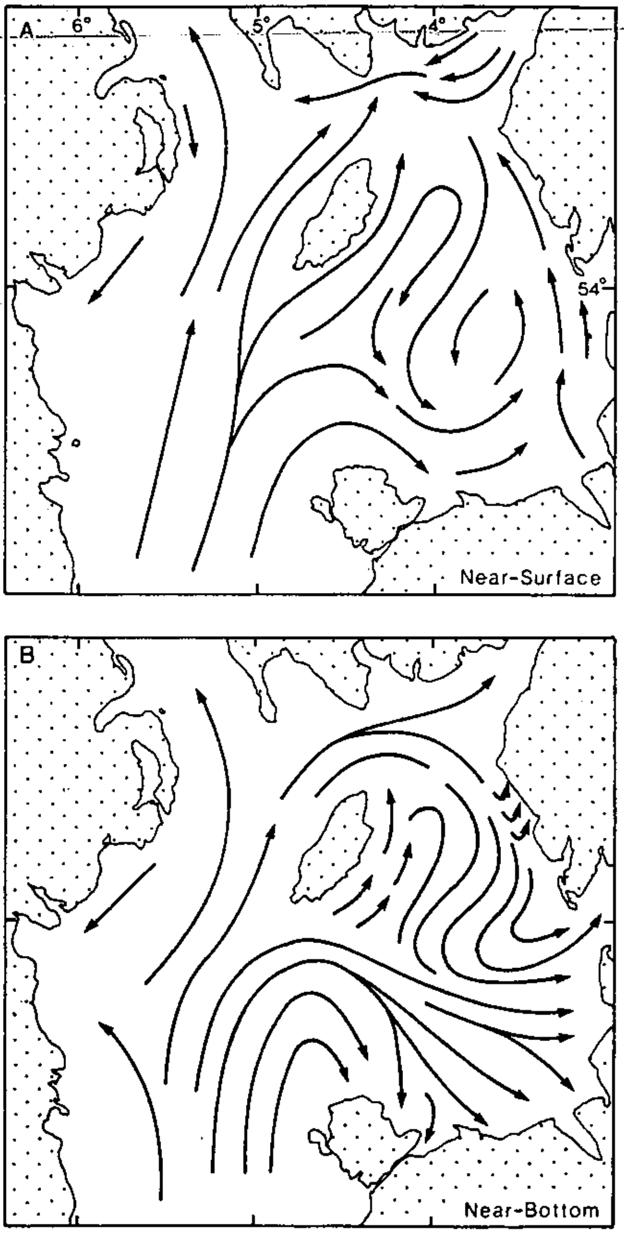


Figure 3 Residual Currents

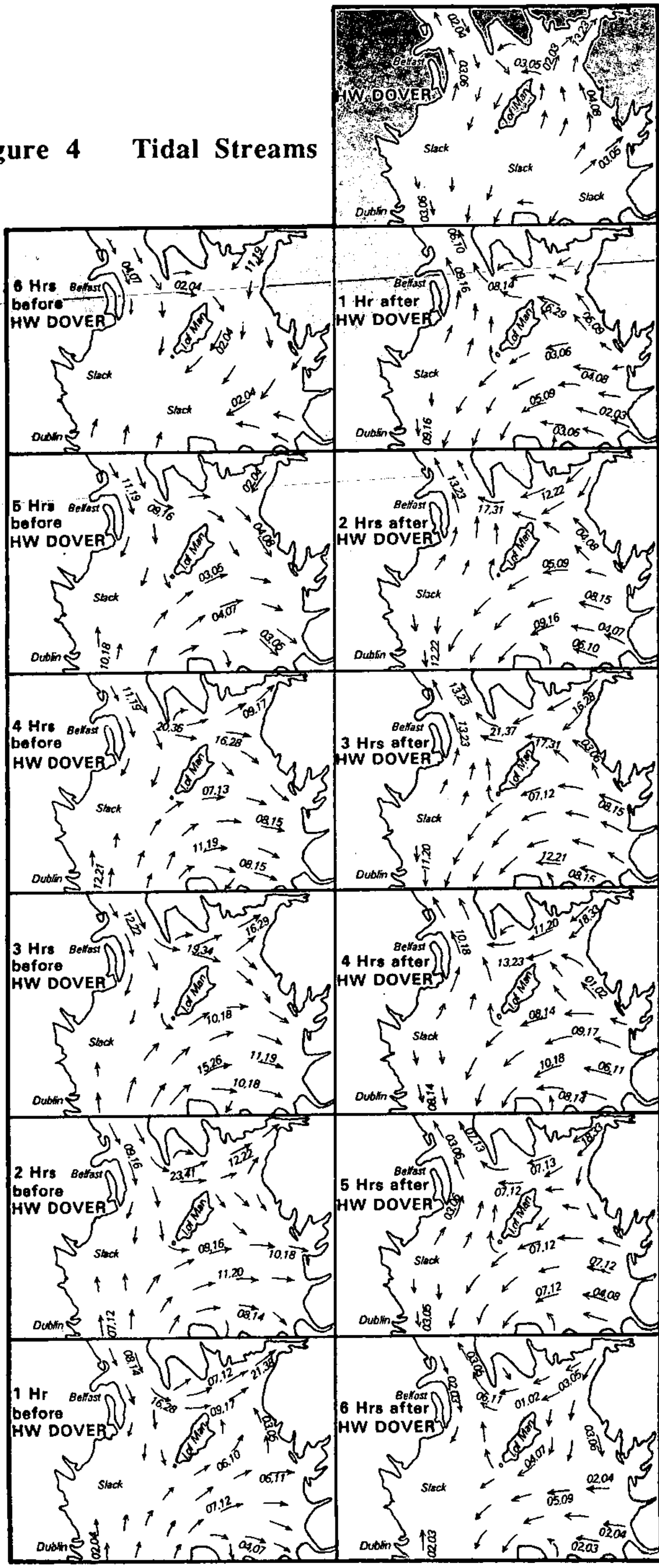
However, the mechanics of movement of water in the Irish Sea is complex and depends on many factors. Currents averaged over longer than a day are driven by four principal forces: wind dynamics, tidal dynamics, density gradients and sea surface slopes. Of these the wind and tidal dynamics generate the most significant currents. Measurements show that there is a high degree of correlation between the flow through the North Channel and the strength and direction of the prevailing wind. Winds from the south and east force water northwards whilst winds from the west and north force the water southwards. Since the Irish Sea is semi-enclosed winds do not generate currents within it as strong as wind generated currents in the North Sea, away from the coastline the fastest wind induced depth - averaged current is estimated to be approximately 1 kn.

A general statement regarding residual currents is provided by Ramster and Hill (1969) when they plotted wind and tide induced currents. Their study was carried out by taking direct measurements using Woodhead sea drifters. Figure 3 shows residual current patterns for currents twelve metres below the surface and currents four metres above the seabed. Similarity of near-bottom and near-surface current patterns along the western trough is observed, however it is seen that this correlation breaks down towards the eastern sector of the Irish Sea.

On a daily basis this picture of slow and steady northward flow is misleading, the currents can reach speeds of over 3 knots in the Solway Firth and directions are variable and often wind dependent. Figure 4 shows the average tidal streams in the northern sector of the Irish Sea at every hour over a spring and a neap tidal cycle, see Imray C62 Yachting Chart.

Off Kirkcudbright Bay longshore tidal streams of 4 kn in both directions are experienced during spring tides. Physical oceanographic measurements taken by Norris (1989) at a number of locations in the North Irish Sea indicate that at location Lat. 54 deg 35'N and Long. 4 deg. 22'W speeds of 1.4 kn are regularly attained and maximum speeds of about 3.2 kn are reached at 13m below the surface. Regular speeds of about 0.8 kn are reached and maximum speeds of about 2 kn were recorded at a depth of 4 m above the seabed. The measurements recorded at both depths indicate that the current directions are generally either 70° from true north or 250° from true north and hence are running virtually parallel to the proposed pipeline route.

Figure 4 Tidal Streams



Current speeds off the east coast of Ireland between Dublin and Loughshinny reach a maximum of about 2 kn during a spring tide.

3.1.6 Sediment Transport

The movement of sediment, which is difficult to quantify is related to the near-bed current and the shear-stress above a threshold value for a sediment it will cause the sediment particles to be lifted into suspension and transported until the current strength weakens, at which time the particles will be deposited. For sand and gravel the threshold resuspension value is directly related to the size and density of the particle. Between Dublin and the North Channel sand moves inwards towards the Isle of Man and then eastwards into Liverpool Bay and the Solway Firth.

3.1.7 Temperature Distribution

The temperature of the Irish Sea varies considerably with the seasons. Between February and March it is between 5°C and 8.5°C whilst between August and September it is between 13°C and 17°C. The greater variations occur in the shallow coastal waters.

During the summer period the surface layer is heated inducing stratification. Throughout most of the Irish Sea tidal currents are strong enough to overcome stratification, ensuring a well mixed waterbody. However, to the west of the Isle of Man, where relatively weak currents prevail a two-layer stratified system develops during April to October. A thermocline develops between 20m and 30m below the surface with the upper layer of water being about 5°C warmer than the lower layer.

Figure 5 presents recorded temperature measurements at Brighouse Bay between 21st August 1991 and 6th September 1991. Figure 6 shows measurements of temperature at Point 1 throughout the depth on 21st August 1991 and 7th September 1991.

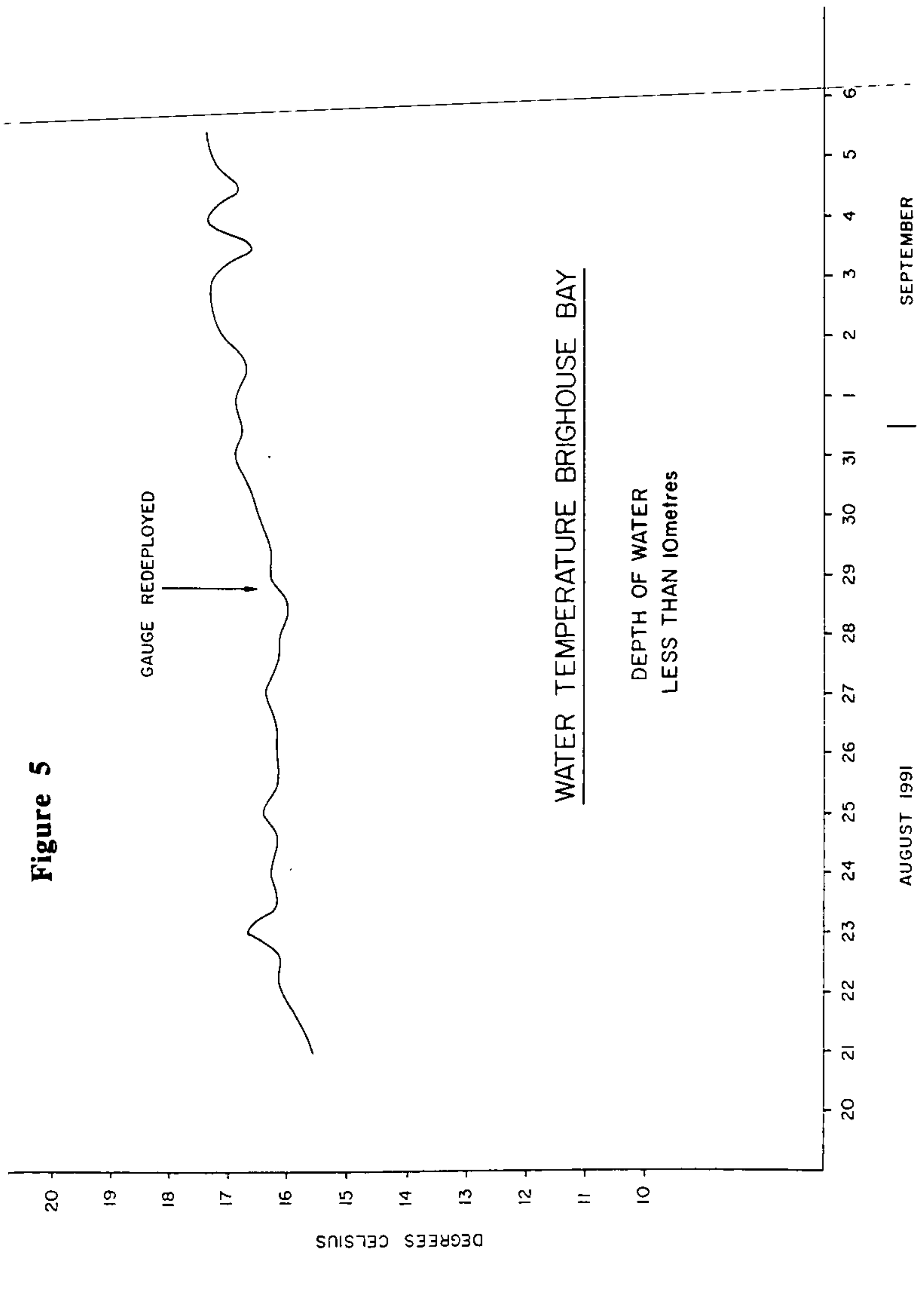

WATER TEMPERATURE BRIGHOUSE BAY
DEPTH OF WATER
LESS THAN 10metres
GAUGE REDEPLOYED
DEGREES CELSIUS
20 19 18 17 16 15 14 13 12 11 10
20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6
AUGUST 1991
SEPTEMBER

Figure 5

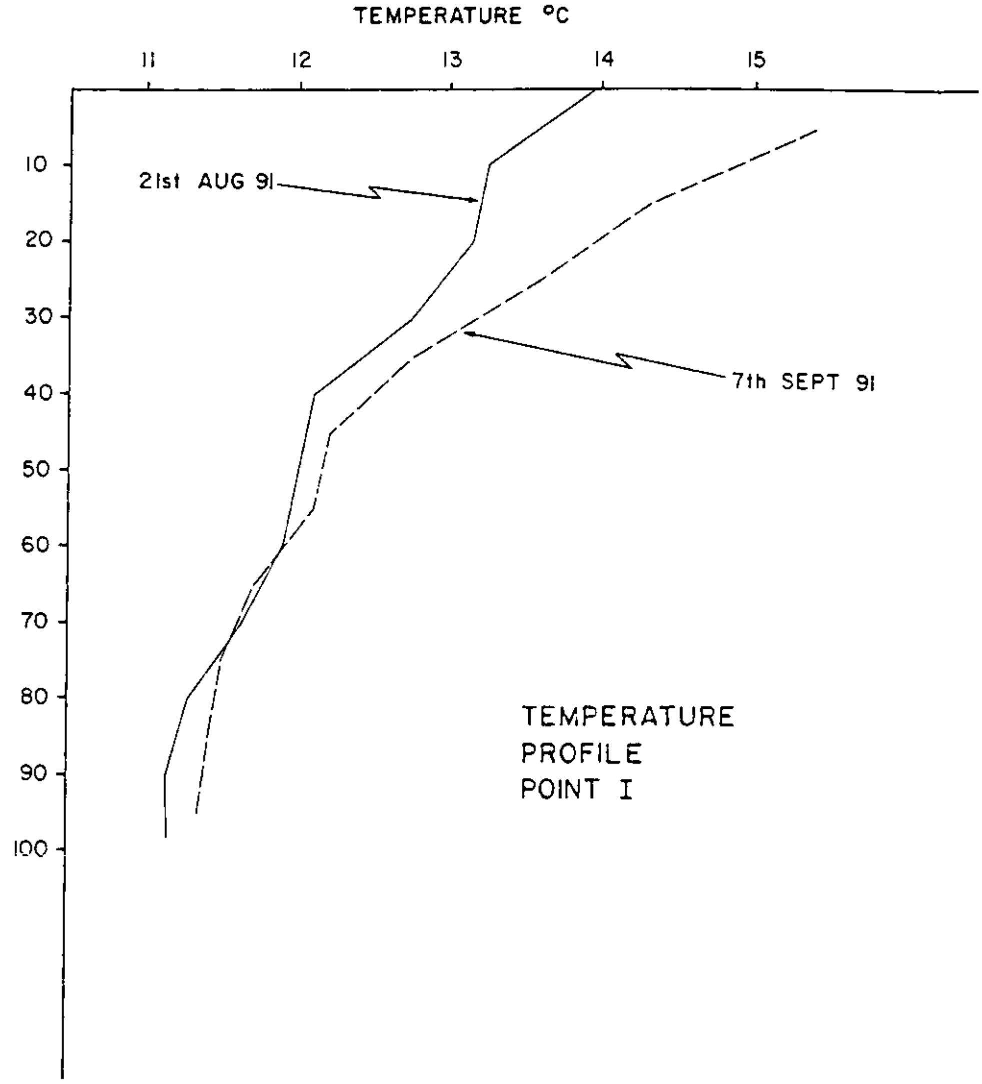

TEMPERATURE °C
11
12
13
14
15
10
20
30
40
50
60
70
80
90
100
21st AUG 91
7th SEPT 91
TEMPERATURE
PROFILE
POINT I

Figure 6

3.1.8 Wind and Waves

Wind conditions play a significant role in defining both wave and current characteristics in the Irish Sea. Figure 7 presents a wind rose of mean hourly wind speeds and directions at Whithorn, Lat 54° 42'N and Long 4° 25'W between the years 1983 - 1989 inclusive, reduced from data obtained from the UK Meteorological Office. Whithorn is in close proximity to Brighouse Bay and may be considered representative of wind conditions at Brighouse Bay. Figure 8 shows wind roses for ten stations around Ireland, Rohan (1986). The low frequency of southerly winds experienced at Dublin Airport is attributed to shelter afforded by the Dublin-Wicklow Mountains. Figure 9 shows the distribution of hourly mean wind speeds with a return period of 50 years around Ireland and the UK.

The wave climate at a particular offshore location is primarily dependant on the following: fetch, duration of wind, wind speed and direction, water depth and variables in bathymetry. Because the Irish Sea is semi-enclosed with narrow entrances north and south, waves are predominantly locally generated of fairly short period and steep. There is very little published information available regarding the distribution of waves in the Irish Sea. Figure 10 shows locations of wave data recording sites in the Irish Sea. Figure 11 is based on data provided by the Institute of Oceanographic Sciences. It can be seen from Figure 11 that the maximum recorded wave height never exceeded 16m, and this wave height is attained outside the confines of the Irish Sea, and that the maximum wave height recorded at the Kish was 10m, which is considerably less than the design maximum wave height of 19.22m. Figures 12 and 13 show distributions of fifty-year return period wave heights and wave periods respectively in the Irish and North Seas. It can be seen from these that the wave conditions within the Irish Sea are not as harsh as those in the North Sea.

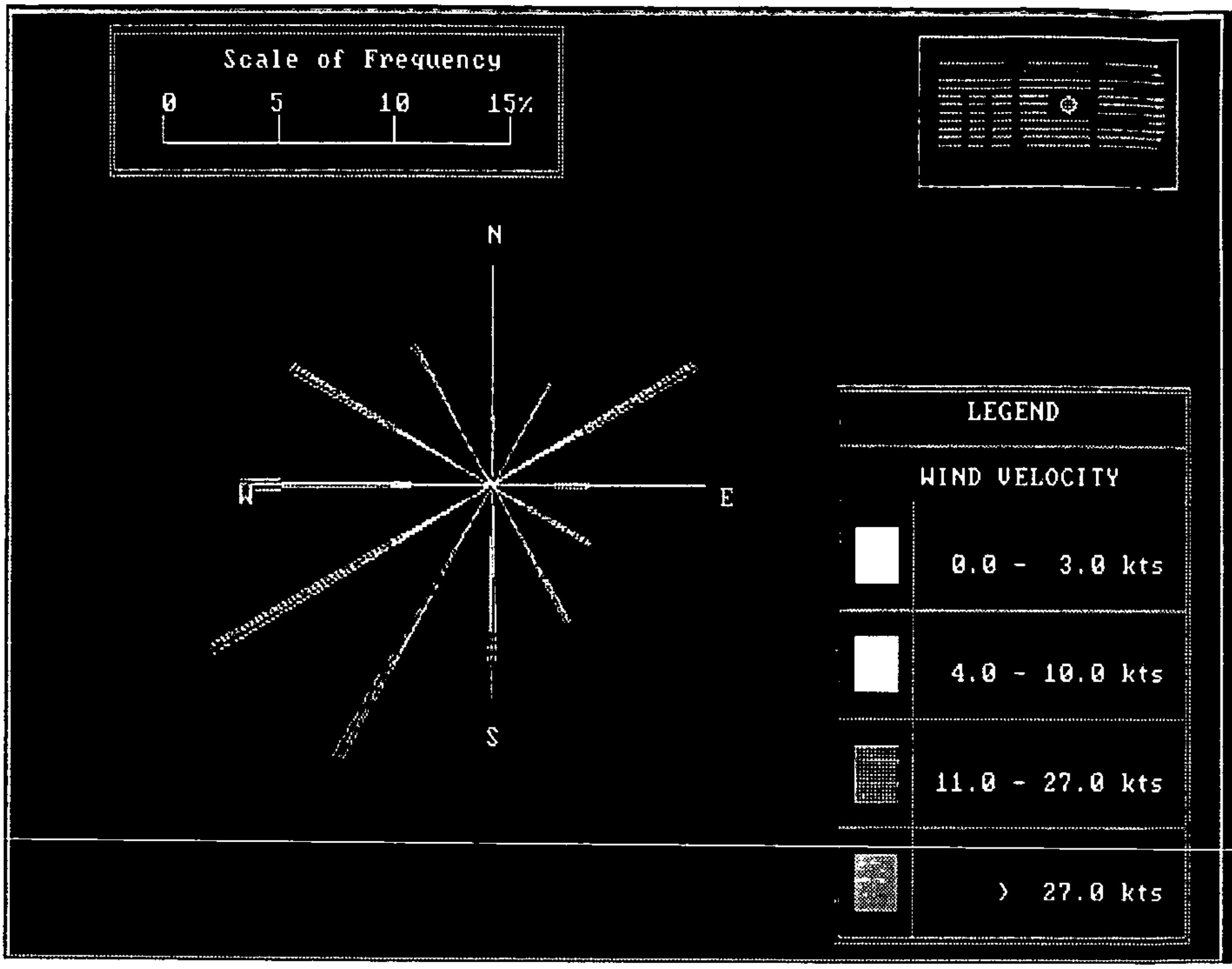


Figure 7 Wind Rose Diagram for Whithorn

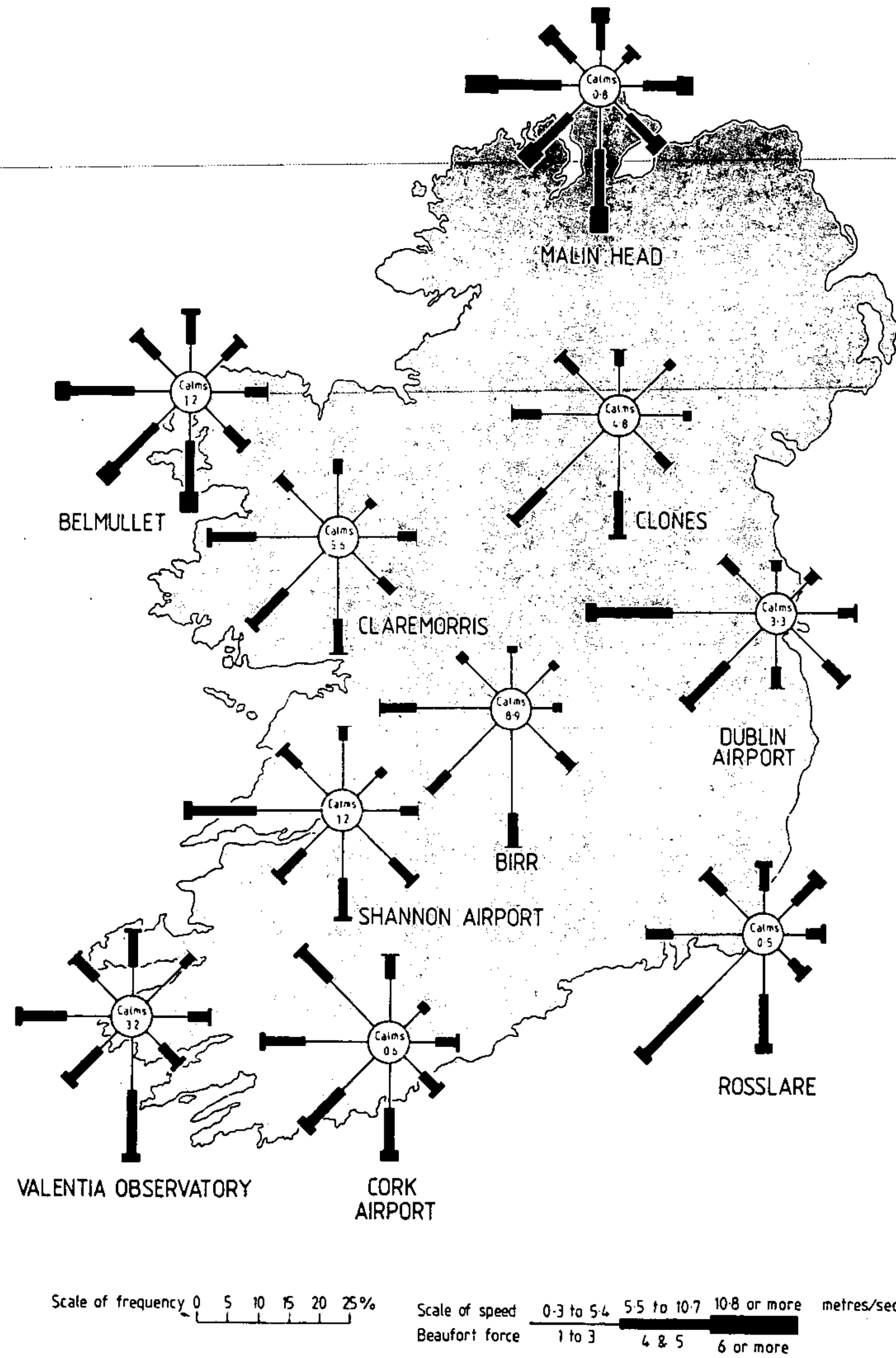
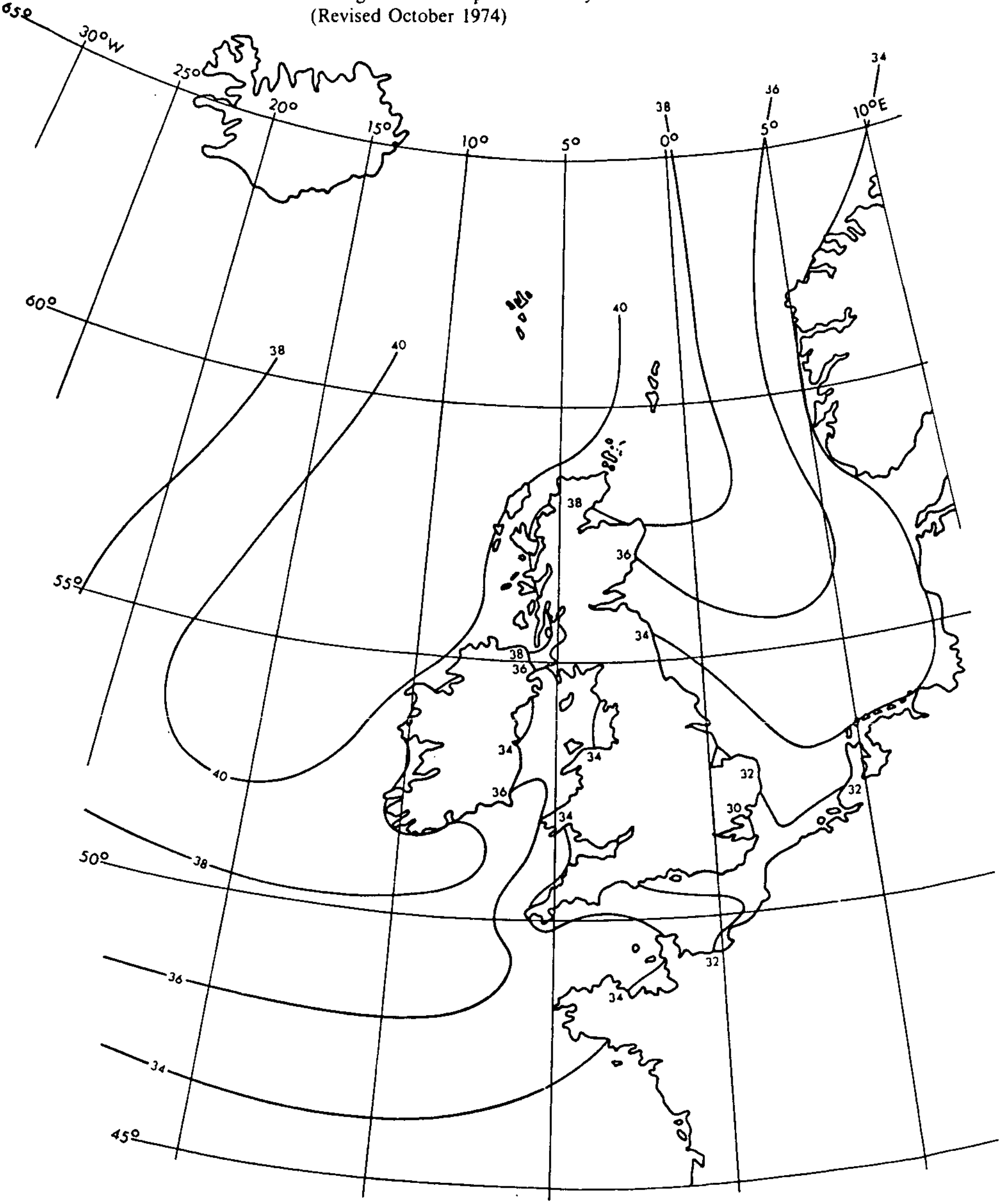


Figure 8 Wind Roses

Figure 9

Hourly mean speed in m/s at 10 metres above the sea surface with an average recurrence period of 50 years.
(Revised October 1974)



April 1984

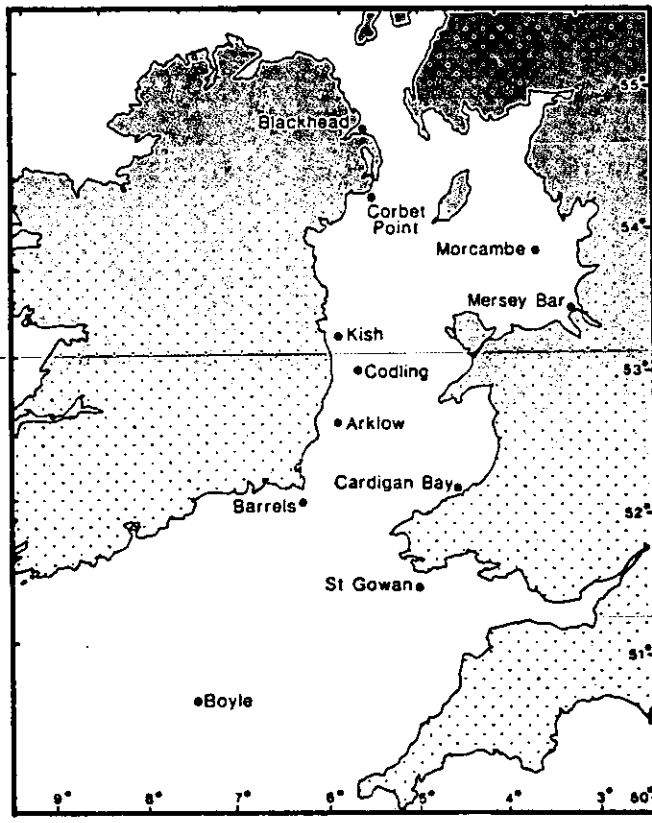


Figure 10 Wave Measurement Locations

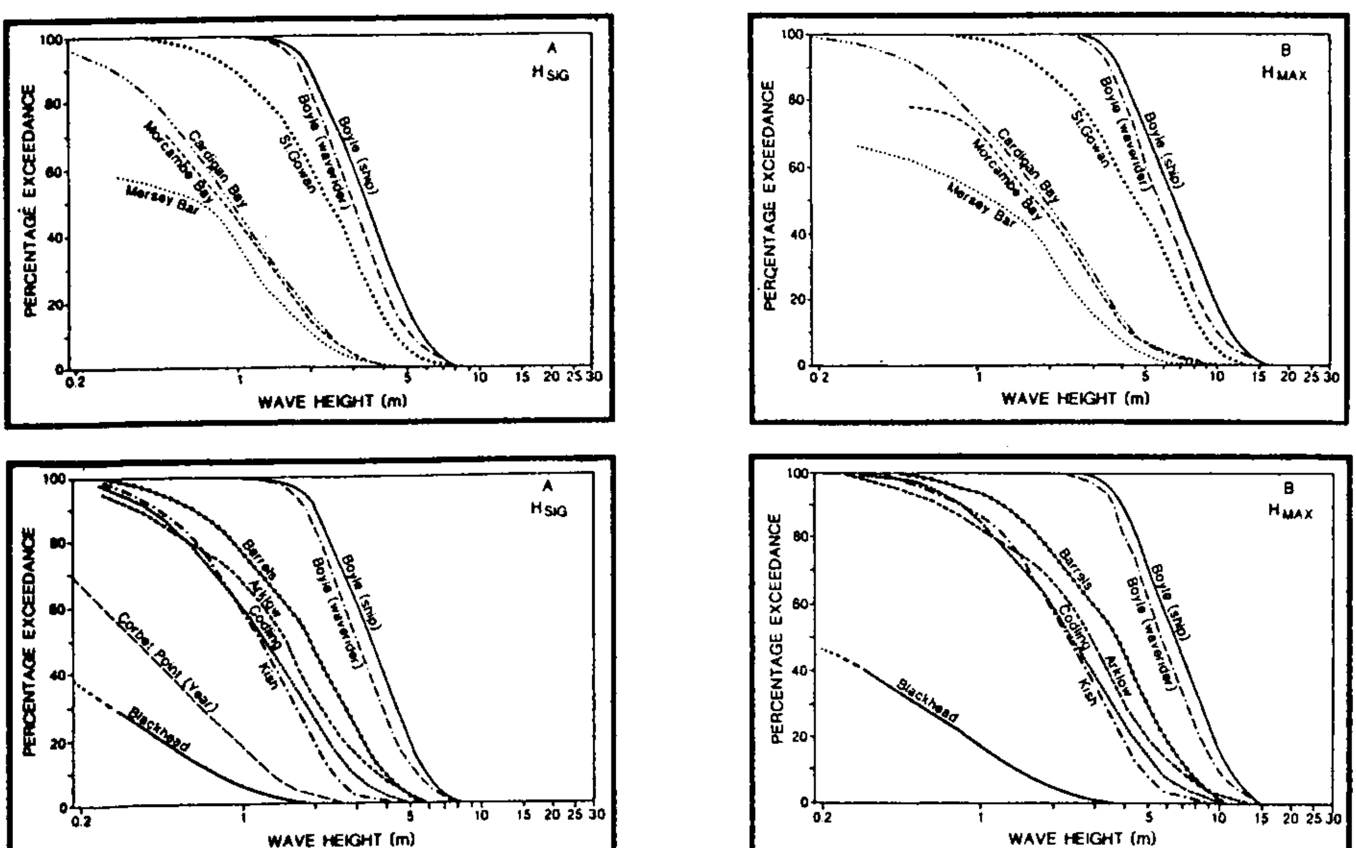
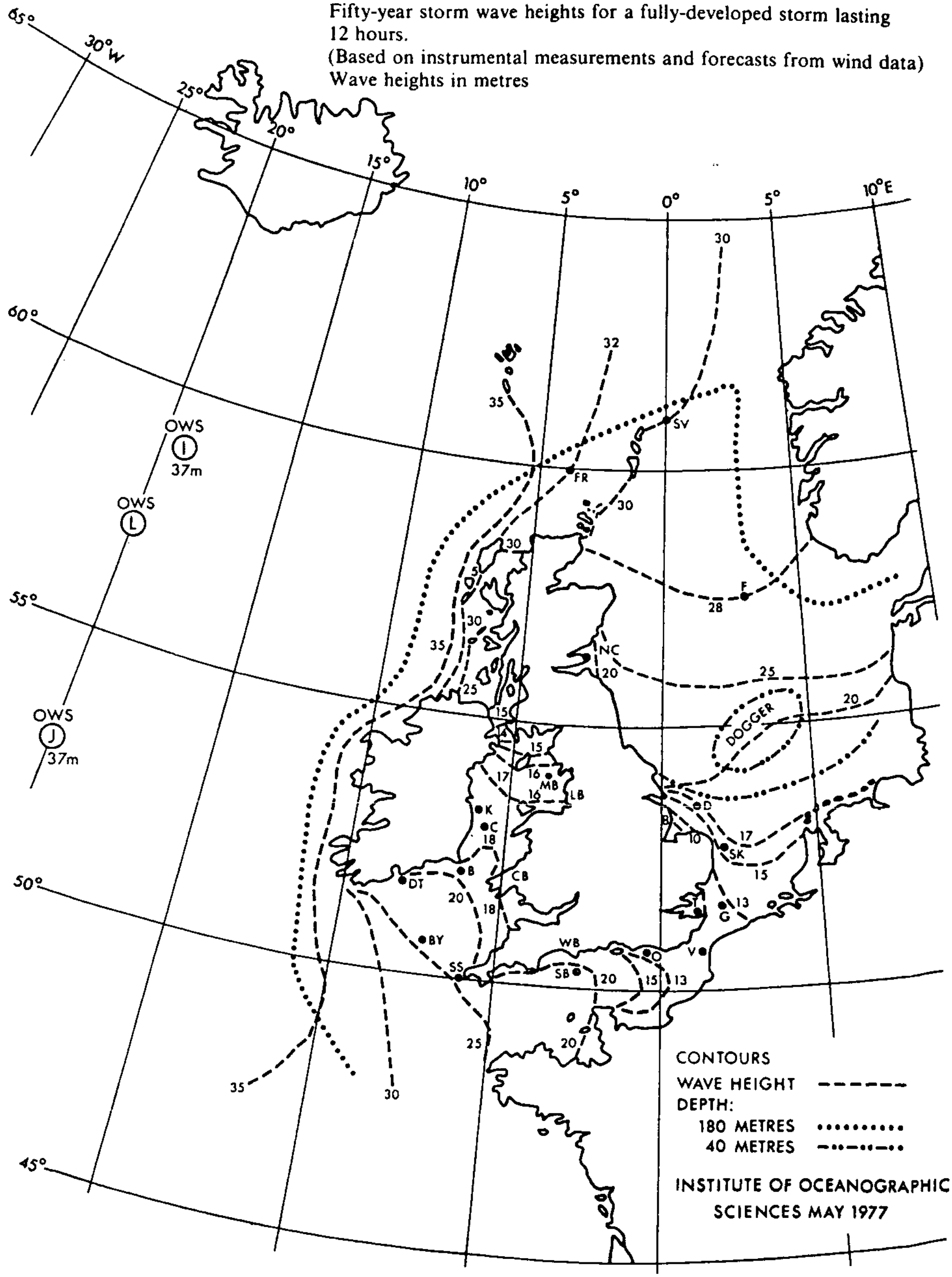


Figure 11 Measured Wave Data

Figure 12

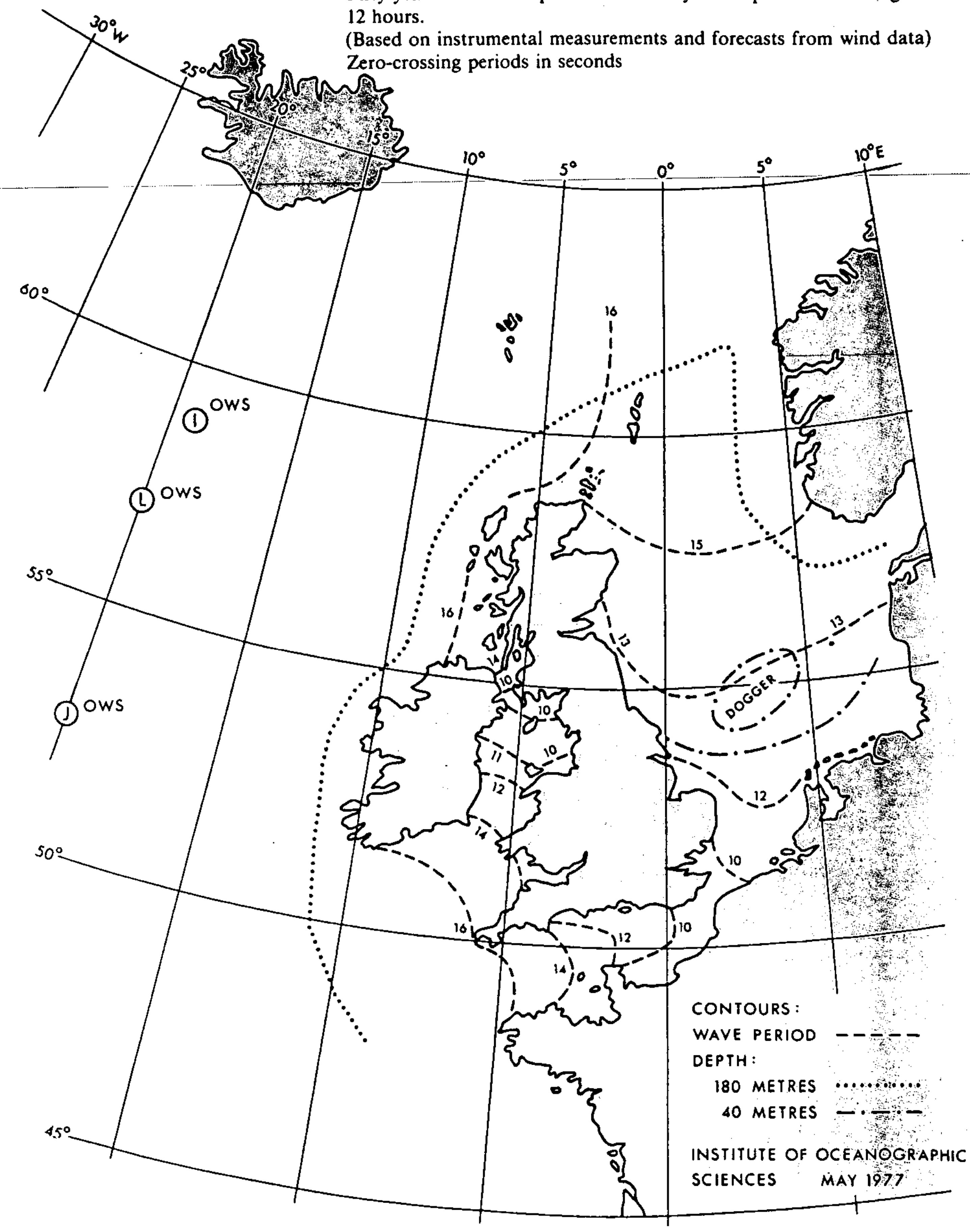
Fifty-year storm wave heights for a fully-developed storm lasting 12 hours.
(Based on instrumental measurements and forecasts from wind data)
Wave heights in metres



NOTE: EXCEPT IN THE SOUTHERN NORTH SEA THE 40m CONTOUR IS OMITTED FOR REASONS OF CLARITY

Figure 13

Fifty-year storm wave periods for a fully-developed storm lasting 12 hours.
(Based on instrumental measurements and forecasts from wind data)
Zero-crossing periods in seconds



NOTE: EXCEPT IN THE SOUTHERN NORTH SEA THE 40m CONTOUR IS OMITTED FOR REASONS OF CLARITY

April 1984

3.2 BIOLOGICAL

3.2.1 INSHORE MACRO BENTHIC COMMUNITIES

The marine environment around the two landfall sites comprise ecologically stable communities, representative of the fauna and flora that would be found in similar areas around the country.

In this context the term "community" is used loosely to mean an assemblage of species, but does not imply that species are reliant on the presence of others. (Holt, Fisher and Graham 1990).

In general terms the seashore can be divided into the **littoral** (above water) and **sublittoral** (below water) zones. The basis of classification is the vertical distribution of key species.
For instance, the boundary between **littoral** and **sublittoral** is that of the lowest astronomical tide (extreme low water spring tides). This coincides with the upper limit of *Laminaria* (kelp).

Spanning the boundary between sea and shore is the **sublittoral fringe** which generally extends from the sea to about 1m above ELWS. This area tends to be dominated by *Laminaria hyperborea.*

The sublittoral is further divided into the **infralittoral** zone where light penetration is greatest and hence is dominated by light loving algae. In the **upper infralittoral** *Laminaria* thrives in well lit conditions, with red algae such as *Chondrus crispus* surviving in the shade under the kelp canopy. As the depth increases to the **lower infralittoral** the kelp dies out leaving the seabed dominated by red algae.

Deeper still, fewer plants survive as the light levels drop. Animals tend to dominate this circalittoral zone. The **upper circalittoral** is characterized by small amounts of algae with bryozoans and hydrozoans, anthozoans, echinoderms and tunicates. The lower limit of the algae is the boundary to the **lower circalittoral**.

The NCC Marine Nature Conservation Review provides a structure for comparing habitats based on the physical characteristics of the individual sites. It basically takes the concept outlined above and adapts it to identify discrete communities.

3.2.1.2 BRIGHOUSE BAY

The sublittoral classification for the Brighouse Bay site is Type 23 Muddy Sand. This is confirmed by the British Geological Survey map of the sea bed sediments around the Isle of Man which identifies the immediate sublittoral zone as being gravely muddy Sand (gmS). The community associated with such sediment tends to fairly species rich compared with simple sand communities. The Irish Sea Study Group list species typical of this environment as being: sea pens *(Virgularia mirabilis)*, *Amphiura* spp with *Corymorpha, Thecocarpus, Molgula occulta, Arctica islandica, Cerianthus lloydii, Ophiura* spp, *Turitella communis, Aporrhais pespelicani* and *Astropecten irregularis.*

It is worth noting that the presence of muddy sand "pockets" around the margins of the Irish Sea accumulate organic food particles more readily than other sediments. Therefore benthic populations in these areas can be, in general terms, ten times more dense than the comparable populations away from these pockets. (Savidge and Kains 1990).

The Joint Nature Conservation Committee have carried out two surveys around Brighouse Bay. A sublittoral survey was conducted using remote sampling methods and diving biologists in July 1990. A littoral survey was carried out in June 1991. The results are recorded below:

Dunrod Point 54. 46.4'N 04.08.16'W

This site was situated on the western side of the entrance to Brighouse Bay and may be regarded as typical for that area of coast. Broken bedrock sloped down from the intertidal zone, through the sublittoral fringe and extended to a depth of 9.5m bcd [below chart datum] before ending at a plain of sandy mud. The lower infralittoral zone extended from around 1.5 to 2.5m bcd, and was characterized by a red algae *Delessaria sanguinea, Phycodrys rubens* and the erect bryozoans *Alcyonidium diaphanum* and *Flustra foliacea*. Below this zone was a circalittoral zone on broken bedrock, extending from 2.5m to 9.5m bcd. This zone was dominated by erect bryozoans *Flustra foliacea* and *Bugula plumosa* and abundant plumose anemones *Metridium senile*. Foliose red algae extended to a depth of 3.6m bcd. Muddy fine sand at 9.7m bcd had small amounts of shell gravel, shells and pebbles. Characteristic animals included *Lanice conchilega, Ophiura albida, Philine aperta, Obelia longissima and Alcyonidium diaphanum.* (Covey, in prep).

Moving offshore, but within the 3 mile limit, Dickson (1987) shows the area off Brighouse Bay as containing an Abra macrobenthic community. This occurs in small pockets in shallow water (5-30m) with muddy sands/muds with rich organic contents. Typical species include the bivalve mollusc *Abra alba* and polychaete worm *Pectinaria koreni*. This community occurs in localized patches throughout the Irish Sea. (Mackie 1990).

3.2.1.3 LOUGHSHINNY

The Irish Sea Study Group report suggests that the underwater habitats of the eastern Irish coast have never been studied in relation to their conservation value. What information is available has been collated from published and anecdotal sources.

The coast from Skerries to Rush tends to be rocky. As such, the sublittoral fringe is likely to exhibit rocky shore ecology with domination by the kelps *Laminaria digitata* and *Laminaria saccharina*. Communities on rocky shores are influenced mainly by exposure to wave action rather than the sediment composition of the "soft" communities.

However, the BGS survey shows the Loughshinny landfall as comprising gravely sand (gS) close to the shore, moving to sand (S) very quickly (BGS 1990). As such the area could be classified as a Type 18 sublittoral community under the NCC Marine Nature Conservation Review. Type 18 sediments are characterized by coarse gravely sand supporting some of the larger burrowing bivalves such as *Ensis arcuatus* and *Mya truncata*. (Holt, Fisher and Graham 1990).

Although 4km distant from Loughshinny, Lambay Island exhibits some ecologically interesting characteristics: The terrestrial part of the island is already an international Area of Scientific Interest. Such sites are chosen on the basis of their geological, botanical and zoological interest. While such sites are not as yet given statutory status under the 1976 Wildlife Act, local authority planners take into account the presence of such a site, and its interest rating (international, national, regional or local).

The Irish Sea Study Group identify the waters around Lambay Island as being:

> Rocky shore, bedrock and boulders, sand at 20m. East side is the best dive site, as it has numerous wrecks....present: seals, cuckoo wrasse, sponges, *Alcyonium digitatum*, hermit crabs. West side of island has stronger currents, silty bottom and less interesting (to sports divers) marine life.(Merne, Costello and Allen 1990).

Further offshore, the macrobenthic communities have been classified by Dickson (1987) as containing *Amphiura filiformus* muddy sediment. This classification was based on work by Rees. A later classification by Mackie (1990), also based on work by Rees, reclassifies the area as being within a Deep Venus community. The Amphiura classification occurs in offshore sandy muds at shallow to moderate depths (15-100m). Typical species include the brittle-star *Amphiura filiformus*, urchin *Echinocardium cordatum* and tower shell *Turritella communis*. The main locations are between Ireland and Isle of Man and off the Cumbrian coasts.

The Deep Venus community occurs in coarse sand/gravel/shell sediments at moderate depths (40-100m). Typical species include the urchin *Spatangus purpureus*, and bivalves *Glycimeris*, *Astarte sulcata* and *Venus spp*. This community dominates the Irish Sea benthos. However, without accurate survey data, complete classification is difficult.

3.2.1.4 OFFSHORE MACROBENTHIC COMMUNITIES

The proposed pipeline passes through a series of macrobenthic communities as illustrated in Figure 14.

The Shallow Venus community extends from the Abra area to south east of Burrow Head. This community is identified in the Irish Sea Study Group report as:

> Often such localities are in areas subjected to strong currents and the sands belong to sand bank or sand wave systems. The community is often regarded as having two sub-communities relating to their preferred sand grades/stability. The *Tellina* sub-community occurs in fine stable sands and typical species include the bivalve *Tellina fabula* and polychaete *Magelona mirabilis*. The *Spisula* sub-community occurs in

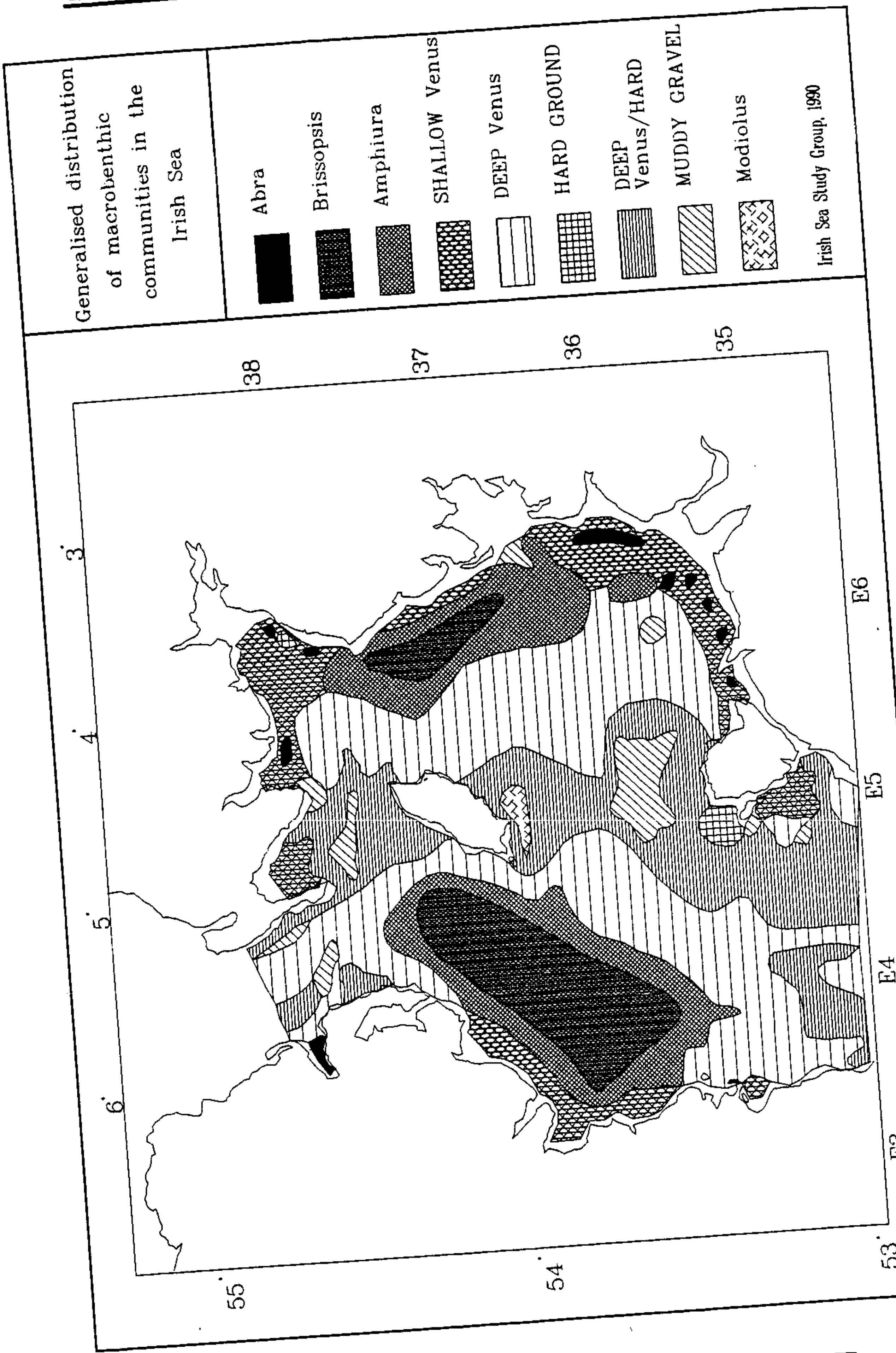

Generalised distribution
of macrobenthic
communities in the
Irish Sea
Abra
Brissopsis
Amphiura
SHALLOW Venus
DEEP Venus
HARD GROUND
DEEP Venus/HARD
MUDDY GRAVEL
Modiolus
Irish Sea Study Group, 1990
38
37
36
35
3°
4°
5°
6°
55°
54°
53°
E3
E4
E5
E6

Figure 14

TABLE 1 Total international catch in kilograms per hectare averaged for the period 1973-78

	North Sea				Irish Sea (VIIa)	English Channel (VIId+e)	Bristol Channel (VIIg)
	IVa North	IVb Central	IVc South	IV Total			
Demersal	20.2	15.3	13.7	17.3	8.0	6.5	6.3
Pelagic	15.9	18.9	1.9	15.8	9.1	19.9	28.3
Industrial	24.8	16.6	3.6	18.7	+	0.1	0.8
Total Fish	60.9	50.8	19.3	51.7	17.1	26.4	35.4
Shellfish	0.3	3.0	21.3	3.9	4.3	10.1	1.0
Area (km^2x 10^3)	253.6	270.4	64.5	588.5	48.2	86.5	18.3

DICKSON 1987

medium to coarse sands subject to disturbance and typical species include the bivalve *Spisula elliptica* and polychaete *Nephtys cirrosa*. (Mackie 1990).

Further offshore the community develops into Deep Venus which occurs in coarse sand/gravel/shell sediments in the depth range 40-100m. Typical species include the urchin *Spatangus purpureus* and bivalves *Glycimeris, Astarte sulcata and Venus spp.* This is the dominant macrobenthic community throughout the Irish Sea area.

Between the west coast of the Isle of Man and the Scottish coast the pipeline passes through an area of hard substrate Deep Venus where the substrate is stony and bedrock is often exposed. The fauna in such areas is often dominated by epifauna species attached to the stones. The Irish Sea communities in such areas are very similar to other regions of the UK coast influenced by strong tidal currents such as the Bristol Channel, English Channel and southern North Sea. (Mackie 1990).

The pipeline passes through another narrow section of Deep Venus before passing into the *Amphiura* and *Brissopsis* communities. The *Amphiura* section occurs in offshore sandy muds at depths of 15-100m. Typical species include the brittle-star *Amphiura filiformis*, urchin *Echinocardium cordatum* and tower shell *Turritella communis*. (Mackie 1990).

The *Brissopsis* community occurs in offshore muds with typical species including the urchin *Brissopsis lyrifera* and brittle star *Amphiura chiajei*. The site between the Isle of Man and the Loughshinny landfall is also identified as the major *Nephrops* site in the Irish Sea.

3.2.2 FISH

The Irish Sea supports a diverse fish fauna similar to other sea areas around the British Isles but the fish yield per unit area is lower than in other areas. (Table 1).

The biomass of the main commercial demersal fish species are shown in Table 2. Trawl survey data shows that other, non-commercial, species make up a small proportion of total fish biomass, although sprat *Spratus spratus*, poor cod *Trisopterus minutus* and Norway pout *Trisopterus esmarkii* are fairly abundant. (Dickson 1987). Compared with the North Sea demersal

TABLE 2 Total biomass of the main commercial demersal species in the Irish Sea and North Sea

Rank	Irish Sea			North Sea		
	Species	Biomass (t)	Cumulative percentage	Species	Biomass ($t \times 10^3$)	Cumulative percentage
1	Cod	18,056	29	Saithe	725	26
2	Whiting	15,482	55	Whiting	625	49
3	Sole	7,342	67	Cod	483	66
4	Plaice	6,241	77	Haddock	400	80
				Plaice	385	94
5	Rays	6,198	87	Sole	50	96
6	Saithe	3,108	92			
7	Hake	1,360	94	Ling	34	97
8	Monk	1,026	96	L.sole	17	98
9	Pollack	786	97	Turbot	13	98
10	Ling	412	98	Monk	13	99
11	Haddock	376	99	Rays	13	99
12	Brill	303	99	Hake	8	99
13	Tarbot	285	100	Pollack	7	100
14	Megrim	205	100	Brill	4	100
15	L. sole	198	100	Megrim	2	100
	Total	61,360		Total	2,779	
	Dab	7,166		Dab	670	
	Dogfish	6,380		Dogfish	589	
	Gunard	3,120		Gunard	39	

DICKSON 1987

fish fauna, the main differences are the small proportions of saithe *Pollachius virens* and haddock *Melanogrammus aeglefinus* and the large proportion of rays *Raja spp.*

Inshore areas, up to the 3 mile zone, are characterized by spawning and nursery grounds of the commercial finfish fisheries coupled with the majority of shellfish areas.

3.2.2.1 INSHORE DEMERSAL SPECIES

Many of the inshore areas are used as nursery areas for a range of commercially exploitable species.

There are two main types of division between species usage - soft sediment assemblages and hard sediment assemblages.

3.2.2.1.i Soft sediment

The most numerous fish in shallow zones tend to be juvenile flatfish (Plaice *Pleuronectes platessa*, Dab *Limanda limanda*, Turbot *Scophthalmus maximus*, Brill *Scophthalmus rhombus*, Sole *Solea solea* and Solenette *Buglossidium luteum*) and Sand Eels *Ammodytes tobianus*. The larger flatfish tend to be found further offshore in deeper water. Species often associated with this group are Sand Gobies *Pomatoschistus minutus*, Lesser Weeverfish *Echiichthys vipera* and Sand-Smelt *Atherina presbyter*. In areas of lowered salinity the Common Goby *Pomatoschistus microps* often occurs along with juvenile and adult flounder *Platichthys flesus*. Within seaweed outcrops there are occasional juvenile Corkwing *Crenilabrus melops*, Goldsinny *Ctenolabrus rupestris*, Pipefish (Nilsson's *Syngnathus rostellatus*, Great *Syngnathus acus*, Snake *Entelurus aequoreus* and Worm *Nerophis lumbriciformis*), 3-Spined Stickleback *Gasterosteus aculeatus*, 15-Spined Stickleback *Spinachia spinachia* and juvenile Lumpsucker *Cyclopterus lumpus*. These inshore areas often have seasonal influxes of Sprat *Sprattus sprattus*, Herring *Clupea harengus*, juvenile gadoids and Thick and Thin-Lipped Mullet *Chelon labrosus* and *Liza ramada* (Nash 1990).

3.2.2.1.ii Hard stratum

The rocky shore assemblages are relatively diverse (Nash 1990) and dominated by small species. The fish extend from Mean High Water rockpools down to the sublittoral. The most common species found in this area include wrasses, Rock Goby *Gobius paganellus*, Shanny *Blennius pholis*, Butterfish *Pholis gunnellus*, Yarrell's Blenny *Chirolophis ascanii*, Bull Rout *Myoxocephalus scorpius*, Sea Scorpion *Taurulus bubalis*, Norway Bullhead *Taurulus lilljeborgi*, Two-Spotted Clingfish *Diplecogaster bimaculata* and Shore Clingfish *Lepadogaster lepadogaster*. The Two-Spot Goby *Gobiusculus flavescens* and Leopard-Spot Goby *Thorogobius ephippiatus* are found lower down the shore. (Nash 1990).

The main commercial species relevant to the landfall areas are as follows:

Cod *Gadus morhua* Figure 15

There are two main spawning areas for cod, one in the northeast Irish Sea and one in the northwest. Spawning takes place in both areas in March and April. Although the planktonic eggs are pelagic, the fish of six months plus are predominantly demersal and the distribution of 0-group and 1-group cod are centred on the spawning areas around the coast.

Cod enter the fishery as 1-group fish and mature at three to five years of age and are fully grown at six years.

Sole *Solea solea* Figure 16

Sole spawn in the south east of the Irish Sea but a large nursery exists throughout the Solway Firth area extending as far west as Burrow Head. Few juvenile sole are found off the Irish coast.

The eggs are fertilised in the sea and take about five to eleven days to develop in the plankton and to hatch. Metamorphosis into flatfish shape occurs within a week or two later and the young sole heads to the seabed nursery sites. They may spend up to two years in these nurseries. The first months are spent over muddy sand, usually in water depths of less than 10 metres. In the second year the young sole are caught most often between 4 - 40 metres. In the third year the fish move out to the open sea in search of larger food organisms.

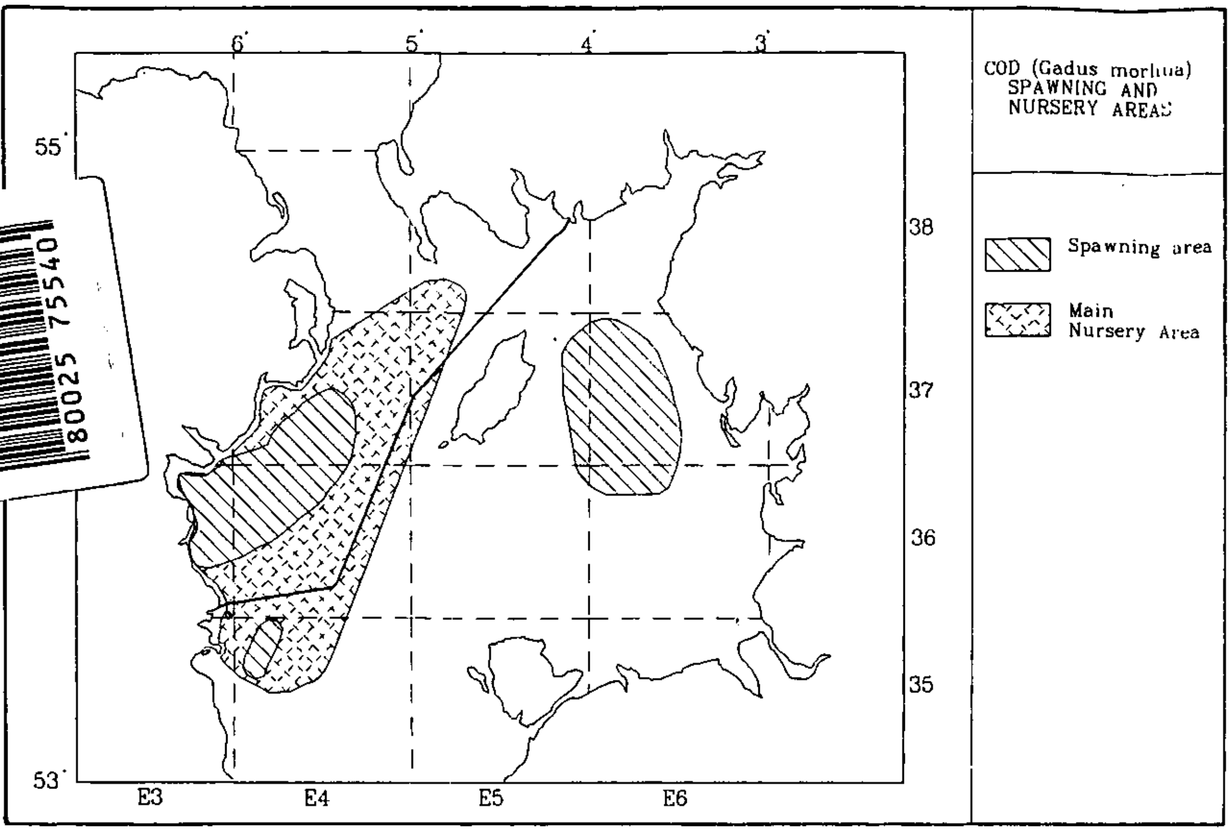
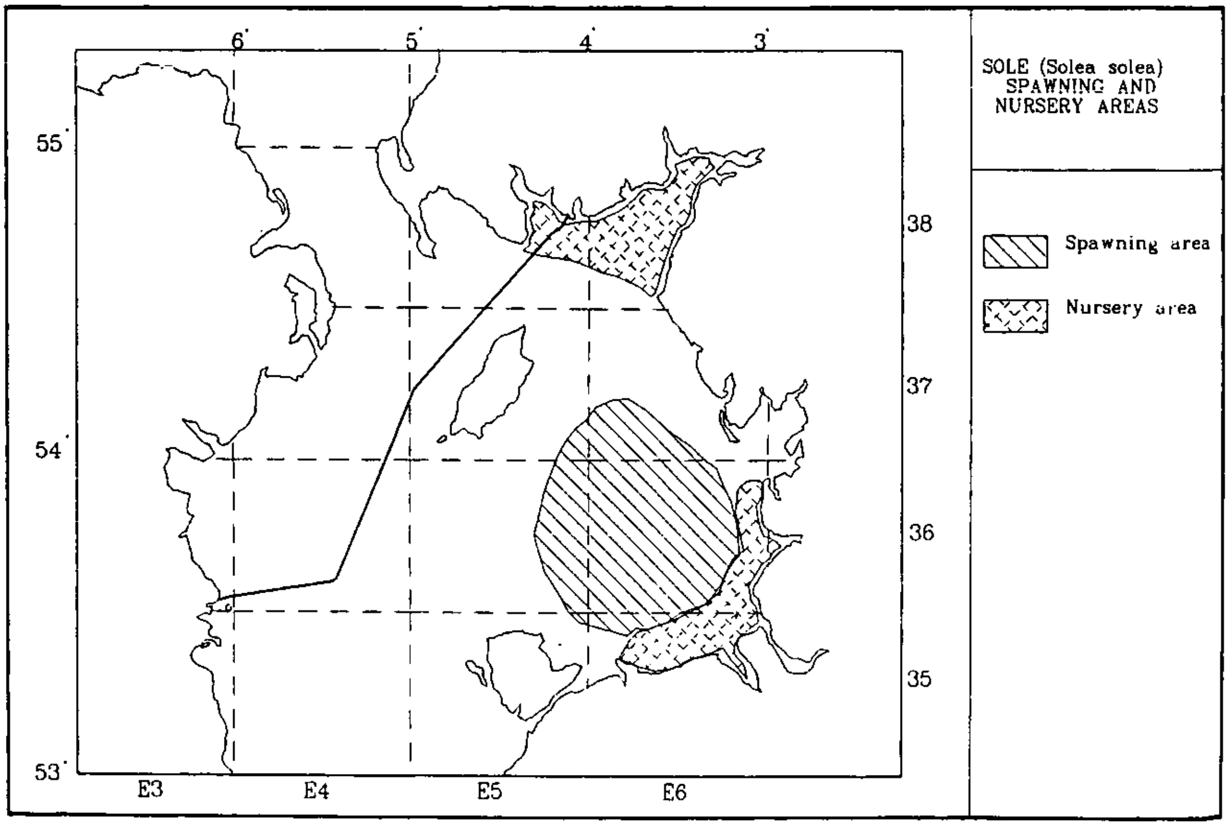


Figure 15



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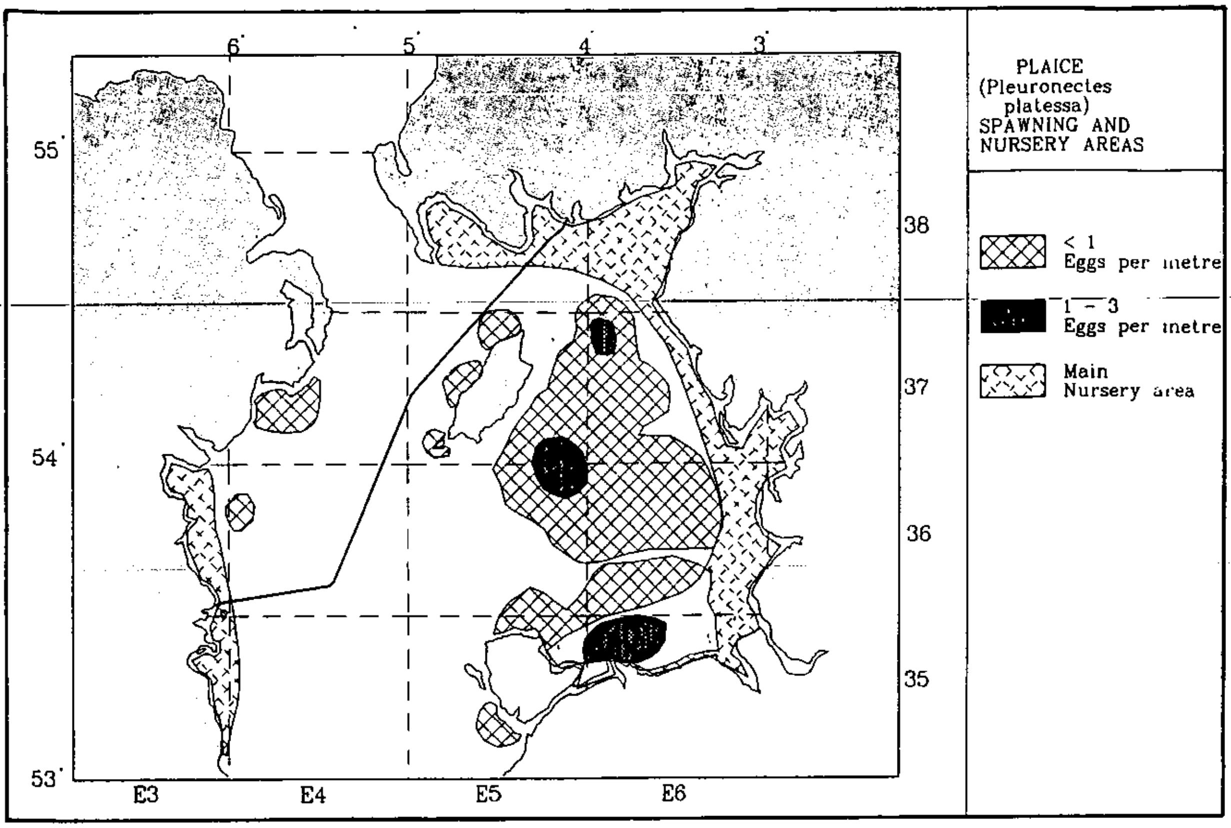

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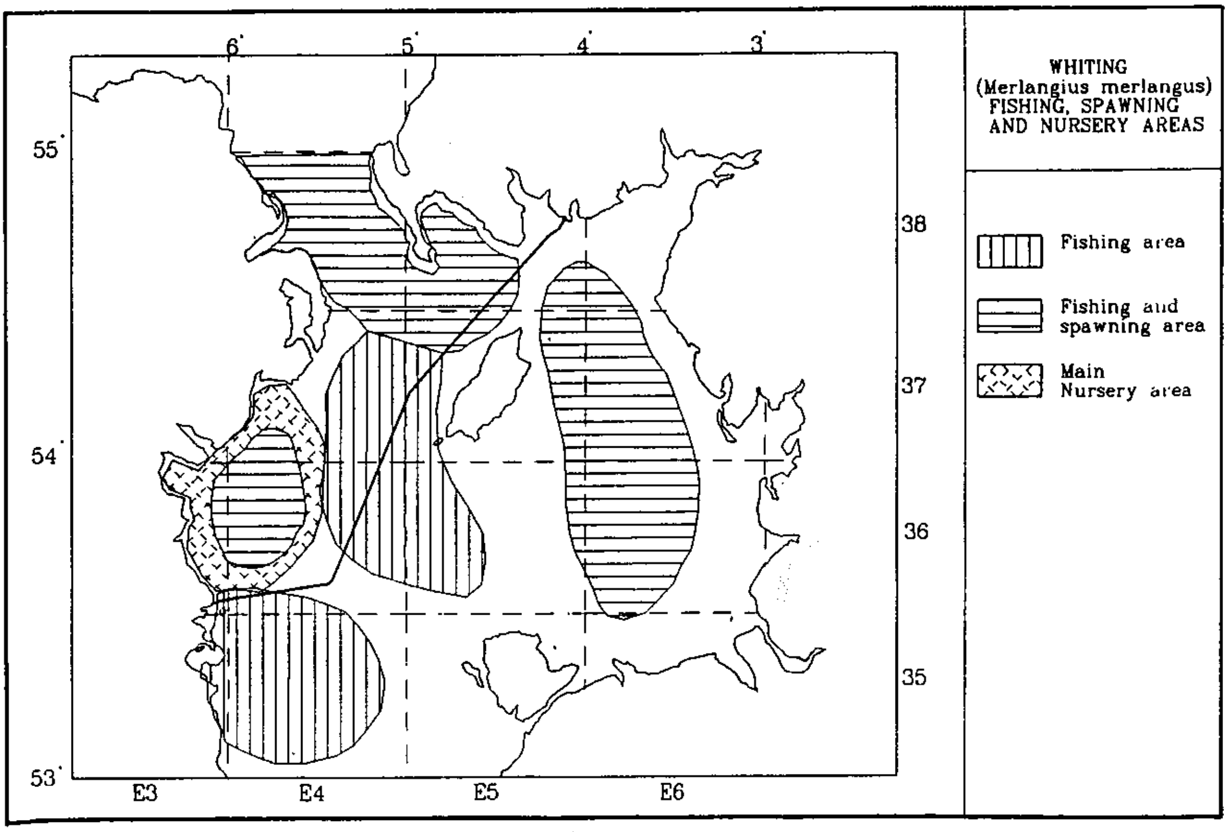


Figure 18

Plaice *Pleuronectes platessa* Figure 17

The main spawning areas in the Irish Sea lie on the south eastern side. The main nursery ground, like sole, is off the Solway Firth with a further nursery near the Irish coast from Dundrum Bay to Wicklow Head.

After spawning offshore, the eggs drift onto the coast. The eggs are fertilised in midwater and hatch after about 20 days depending on water temperature. The larvae drift in near-surface waters with metamorphosis taking place after 90-120 days after fertilisation. They then move to the sandy seabeds as flatfish. Young plaice spend one or two years in these nurseries moving gradually deeper in search of larger food organisms before they migrate offshore into the adult populations.

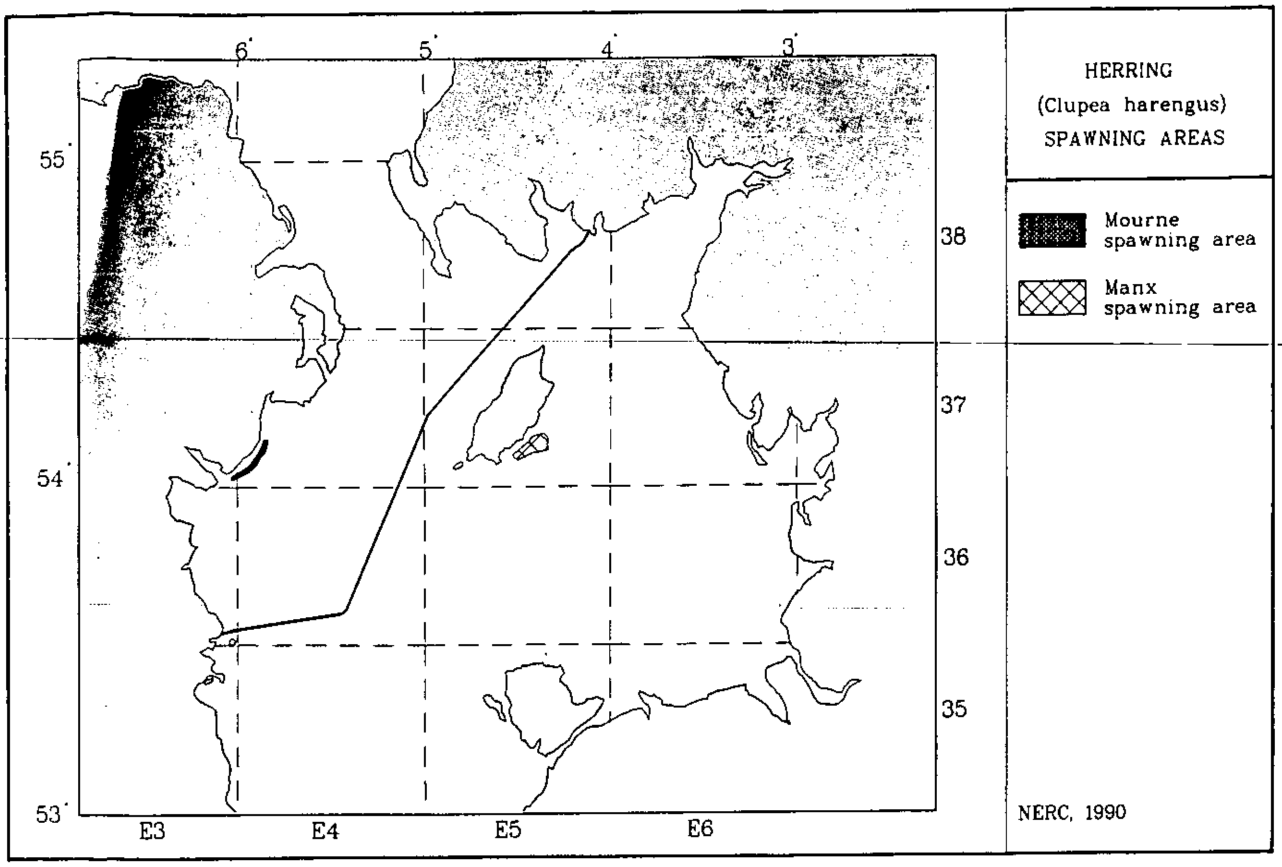
Whiting *Merlangius merlangus* Figure 18

Whiting spawn mainly in the northeast Irish sea, southeast of the Isle of Man, and also in the northwest Irish Sea and in the North Channel and Firth of Clyde. Spawning occurs mainly between March and May. The main nursery ground is off the Irish coast between Counties Down and Dublin.

3.2.2.2 INSHORE PELAGIC SPECIES

Herring *Clupea harengus* Figure 19

The only important pelagic fishery is for herring. There are two spawning grounds in the Irish Sea, off the Co.Down coast (the Mourne ground) and southeast Isle of Man (the Manx ground). Spawning takes place in September and October. Pre-recruit fish of Mourne origin are found off the Irish coast between Dundrum Bay and Skerries, whereas Manx juveniles are found along an extensive stretch of coast from the Solway Firth to Liverpool Bay.



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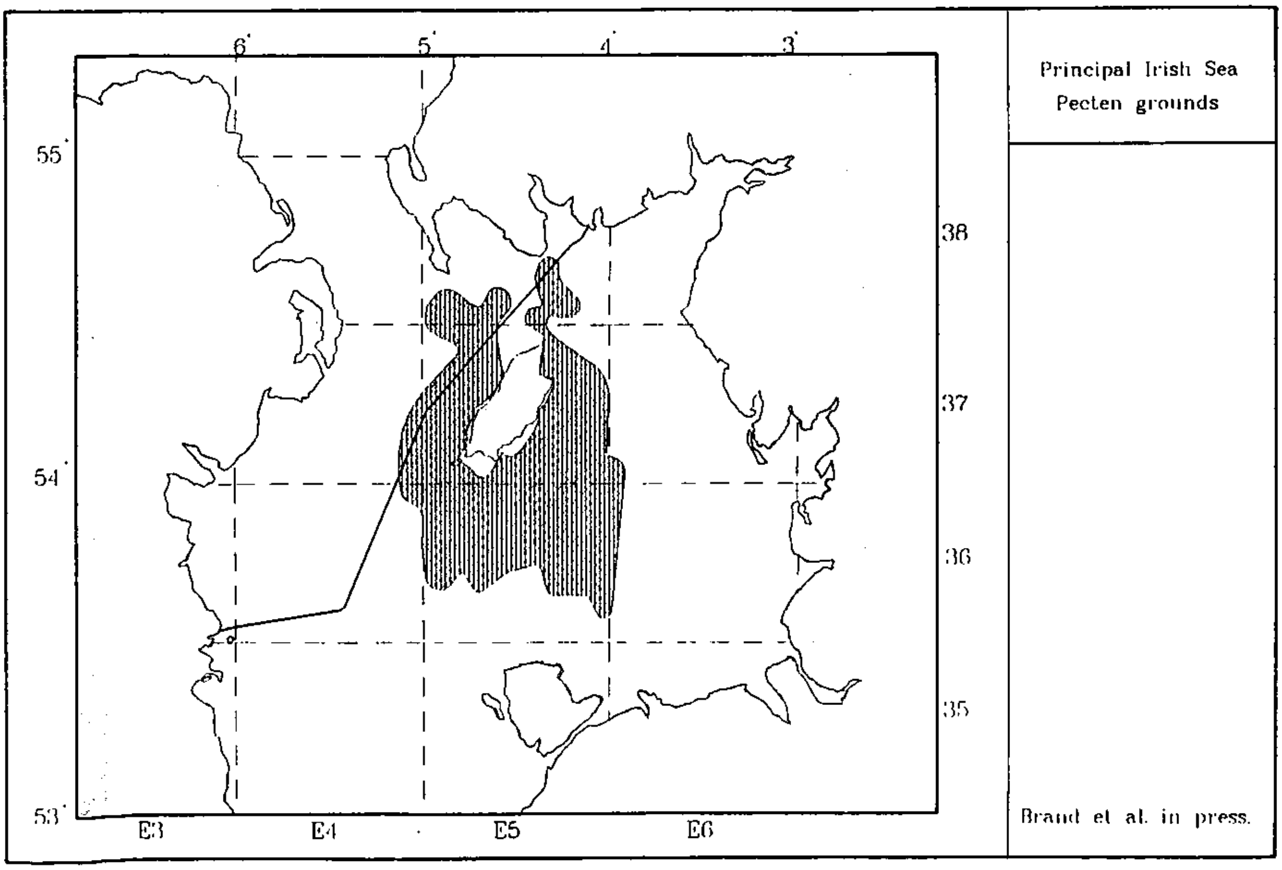


Figure 20

3.2.2.3 INSHORE SHELLFISH SPECIES

Scallop *Pecten maximus* Figure 20

The main scallop beds occur mainly in depths of about 18-46m between the Isle of Man and the Scottish mainland. They are an important commercial species. Their sedentary nature makes them more susceptible than other commercial species to interactions from the pipeline development and an understanding of the scallop fishery in the project area is important in assessing any potential interactions.

Available data indicates that the Pecten grounds are located as on Figure 20. Active research into the nature of the Irish Sea stocks is being led by the Liverpool University Research Station at Port Erin in the Isle of Man. There are still many uncertainties about scallop ecology. However, two phases have been identified in the recruitment to the population; that of recruitment to the fishable stock and recruitment to the commercial fishery. Brand (1991) suggests that the first phase occurs at spatfall, as there is no conclusive proof and scallops in other locations have been shown to migrate by the action of currents. This will be an important point in any potential impact assessment on the stocks; if it can be shown that migration does occur the overall impact caused by the pipeline construction operation would be reduced. This is examined further in Section 5.

The second phase occurs on reaching 110mm, this being the minimum landing size which occurs at ages 3-5 years.

The annual variation in recruitment can be assessed from the population age structures. (Brand 1991). Strong year classes, which can be followed through the fishery for several years in most areas, were those spawned in 1980 and 1982 (in recent years). In other years there has been variation in recruitment; some grounds being more successful than others. Some authors have noted differences in the strength of particular year classes between grounds to the east and to the west of the Isle of Man which could result from variations in the northerly flowing currents affecting larval dispersal from the extensive grounds to the south. (Brand 1991). As such, it has been suggested that strong year classes have been the result of good spat settlement.

However, Brand notes that recruitment to thc Isle of Man inshore scallop grounds is regular compared to that in other Pecten fisheries. Even offshore recruitment is noted as being remarkably constant. This has been linked to the wide distribution of Pecten in the north Irish Sea, occurring in dense fished concentrations in some areas and economically unfishable areas in others. Brand suggests these unfished areas may provide a spawning stock refuge and prevent recruitment overfishing by maintaining larval production in years of heavy stock depletion on the fished grounds. (Brand1991).

It is also important to note that the areas of heaviest fishing also tend to have the best recruitment. This could be because the local tidal currents are strong over the inshore grounds so it is likely they bring large numbers of potential settlers into the area. (Brand 1991). This will obviously be very important in assessing recolonization of any areas significantly disrupted by the project.

It has also been suggested that fishing enhances spat settlement, whether by removing the adult stock and therefore reducing predation by adults on larvae or by changing the nature of the substrate, making it more attractive to settling larvae. It is further suggested that dredge fishing tends to make the ground harder by eroding soft sediments after disturbance. This may in turn increase the hard substrata available for the attachment of erect hydriods and polyzones on which scallops and queens attach during the post settlement phase. (Brand 1991).

It has also been noted that the prevalent northward residual currents in the north Irish Sea, and the 4-6 weeks larval life of both species suggest that larvae settling around the Isle of Man originate from the extensive beds between Anglesey and the south of the Isle of Man. (Brand 1991).

Queen Scallop *Chlamys opercularis* Figure 21

This is another common sedentary inshore species of local commercial importance. The Queen fishery makes up 80% of the Scottish landings, while the Isle of Man fishery is more reliant on the scallop beds. The range is similar to that of *Pecten*, but because it does not excavate a hollow in which to eventually live, it can be found on harder sediment than *Pecten*. The queen scallop is also capable of swimming, albeit for a limited range. However this could enable it to escape potential interactions.

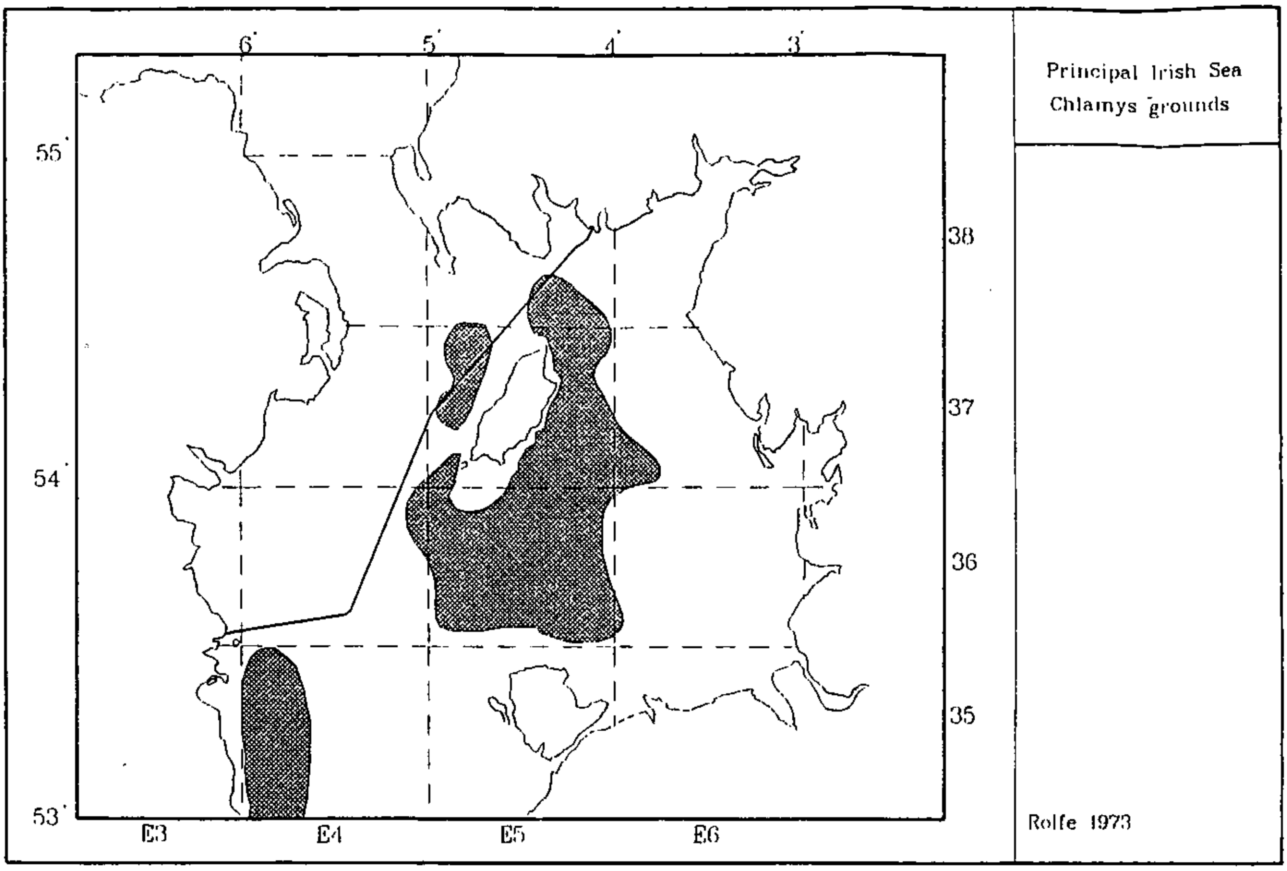


Figure 21

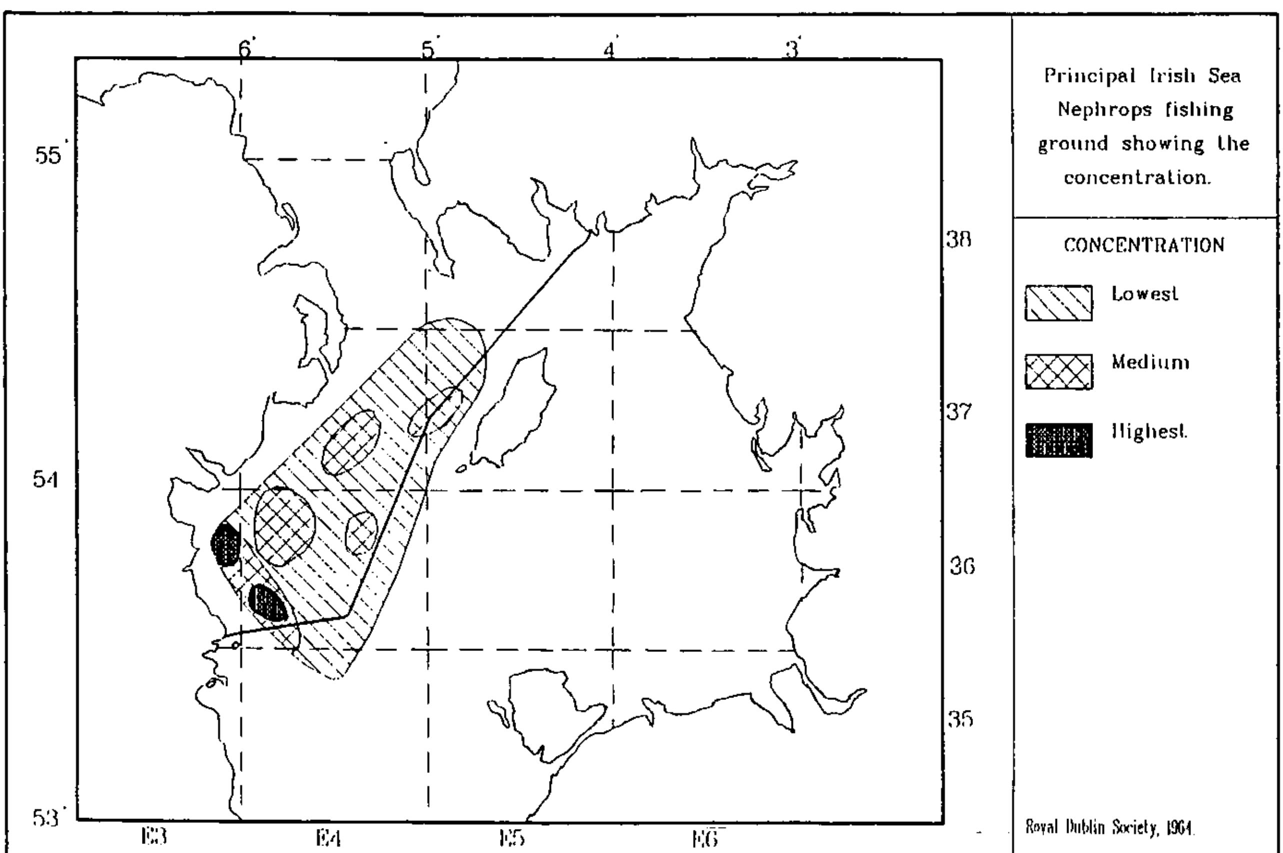


Figure 22

The populations are more sporadic in their occurrence and stocks are less predictable than *Pecten*. *Chlamys* also have a much shorter lifespan than *Pecten*. The initial growth rate is rapid with a marketable size of 55mm occurring between 14-18 months. Brand (1991) notes that beyond 4-5 years old natural mortality is high and individuals older than 6 years are rare. He notes that having only two of three age classes well represented in the commercial catches makes it difficult to detect effects of fishing on population structure.

Recruitment is apparently regular, although it can vary within a small area. However, the theories mentioned for *Pecten* also apply to *Chlamys*.

3.2.2.4 OFFSHORE FISHERY SITES

The Irish Sea Study Group divided the offshore habitats into depths greater or less than 50m and areas of soft mud, sandy and gravely areas. Twelve species were found on all areas (Lesser spotted dogfish, Spurdog, Sprat, Herring, Whiting, Norway Pout, Poor cod, Hake, Scad, Mackerel, Dab and Anglerfish).

Soft Mud - This occurs to the west of the Isle of Man in water deeper than 50m. Nash (1990) points out that the most indicative species of this type of habitat is the burrowing Frie's Goby. However, the area is best known for the commercially important *Nephrops* which burrow into the soft mud.

Muddy areas - This is very similar to the soft mud areas in terms of species content and is usually found bordering the *Nephrops* ground in waters deeper than 50m.

Sandy areas > 50m - Nash records that the species content is less than the shallower sandy areas and is typified by the presence of dragonets, gurnards, place, scaldfish and lemon sole, along with many of the skates and small sharks.

Sandy areas< 50m - This is noted as having a species content similar to the gravely areas in similar depths. The species diversity is high with many of the skates, the majority of gadoids, a large number of the flatfish, a large number of wrasses and many of the flatfish being found.

Gravely areas > 50m - The harder ground has a similar species content to the deep soft sediment areas. Nash suggests that this is due more to the depth rather than the sediment characteristics. Flatfish species are found in lower numbers although the gadoids are well represented.

Gravely areas < 50m - The areas are generally similar to the shallow sandy areas and are often mixed to provide sand/gravel habitats. It is common to find species such as wrasse in areas with rock substrata. (Nash 1990).

There are a number of offshore species which are of commercial importance.

The most valuable species in the Irish Sea is the crustacean *Nephrops norvegicus*, also known as the Dublin Bay Prawn or Norway Lobster. The animal burrows into soft muddy sediment and coincides with the Brissipsis macrobenthic community. The major area in the Irish Sea is between the Isle of Man and the Irish coast. (Figure 22).

The *Nephrops* spawn from July to September with the females carrying the eggs over the winter. Following spawning the females remain in their burrows, effectively removing them from the fishery. In late spring the eggs hatch and the females moult and then mate; at this time the proportion of females in the catch increases.

The stocks also exhibit diurnal and nocturnal variation. Experiments carried out in 1960 on the Clogherhead grounds showed that maximum catches occur about sunrise and approximately 1.5 hours before sunset. Approximately 2 hours before sunrise the catch rapidly increases. In the forenoon the catch decreases somewhat but remains fairly high during the day. It rises to a high level again approximately 2.5 hours before sunset. By sunset the catch, already declining, falls off rapidly and approximately 2.5 hours after sunset it is at a very low level and remains so until just before sunrise. (O'Riordan 1964).

While some experiments carried out in different locations showed highest catches during night hours, O'Riordan concludes:

> *Nephrops* are sensitive to changes in light intensities and most likely avoid complete darkness and bright daylight whilst favouring low light intensities such as might be present at dawn or dusk in Irish waters or during turbulent conditions after severe storms when suspended matter reduces light intensity... it is thought that

> *Nephrops* burrow sufficiently deep during the hours of darkness (in Irish waters) that the trawl is unable to catch a large proportion of them. (O'Riordan 1964).

The spatial variation of the *Nephrops* in the western Irish Sea were mapped in 1961. This shows the areas of high, medium and low concentrations. In experiments carried out by the Department of Agriculture for Northern Ireland (DANI), they concluded that:

> Although *Nephrops* density and mean size showed a negative correlation no correlation could be demonstrated between sediment structure and *Nephrops* size ... studies of Scottish *Nephrops* stocks ... suggest that *Nephrops* might exhibit density dependent growth. The existence of such a correlation in the NW Irish Sea *Nephrops* should not be dismissed. (Briggs 1989).

3.2.3 PLANKTON

3.2.3.1 PRIMARY PRODUCTION

Photosynthesis by phytoplankton is the basis for all marine life and forms the base of the marine food chain. The production of organic material, known as primary production, affects the distribution and nature of other organisms higher up the food chain. The phytoplankton provides food for the zooplankton. Larger members of the zooplankton feed on smaller members and so on up the chain. As plankton die they fall to the seabed to form detritus and provide nutrients for bottom dwelling animals and bacteria.

However, plankton distribution is exceedingly variable, both spatially and temporally, and as such no definitive picture can be given in relation to the landfall sites or inshore waters. A generalised impression of the main factors in primary production from phytoplankton, macroalgae and zooplankton will be given to demonstrate the difficulties in accurate assessment.

As with other European seas, the Irish Sea contains defined zones of vertically mixed and stratified water during the main spring-summer phytoplankton growth season. The location of these zones is related to the velocity of the local tidal streams. (Savidge and Kain 1990). Restrictions to the growth of plankton under mixed water conditions tend to be related to the availability of light since mixing restricts the residence time of phytoplankton

within the well lit surface waters. Under stratified conditions the main restriction tends to be availability of nutrients because nutrients from deep water cannot cross the thermocline. Boundaries at the sea surface between the mixed and stratified zones are usually sharply delineated and are referred to as fronts and are highly dynamic regions of phytoplankton growth.

There are great differences in biological activity between the various water masses within the Irish Sea and it is impossible to give an integrated estimate of primary production. (Dickson 1987). Dickson points out that biological activity is highest in the large stratified water mass in the northwest Irish Sea. Biological activity is highest in the large stratified water mass in the northwest, especially along the front separating it from the mixed water further south. Other areas which stratify occur off the English coast, in Cardigan Bay and in bays and estuaries.

Continuous Plankton Recorder (CPR) surveys carried out by MAFF from 1971 - 1984 across the Irish Sea from Liverpool to Dublin showed that in the mixed waters the spring bloom is about one month later and the autumn decline nearly two months earlier than in the open shelf areas to the north and south. This has a marked impact on the abundance of zooplankton. (Dickson 1987).

3.2.3.2 SEAWEED PRODUCTIVITY

The most productive benthic algae are the dominant browns; fucoids in the intertidal region and laminarians subtidally.(Savidge and Kain 1990).

The type of sea bottom is the critical aspect for seaweed production. The important macroalgae occur only when rocks are present for attachment. Brighouse Bay has a limited rocky aspect and seaweeds will play a part in the productivity of the area. From the Mull of Galloway to the mouth of the Solway Firth, 38% of the length of coast is rocky in the intertidal region producing a "standing crop" has been estimated at 3-7kg/m or >60 tons per km. (Savidge and Kain 1990). Brighouse Bay has "broken bedrock...extending to a depth of 9.5m bcd" (Covey 1991). While this is not very much rock, there will obviously be some productivity associated with the area.

3.2.3.3 ZOOPLANKTON PRODUCTION

Maximum densities of zooplankton, primarily copepod species, are found in western Irish Sea in late spring and early summer in surface layers of the stratified water to the north of the western Irish Sea front. The copepods, small shrimp-like animals, provide a major source of food for pelagic fish with *Calanus finmarchicus* and *C. helgolandicus* being widely distributed in both the Irish Sea and Liverpool Bay. (Savidge and Kains 1990). Other species common to the UK coast are also regularly found with *Pseudocalanus elongatus* and *Paracalanus parvus* being the most abundant. However, comparison of the densities of the four major copepod species in the North Sea and Irish Sea shows a clearly marked reduction in zooplankton numbers in the Irish Sea. This is consistent with the indication of comparatively lower primary production in the Irish Sea.

3.2.3.4 NATURAL FACTORS INFLUENCING THE CHANGES IN BENTHOS

Sublittoral benthic communities as described are susceptible to natural as well as anthropogenic influences such as pollution and disturbance.

While some changes can be seen to be caused by obvious events such as storms or temperature extremes, others such as long term natural cycles may be less easily understood. (Mackie 1990).

i. Storms. Severe onshore winds can cause strandings and death of shallow sublittoral fauna. This can also cause the relocation of the organisms.

ii. Tidal currents. Bed-load partings in the North Channel and St George's Channel regions create a situation where sand is transported from the open sea towards estuaries such as the Solway Firth. This can cause the long term change in sediments and hence the faunal composition in some areas.

iii. Temperature. Extreme increases or decreases of temperature can have profound effects on intertidal and shallow sublittoral fauna. Mackie (1990) notes the 100%

mortality of scallops *Pecten maximus*, even at 9m depth, during the severe winter of 1962-3.

iv. Plankton blooms. "Red tides" caused by blooms of dinoflagellates, can cause an accumulation of toxins in the water which can be poisonous to invertebrates and species further up the food chain.

v. Temporal changes. The normal life history of many species depends on such factors as successful settlement, growth, reproduction and recruitment. Survivability of a particular year class depends on many factors such as reproductive success, larval settlement, food availability, competition and predation. With many invertebrate communities experiencing massive larval mortality in normal years, a bad year can cause the decline of an entire species locally. Many populations show this boom and bust cycle. (Mackie 1990)

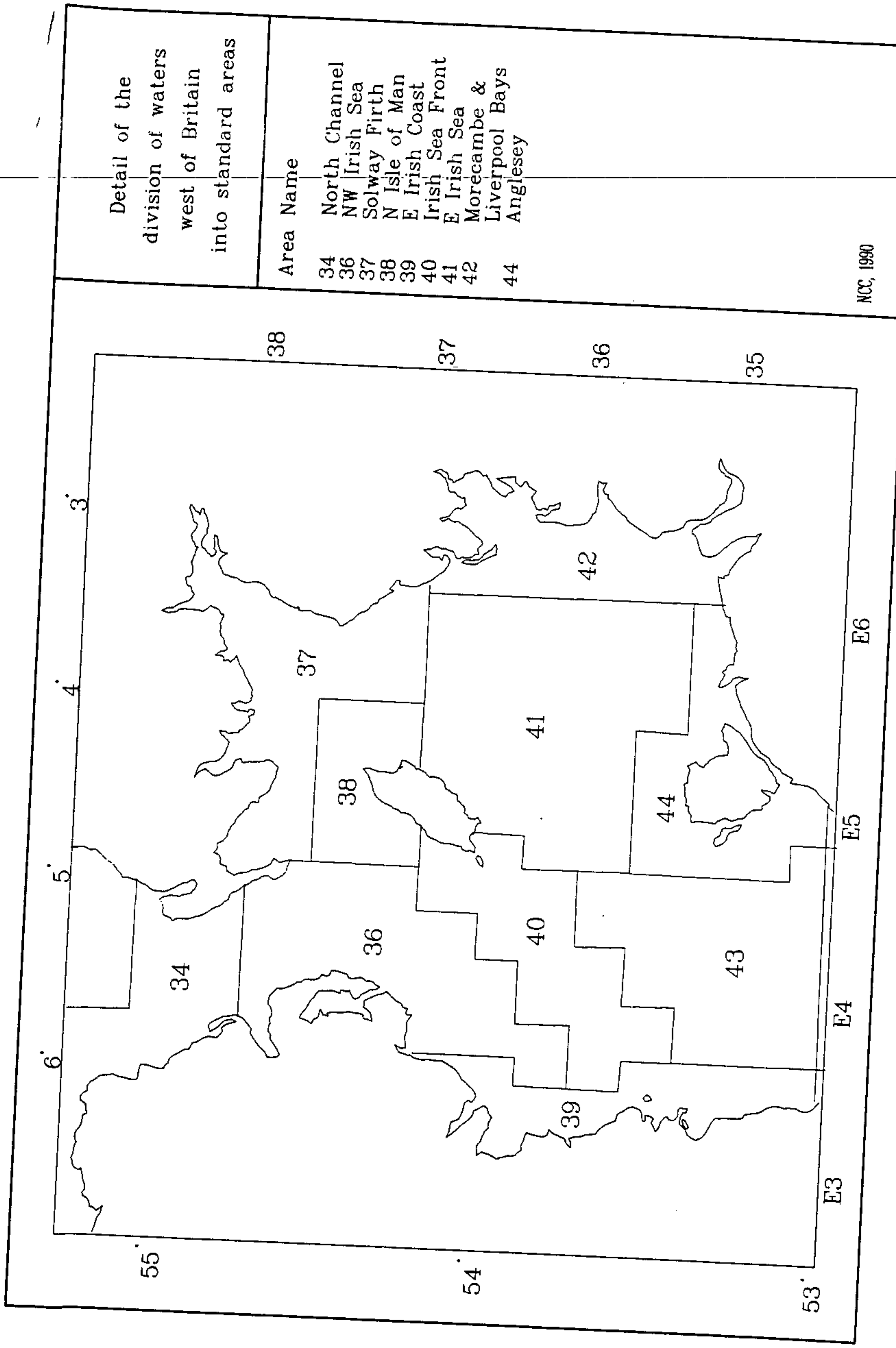
3.2.3.5 CONCLUSIONS OF PRODUCTIVITY

No data is available for the coastal regions near the two landfall sites. However, sewage related nutrients discharged from Kirkcudbright could cause increased phytoplankton activity. This could be coupled with the presence of muddy sand pockets just off Brighouse Bay which will suggest a more productive area compared with populations on more coarse sediments. The nearshore region of Loughshinny is a more coarse sediment and it is therefore unlikely to be as productive as Brighouse Bay.

3.2.4 SEABIRDS

Birds are the most mobile animals within the project area; therefore the major concern is the potential interaction with nest sites during the breeding season.

Twenty-one species of seabird nest around the Irish Sea, the population of 13 species being more than 10% of the whole of Britain and Ireland. While the littoral area of the coast is of most importance especially in relation to breeding sites, it is important to examine the status of birds at sea.



Detail of the division of waters west of Britain into standard areas
Area Name
34 North Channel
36 NW Irish Sea
37 Solway Firth
38 N Isle of Man
39 E Irish Coast
40 Irish Sea Front
41 E Irish Sea
42 Morecambe & Liverpool Bays
44 Anglesey
NCC, 1990
38
37
36
35
3°
4°
5°
6°
55°
54°
53°
E3
E4
E5
E6
34
36
37
38
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41
42
43
44

Figure 23

The NCC Seabirds at Sea Project surveyed the west of Britain between 1986 and 1990. Each area of the Irish Sea was divided into reporting zones to differentiate the spatial distribution (Figure 23).

Table 3 of numbers of breeding seabirds shows the relative importance of the sites:

Area	Main Species	Breeding Pairs
36 NW Irish Sea	Herring Gull *(Larus argentatus)*	11700
	Black-Headed Gull *(Larus ridibundus)*	4300
	Sandwich Tern *(Sterna sandvicensis)*	2270
	Manx Shearwater *(Puffinus puffinus)*	700
	Common Tern *(Sterna hirundo)*	630
37 Soloway	Lesser Black-Backed Gull *(Larus fuscus)*	3000
	Herring Gull *(Larus argentatus)*	2200
	Kittiwake*(Rissa tridactyla)*	1490
38 N Isle of Man	Herring Gull *(Larus argentatus)*	2450
	Fulmar *(Fulmarus glacialis)*	610
	Kittiwake *(Rissa tridactyla)*	490
39 E Irish Coast	Herring Gull *(Larus argentatus)*	7010
	Kittiwake *(Rissa tridactyla)*	6980
	Shag *(Phalacrocorax aristotelis)*	1750
	Cormorant *(Phalacrocorax carbo)*	1050
	Fulmar *(Fulmaris glacialis)*	810
	Common Tern *(Sterna hirundo)*	630
	Great Black-Backed Gull *(Larus marinus)*	410

(NCC 1990b)

The importance of the Eastern Irish coast can be readily identified, even though the area has not yet been extensively surveyed.

TABLE 3 NUMBERS (PAIRS) OF BREEDING SEABIRDS IN THE IRISH SEA

AREA	NAME	CORMORANT	SHAG	BLACK-HEADED GULL	SANDWICH TERN	ROSEATE TERN	COMMON TERN	ARCTIC TERN	COMMON/ ARCTIC TERN
36	NW Irish Sea	220	70	4300	2270	4	630	310	0
37	Soloway Firth	190	160	450	0	0	1	8	90
38	N Isle of Man	44	150	93	0	0	7	13	0
39	E Irish Coast	1050	1750	12	290	265	630	87	0
40	Irish Sea Front	7	410	0	0	0	0	0	0

AREA	NAME	FULMAR	MANX SHEARWATER	STORM PETREL (2)	GANNET	COMMON GULL	LESSER BLACK-BACKED GULL	HERRING GULL	KITTIWAKE	GREAT BLACK-BACKED GULL
36	NW Irish Sea	120	700	0	0	110	280	11700	93	140
37	Soloway Firth	280	0	0	770	1	3000	2200	1490	23
38	N Isle of Man	610	0	0	0	0	30	2450	490	73
39	E Irish Coast	810	?	0	0	2	160	7010	6980	410
40	Irish Sea Front	1200	<100	P	0	0	40	3730	810	250

(2) PAIRS OR PRESENCE (P)

N.B: THE BREEDING POPULATIONS OF GULLS ARE OF COASTAL BIRDS. COUNTS OF INLAND COLONIES ARE NOT INCLUDED (NCC, 1990)

3.2.4.1 SCOTTISH WATERS

Two estuaries flank the landfall site: Kirkcudbright Bay and Fleet Bay. Kirkcudbright is reported as having a low species diversity of estuarine birds and supporting only a moderate number of birds. Three main species present are Lapwing *(Vanellus vanellus)* - 2250, Redshank *(Trigna totanua)* - 500 and 500 and Golden Plover *(Pluvialis apricaria)* - 550.

Fleet Bay has a small estuarine bird population with up to 50 Ringed Plovers *(Charadrius hiaticula)* and 60 Bar-Tailed Godwit *(Limosa lapponica)* in winter and 300 Oystercatcher *(Haematopus ostralegus)* and Curlew *(Numenius arquata)*. Wildfowl are few with only 80 Wigeon *(Anas penelope)* and 60 Shelduck *(Tadorna tadorna)*. (Prater 1981). See Table 4 for details of monthly counts for estuary birds in Fleet Bay and Kircudbright Bay.

3.2.4.2 IRISH WATERS

The important estuaries and bays are Dundalk near the Northern Ireland border, Dublin and Wexford in the south. In between there are relatively few shore waders or wildfowl. (Prater 1981). However, there are important breeding sites on islands in the vicinity of the landfall.

Lambay Island to the south of the landfall has the largest colony of Cormorants in the Irish Sea with more than 1000 pairs breeding on the island. This represents 9% of the British and Irish population and more than 25% of cormorants breeding in the Irish Sea. It is also home to 40% of the Irish shag population (1600 pairs) and 40% of the Irish guillemot *(Uria aalge)* population as well as 7% of the Kittiwakes in Ireland. (Mern 1990).

Rockabill Island is the most important site in the Irish Sea and one of the most important in Europe for Roseate Terns *(Sterna dougalli)* with 50% of the European population. (Merne 1990). Both these islands are regarded as being of international importance for breeding habitat.

Rogerstown estuary to the south of the landfall is registered as a Ramsar site as a wetland of international importance. While the location of these important bird sites is not immediately in the vicinity of the project, the

List of highest average monthly counts for estuary birds

Species	Fleet Bay	Kirkcudbright Bay
Mute Swan *(Cygnus olor)*	6	14
Whooper Swan *(C.cygnus)*		4
Greylag Goose *(Anser anser)*	50	75
Shelduck *(Tadorna tadorna)*	60	90
Wigeon *(Anas penelope)*	90	130
Teal *(A.crecca)*	3	
Mallard *(A.platyrhynchos)*	3	10
Oystercatcher *(Haematopus ostralegus)*	350	300
Golden Plover *(Pluvialus apricaria)*	250	550
Lapwing *(Vanellus vanellus)*	600	2300
Knot *(Calidris cantus)*	600	200
Dunlin *(Calidris alpina)*	520	730
Curlew *(Numenius arquata)*	310	60
Redshank *(Tringa totanus)*	100	500

(from Prater 1981)

TABLE 4

existence of important bird populations in the surrounding area must be noted.

3.2.4.3 OFFSHORE BIRDS

Birds are very mobile and consequently accurate assessment of the temporal and spatial distribution is difficult. Surveys such as those carried out by the NCC further our knowledge enormously, but there are still large gaps in our knowledge of distribution in space and time. As a result the data available for offshore and migrating birds is sketchy. (See Table 5).

The most vulnerable time for seabirds is either during the brood rearing or moulting season e.g. the Razorbill and Guillemot have a parental care strategy in which the young leave the cliffs and are closely attended at sea for more than two months. The parents also moult at this time, so for a period in late summer the entire population is flightless and concentrated in favoured feeding areas. (Rees and Tasker 1990).

3.2.4.4 CONCLUSION

The presence of birds in the vicinity of the pipeline project, especially the important breeding grounds to the north and south of Loughshinny must be noted. There are several internationally important sites in the vicinity, which although several miles from the proposed landfall, will probably form part of the feeding grounds for the brood rearing birds during the spring and summer months.

3.2.5 MARINE MAMMALS

Of twenty three species of cetacean which are found in British and Irish waters, only about eight species have been recorded with any regularity in the Irish Sea in recent years.(Northridge 1990).

Cetaceans have not been sited off either of the landfall sites with most not penetrating far from the entrance narrows. In recent years occasional minke whales *Balaenoptera acutorostrata* and small schools of common dolphins *Delphinus delphis* have been seen in the richer stratified waters of the western Irish Sea.(Dickson 1990).

TABLE 5 Seabird distribution offshore

Species	Date	Location	Density/bird perkm^2
Gannet			
Sula bassana	March/April	IoM-Scotland	1.00-1.99
	May/August	IoM-Scotland	2.00-4.99
	May/August	IoM-Ireland	1.00-4.99
	Sept/Oct	IoM (Chicken Rk)	5.00+
		Scotland (Burrow Hd)	0.01-0.99
Cormorant/Shag			
Phalacrocorax spp.	March/June	Scotland	0.01-0.99
		MW IoM	0.10-0.99
	July/Feb	Scotland-IoM	0.10-0.99
Arctic Skua			
Stercorarius parasiticus	Sept/Oct	IoM (Chicken Rk)	0.20-0.49
Common Gull			
Larus canus	Oct/Jan	IoM (Chicken Rk)	1.00-1.99
Kittiwake			
Rissa tridactyla	April/May	IoM (Point of Ayre)	1.00-1.99
	June/August	Ireland (Lambey)	2.00-4.99
	Sept/Nov	Ireland (Lambey)	5.00+
		IoM (Chicken Rk)	1.00-1.99
		Scotland (Burrow Hd)	0.01-0.99
Guillemot			
Uria aalge	May/June	IoM (Chicken Rk)	2.00-4.99
	July/Oct	IoM-Ireland	5.00+
Razorbill			
Alca torda	Sept/Oct	Ireland (Lambey)	2.00-4.99
	Nov/Feb	IoM (Point of Ayre)	5.00+
Fulmar			
Fulmaris glacialis	March/May	IoM (Chicken Rk)	0.01-0.99
	July/August	IoM-Ireland	0.01-
5.00+			
	Sept/Nov	IoM-Scotland	1.00-4.99
Manx Shearwater			
Puffinus puffinus	Sept/Nov	Ireland (Lambey Deep)	Sightings
	Sept/Oct	IoM-Ireland (front)	1.00-10+
Grey Throated Diver			
Gavia stellata	March/April	Scotland	0.50-0.99
Eider			
Somateria mollissima	Jan/April	IoM-Ireland	0.01-0.99
Scoter			
Melanitta nigra			
M. fusca	Feb/March	IoM-Ireland	
		IoM-Scotland	0.01-0.99
	April/Sept	IoM-Ireland	
		IoM-Scotland	1.00-9.99

(NCC 1990b)

However, pinnepeds such as the Common Seal *Phoca vitulina* are seen along the coast from Balbriggan to Loughshinny although the major breeding sites are further north around County Down.(from Northridge 1990).

The Grey seal *Halychoelus grypus* is more widespread throughout the Irish Sea with a small breeding site based around Lambay Island and surrounding coasts as far as Dublin Bay.
(Northridge 1990).

3.3 SEA USERS

3.3.1 FISHING

Research has shown that the Irish Sea is not as productive as the North Sea (See Section 3.2), however, parts of the Irish Sea are intensely fished. The Irish Sea Study Group Report illustrates the degree of fishing intensity in the Irish Sea by estimating that an area equivalent to the bed of the Irish Sea is swept at least twice during the course of a year.

Fishing is by far the single biggest user of the Irish Sea and as such it is inevitable that the pipeline will interact with the fishing industry to some extent. It is important therefore to be aware of the nature and extent of fishery activity within the vicinity of the proposed route. The factors that must be considered in relation to the pipeline route are:

i. Characteristics of fishing activity.
ii. Extent of fishing activity, both temporally and spatially.
iii. Trends in fishing activity.

3.3.1.1 GENERAL DESCRIPTION OF GEAR TYPES

The types of gear used in fishing in the Irish Sea can be categorised into pelagic (fish found within the water column) and demersal (found at, or near, the seabed).

The methods used to catch the fish include:

Pelagic gear

i. Purse seine
ii. Mid water trawl
iii. Gill nets

Demersal gear

i. - Motor trawl/otter trawl
- light trawl
- nephrops trawl
- industrial trawl
- pair trawl

ii. Beam trawl
iii. Seine net (or Danish Seine)
iv. Long lines
v. Creels
vi. Dredges

Obviously some of these fishing methods are more vulnerable to interference with pipelines than others; primarily pelagic gear will not have an interaction while demersal gear, being dragged along the sea-bed can have a significant interaction.

The purse seine can be up to 1200m long and 240m deep, and as the name implies it is shaped like a purse. The net is deployed around a shoal with one end being first attached to a buoy. The vessel then encircles the area paying out the net and on its return to the buoy the net is closed at the foot or "pursed". The net is winched to the side of the vessel and the catch often lifted on board by means of a fish pump. The method is used exclusively to catch pelagic species, mainly herring, mackerel and sprat, and under normal operations no part of the net comes into contact with the sea floor. Thus no interaction with pipelines is foreseen.

The mid-water trawl is a variant of the demersal motor trawl used to fish at intermediate depths between the surface and the sea floor. The depth of the net is controlled by the length of the warps and the vessel's speed, and often two vessels up to 440m apart are used. Depending on the design of the net it's range may be limited to near-bottom waters or to any depth between the surface and the sea floor. A variant of this trawl, developed in Scotland, is known as the "delagic trawl" (a terminology combining demersal and pelagic). This may be used by a single vessel and can be deployed either in mid-water or in contact with the seabed on the same haul without changing the rigging. Thus while true mid-water trawls are unlikely to experience any interference with a pipeline this is only the case where the gear cannot be

deployed to allow near-bottom fishing or contact with the seabed. Many trawlers are able to change gear in order to be able to exploit both pelagic and demersal stocks thus the mid-water trawl described a particular fishing method and not an exclusive combination of vessel and gear.

Gill nets as the name implies are used to trap fish by their gills. Sheets of netting each about 30-40m long are paid out in lengths of 1500-2000m to form a curtain barrier. The net is held vertical in the water by a weighted footrope and by buoys on the headrope. Although predominantly used for pelagic fishing it is possible to anchor the nets close to the sea floor with weights and form a fence of netting close to the seabed. Even when deployed in this manner to catch demersal fish it is unlikely that pipelines present any obstacle to this static method of fishing.

In contrast the towed demersal gears are all subject to interference from any seabed obstruction.

The motor or otter trawl consists of a funnel shaped net towed over the seabed. Attached to the warps are otter boards or "doors" which in combination with floats and weights on the mouth of the net serve to keep the net open. The length of the warps is usually 3.5-4 times the depth of the water and thus for example in depths of 100m the net may be some 400m from the stern of the vessel. The term "motor trawl" is usually applied to the deep sea trawlers from Scotland but is similar to the English term "heavy otter". The term "light trawl" distinguishes smaller vessels and gear which is used in inshore waters, with nephrops trawl and shrimp trawl describing the targeted species of these fishing gears.

In the beam trawl the requirement for otter doors to hold the net open is overcome by the use of a solid beam with runners at either end. The net is heavily weighted with chains some of which may be used as t(r)ickler chains in the mouth of the net. Beam trawls are used predominantly to exploit flatfish though some catches of shellfish (e.g. shrimp) are also taken.

The scallop dredge is in some respects similar to the beam trawl in operation but considerably smaller. A steel framed mouth is attached to a bag of usually light metal chain link. Teeth on the underside of the mouth rake the shellfish into the bag. Several dredges may be deployed simultaneously from a single vessel. Such vessels are generally quite small (usually < 25m) and their fishing activities restricted to shellfish grounds in coastal regions.

Another demersal net fishing method is the Danish seine and many inshore vessels are now multipurpose in that they can deploy both light trawl gear and seine nets. The seine net is a sac of netting with characteristic wings on either side, kept in position vertically by floats and weights. One of the warps attached to the net is initially fastened to a pole passed through a buoy, the "dahn buoy". The vessel steams forward paying out first warp, then the seine net, and then more warp and in doing so takes a course which forms a triangle returning finally to the dahn buoy which may be between 1-3km distant from the net. The vessel steams ahead to pull the warps straight before the net is winched on board.

Creels or pots are used to catch shellfish, principally lobsters and crabs. They are normally lowered to the seabed in lots with a buoy marking their position. They are usually checked daily and deployed at specific locations favoured by the fishermen.

3.3.1.2 COMMERCIAL FISH SPECIES IN THE IRISH SEA

Irish national catch statistics list 67 species caught in fishermen's nets - 46 fish species, 10 crustacean and 11 mollusc. The major commercial fisheries which are likely to interact with the pipeline development are examined below.

a) Norway lobster or Dublin Bay prawn (*Nephrops norvegicus*)

This is the most valuable species in the Irish Sea and is fished with light trawls in the soft mud areas between the Isle of Man and counties Dublin and Down. Consequently many of the fishermen in the area rely heavily on the prawn fishery for their livelihood. Northern Ireland and Ireland usually take 45%-60% and 30%-45% of the total catch respectively. It is usually fished in summer with the importance of previously marginal months increasing steadily.

The ICES Advisory Committee on Fishery Management (ACFM) note that landing in the Irish Sea East have been falling overall since 1984 but with a slight increase in 1990 to 630 tonnes. The Irish Sea West has been fluctuating without trend. The landings since 1984 have been:

	1984	1985	1986	1987	1988	1989	1990
			('000 tonnes)				
Irish Sea East	0.62	0.52	0.69	0.47	0.50	0.43	0.63
Irish Sea West	7.07	6.43	8.75	8.50	8.07	8.50	8.25

The ACFM note that effort has been increasing in the Irish Sea West fishery since 1986. They note that mean size of *Nephrops* landed have been falling but remaining fairly constant. The total preferred catch for 1992 would be about 8900 tonnes.

They summarize the trends in the stock between 1985-1990 as follows:

	Effort	Landings	CPUE/LPUE	Mean Size
Irish Sea East	-	~	-/~	-
Irish Sea West	+	-	-	~/+

where + (increasing), - (decreasing), ~ (stable or fluctuating without obvious trend). CPUE (catch per unit effort), LPUE (landings per unit effort).

It is important to note that in the western Irish Sea region, although the effort has increased since 1985, the landing and therefore the catch per unit effort has been declining. (ACFM 1991a).

In 1988 Ireland landed 3210 tonnes, England and Wales 693 tonnes, Isle of Man 39 tonnes, Northern Ireland 5255 tonnes and Scotland 16 tonnes. By 1990 England and Wales took 748 tonnes, Isle of Man 39 tonnes, Northern Ireland 5739 tonnes and Scotland 164 tonnes. Ireland has not yet reported to ICES. (ICES 1991).

b) Cod *(Gadus morhua)*

Cod are caught from age 1 upwards within the spawning grounds with otter trawls and pelagic trawls being utilized before and during the spawning season of March and April. The remainder of catches are taken in mixed species fisheries, especially in the north west Irish Sea, an area through which the pipeline passes.

47% of the total catch is usually taken by the UK, 40% by Ireland and 14% by other countries.

The ACFM summarised the state of the cod stocks in the Irish Sea as catches being high recently due to a large 1986 year class, but decreasing in 1990 to below average levels. Spawning biomas was at lowest recorded level in 1990. Northern Ireland accounted for 3486 tonnes, Scotland 1700 tonnes, England and Wales 1310 tonnes, Isle of Man 48 tonnes and Belgium 310 tonnes. The Irish data was not available, with the last data for 1988 being 5821 tonnes.

It is estimated that 1992 catches would be in the order of 10,000-11600 tonnes. The TAC has been set at 10000 tonnes. Cod are the major predator on *Nephrops* and the ACFM suggest that a large reduction in cod fishing mortality will reduce the Nephrops yield, resulting in a likely reduction in the economic yield from the combined fishery. (ACFM 1991b).

c) Whiting *(Merlanguis merlanguis)*

Whiting are often taken in mixed species fisheries conducted by whitefish and *Nephrops* otter trawls and pelagic trawls. The *Nephrops* trawls often catch a large by-catch of juvenile whiting in their small mesh nets.

Irish Sea catches for whiting since 1980 have been lowest in 1990 with 10700 tonnes. Of this, 2700 tonnes were estimated to be discards from the *Nephrops* fishery. Northern Ireland accounted for over 4000 tonnes, England and Wales 1106 tonnes, Scotland 280 tonnes and Isle of Man 75 tonnes. The Irish data was not available. The latest figures for Ireland were 4394 tonnes in 1988.

It is estimated that landings for 1992 will be in the region of 10400-12100 tonnes. The TAC for 1992 has been set at 10000 tonnes.

d) Plaice *(Pleuronectes platessa)*

Plaice are usually taken on the inshore grounds in the northeast and northwest Irish Sea, using otter trawls and beam trawls. The beam trawlers often catch plaice as a by-catch to their target species of sole.

Catches for 1990 have been below average, with an estimated total catch of 3300 tonnes compared with 6200 tonnes in 1987. Fishing mortality is estimated to be near record high levels with the species stock biomass down from 1986 to 67% of the long term average by 1990. England and Wales accounted for 1644 tonnes in 1990, Isle of Man 27 tonnes, Northern Ireland 325 tonnes and Scotland 204 tonnes. The figures for Ireland were not available. The last data for 1988 was 2009 tonnes.

The ACFM estimate a total catch of between 3000 and 3800 tonnes in 1992. They note that although the spawning stock is at a fairly low level and expected to decrease the stock is not in immediate danger. The TAC has been set at 3800 tonnes and is not expected to be met.

e) Sole *(Solea solea)*

Over 80% of the sole caught in the Irish Sea is taken by beam trawl. The remainder is taken by otter trawl.

Catches have been relatively stable around 1500 tonnes with peaks in 1980 (1900t) and 1987 (2800t). Catches for the last four years have exceeded the TAC's with 1990 catches estimated at 1600 tonnes compared with a TAC of 1500 tonnes. It is estimated that England and Wales accounted for 493 tonnes, Isle of Man 10 tonnes, Northern Ireland 73 tonnes and Scotland 41 tonnes. The figures for Ireland were not available. Their last record was for 366 tonnes in 1988. It is interesting to note that the biggest fishery for sole was the Belgian fleet, catching over 1000 tonnes in 1989 and 786 tonnes in 1990.

ACFM suggest that no long-term gains in yield will be obtained by increasing fishing mortality above its current level and a TAC of 1350 tonnes has been set for 1992.

f) Scallop *(Pecten maximus)*

This species is fished mainly by dredges 0.6-1.2m wide with metal tines vertically along the lower front edge of the dredge mouth. On rough ground the tines are spring loaded. the dreges are fished in gangs from each side of the boat for 1.0-1.5 hours at a time. The upper net surface is netting with the lower net being made of steel links.

There is evidence of high mortality rates and evidence of overfishing on all inshore grounds around the Isle of Man, but the fishery is sustained by regular recruitment. (Hillis and Grainger 1990).

In 1988 a total of 2361 tonnes were landed from the Irish Sea. The Isle of Man landed 1230 tonnes, Scotland 594 tonnes, England and Wales 387 tonnes and Ireland 112 tonnes. By 1990 the total has dropped to 1622 tonnes with Isle of Man 882 tonnes, Scotland 481 tonnes, England and Wales 212 tonnes. (ICES 1991).

g) Queen scallop *(Chlamys opercularis)*

Fishing methods are similar to the scallop fishery with the main difference being that the queen can live on harder ground than the scallop because it does not excavate a recess for itself. The queen can also swim off the seabed when disturbed so the dredge design is slightly different. There are no tines used, the frame has a tickler chain attached to disturb the queens, and towing is faster. (Hillis and Grainger 1990).

In 1988 5609 tonnes were landed within area VIIa, 3529 were landed in Scotland, 1636 tonnes in Isle of Man, 389 tonnes in England and Wales and 32 tonnes in Ireland. Northern Ireland landed 23 tonnes. By 1990 this had risen to a total of 8102 tonnes of which Scotland landed 5033 tonnes, Isle of Man 2196 tonnes, England and Wales 779 tonnes and Northern Ireland 95 tonnes. (ICES 1991).

h) Herring *(Clupea harengus)*

This is a pelagic species and therefore of limited interest to the pipeline operation. However, during the fishing season of June-September, the paired mid-water trawls used in the fishery between the Manx and Mourne fishing grounds will have to avoid the laybarge during construction operations.

Catches have been slowly dropping since 1988 (10200 tonnes) to a 1990 catch of 6300 tonnes. Of that, the UK accounted for 4613 tonnes and Ireland 1699 tonnes. The 1992 TAC has been set at 7000 tonnes with predicted landings varying from 5900-7400 tonnes. (ACFM 1991c).

Hillis and Grainger conclude that:

> both demersal and shellfish landings in these areas are currently near their highest levels though there is good evidence that many of the stocks are being over-fished. Despite declining stock biomasses, catches have been increased generally due to rapid increases in fishing effort ... a reduction in fishing effort would lead, after a few years, to larger stock sizes and consequently higher catch rates with corresponding higher profitability. Overall catches could thus be maintained close to the current levels or increased somewhat with less fishing effort. There are practical difficulties in implementing a reduction in fishing capacity when a shared resource is involved,

but to have a prosperous and viable industry it is essential that these are overcome. (Hillis and Grainger 1990).

3.3.1.3 TRENDS IN FISHING ACTIVITY

a) INTRODUCTION

The International Council for the Exploration of the Seas (ICES) classify the Irish Sea as Division VIIa.
Each country reports its fishing activities to ICES.

Figure 24 (ICES Sightings in the Irish Sea) applies to the whole of area VIIa. It can be seen that across the Irish Sea there is a relatively constant and stable fishing presence throughout the year.

Figure 25 (Sightings by Country) demonstrates the overall importance of the English and Scottish fleets. Ireland is seen to have a stable overall presence.

Figure 26 (Demersal fishing effort by gear type) shows the importance of the otter trawl and increasing importance of beamers. Dredging is shown to be gradually diminishing in importance across the whole of Area VIIa. Shrimp gear, catching *Nephrops*, is seen to have a stable but relatively low level of effort compared with other gear. However, because the *Nephrops* are confined to a small, discrete habitat within the Irish Sea, their importance will obviously be much greater within that area.

b) FISHING ACTIVITY IN THE PROJECT AREA

For statistical purposes the whole of the North Atlantic is subdivided into blocks of 3091 km^2. These are referenced as seen in the maps as a coordinated combination of latitudinal prefixes 35,36,37,38 and longitudinal suffixes E3, E4, E5, E6. (Figure 27). The route passes through ICES squares 35E3, 35E4, 36E3, 36E4, 37E4, 37E5 and 38E5.

ICES Data
Sightings in the Irish Sea
1984 - 1987

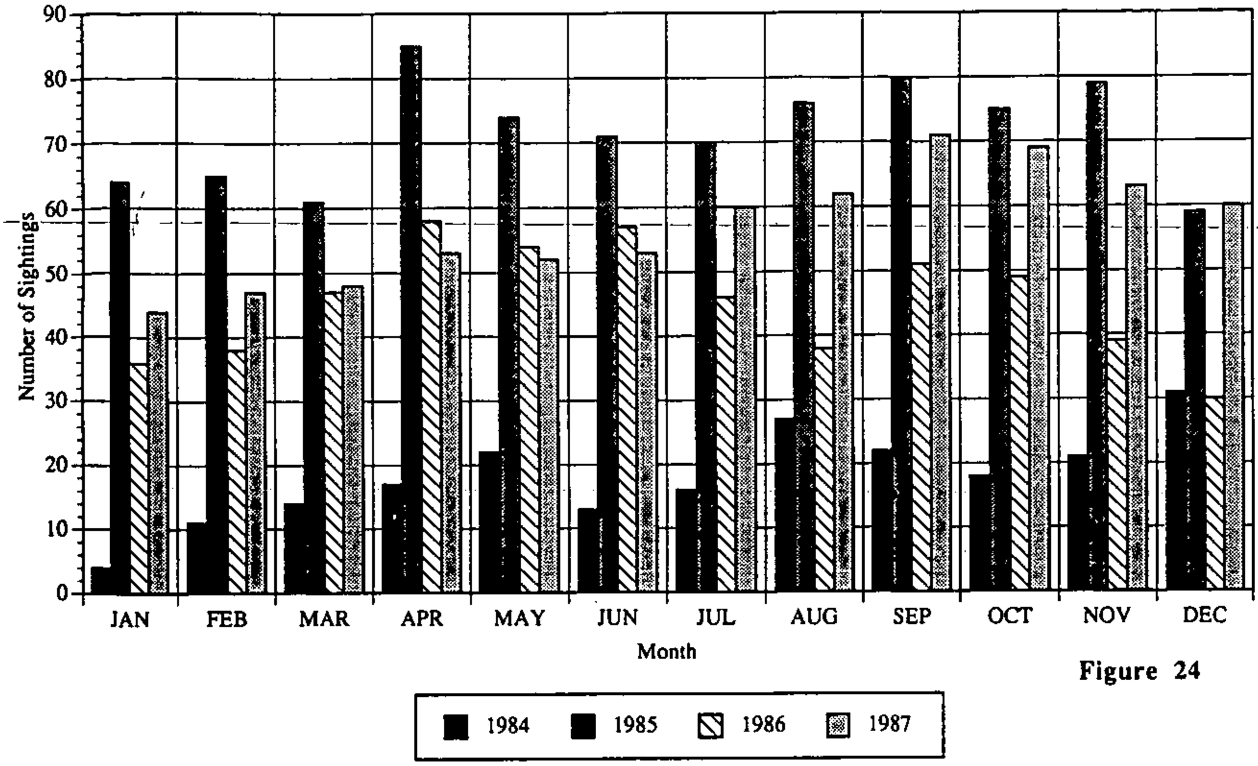


Figure 24

NB This includes data from the whole of area VIIa.

ICES Data
Number of Sightings in the Irish Sea by Country
1984 - 1987

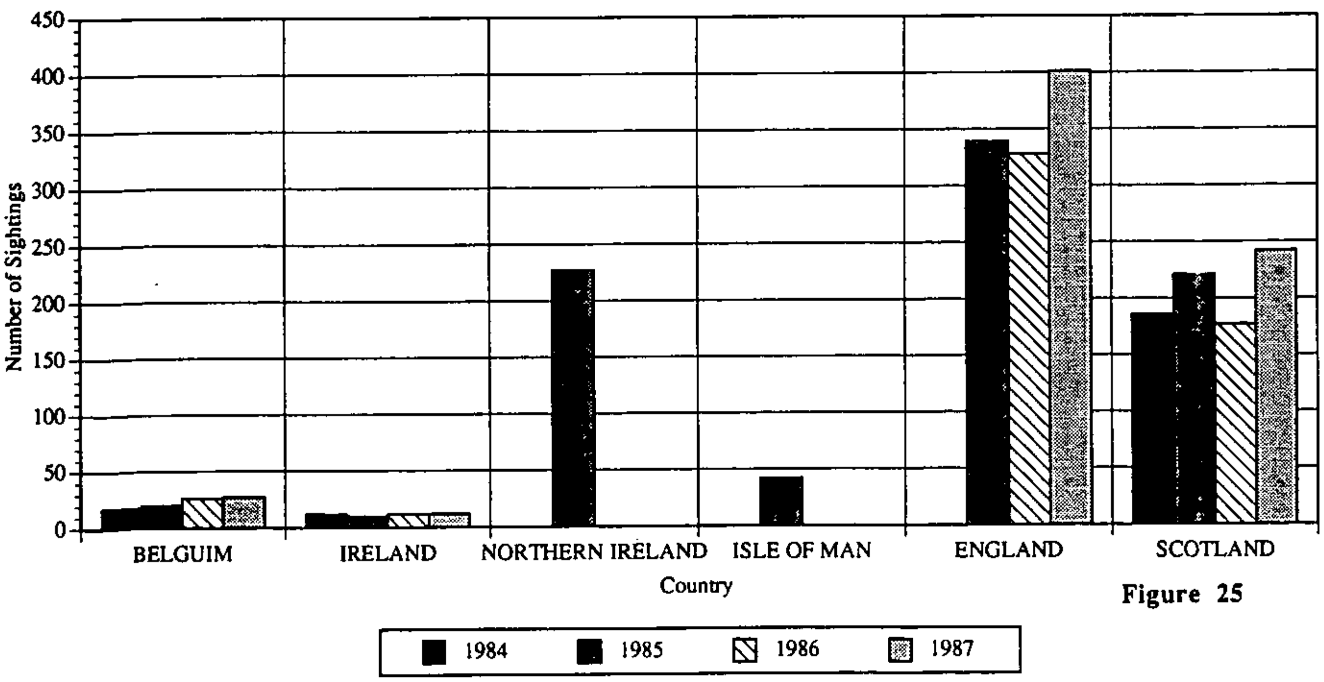


Figure 25

NB This includes data from the whole of area VIIa.

ICES Data
Demersal Fishing Effort by Gear Type of Vessels Sighted in the Irish Sea 1984 - 1987

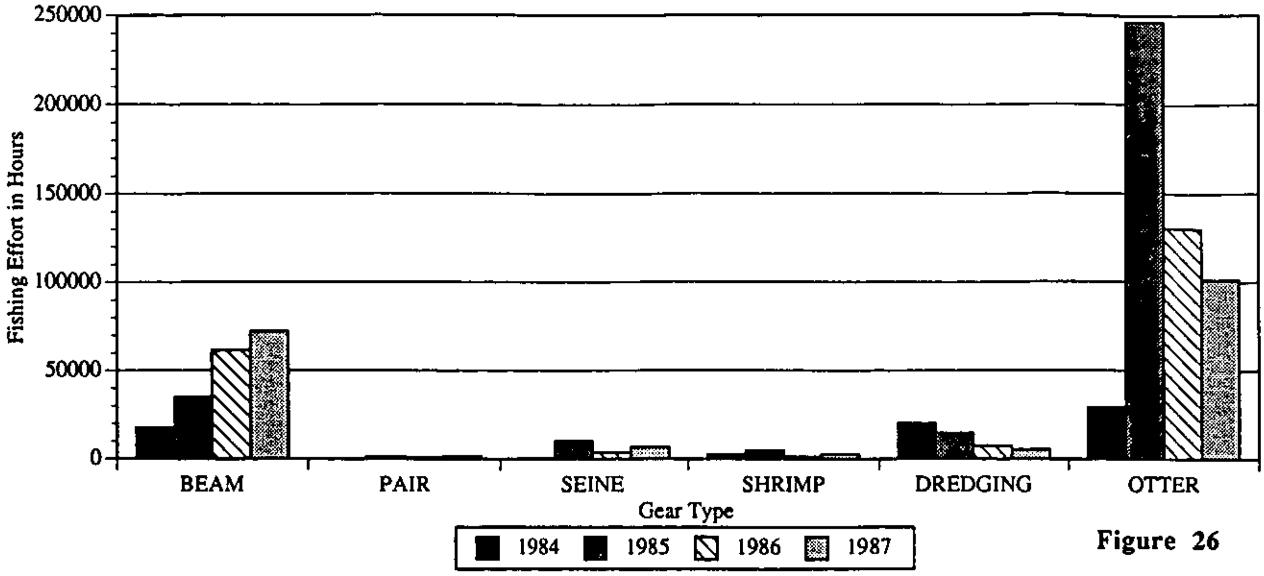


Figure 26

NB This includes data from the whole of area VIIa.

	1984	1985	1986	1987
BEAM	17774	34903	61391	72183
PAIR	33	1496	631	1585
SEINE	393	10141	3440	6653
SHRIMP	2772	4962	1176	2818
DREDGING	20271	14680	7532	5389
OTTER	29272	246294	130285	101433

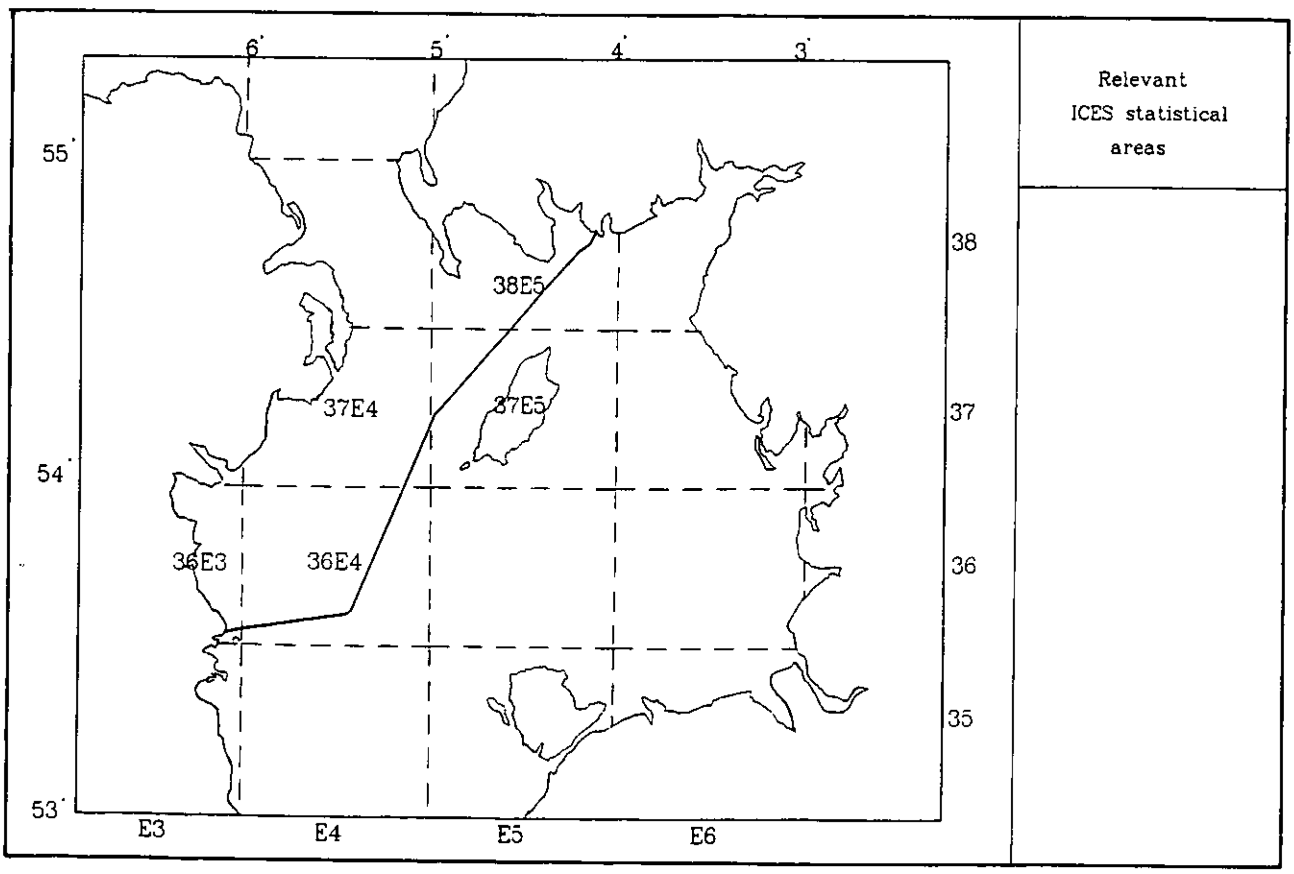


Figure 27

The length of pipeline passing through each ICES square is listed below:

38E5	43km	21% of total pipeline length
37E5	45km	22% of total pipeline length
37E4	23km	11% of total pipeline length
36E4	87km	43% of total pipeline length
36E3	5km	3% of total pipeline length
TOTAL	203km	

This will allow a rough assessment of the importance of the pipeline within each 3091km^2 block. It can be seen that 43% of the entire length of the pipeline will be confined within area 36E4.

All things being equal this area would appear to have more significance when considering potential interactions between fisheries and the project. However it is important to take the nature of the fishing activity into account before considering the potential impact.

The main index of fishing trends is effort; i.e. the amount of hours spent fishing. This, when coupled with information on gear used and catch taken can provide a useful view of fishery activity over a period of time. A second source of information is surveillance data from aircraft observations which provide a snapshot view of fishery activity. The combination of this data can be used to estimate the state of the fishery.

Unfortunately, accurate identification of trends is notoriously difficult; effort and landings information collation relies entirely on fishermen's returns. Of necessity this assumes accurate reporting by the fishermen. However, with the constraints imposed by the EEC quota system coupled with a low level of policing, the level of misreporting is widely regarded as a major problem. Therefore any conclusions made on the basis of catch records must be seen in this light.

Another problem is posed by the different information gathering activities of the five regional/national components surrounding the Irish Sea.

In Scotland the Scottish Office Agriculture and Fisheries Department (SOAFD) collect data on all landing vessels regardless of their length. In

England and Wales the Ministry of Agriculture Fisheries and Food (MAFF) collect only effort data for vessels > 40 feet in length. Ireland only keeps surveillance records and the Isle of Man only records landings. Therefore it is difficult to reconcile these differing images of the overall picture.

c) SCOTTISH WATERS

i. Inshore

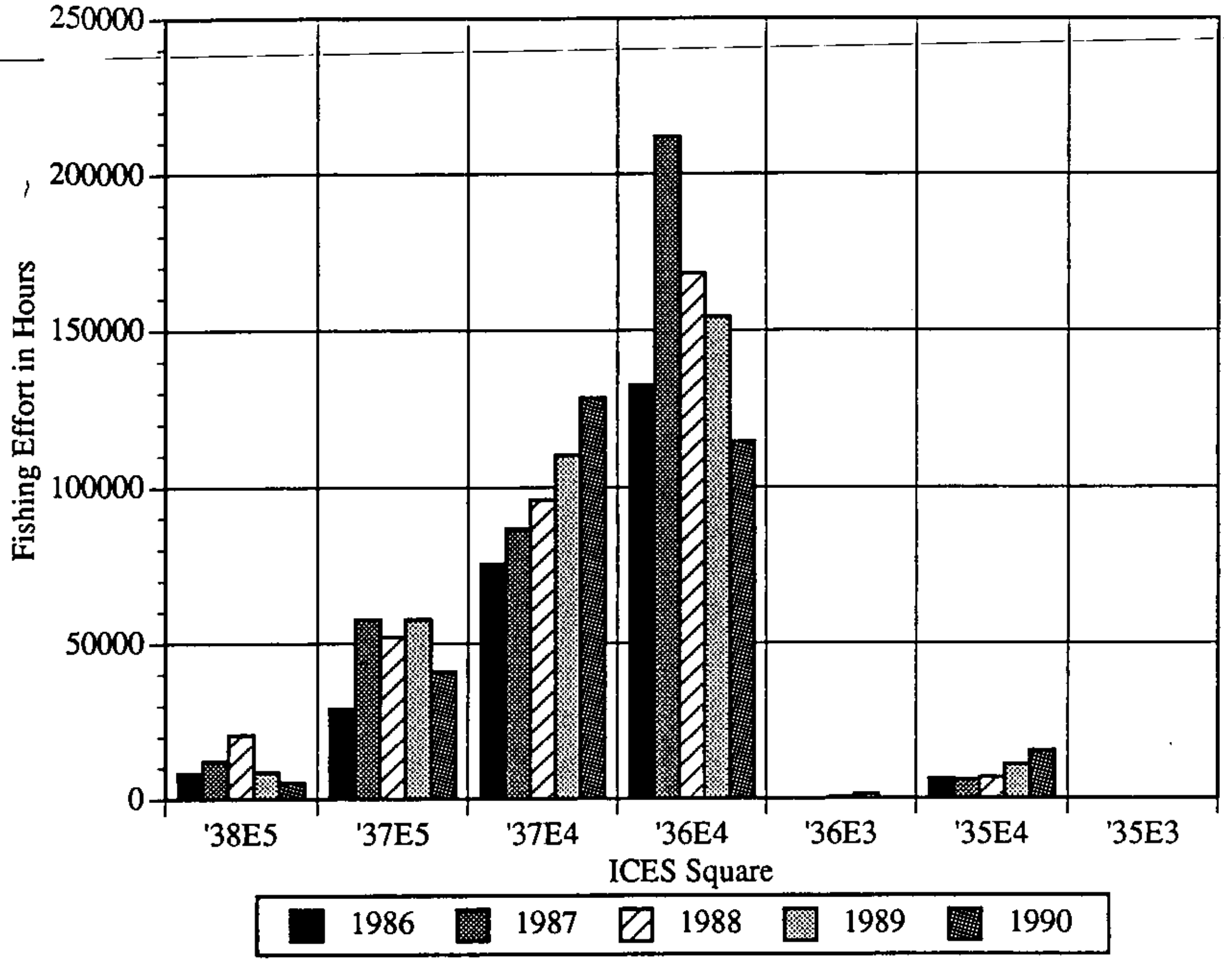
Kirkcudbright is the nearest port to the Scottish landfall, and was the 15th biggest Scottish fishing port in terms of landings in 1988. It is the main commercial port of Dumfries and Galloway. Fishing is the largest industry in the area, with particular importance placed on the shellfish beds between the Scottish mainland and the Isle of Man. Although it is likely that any long term impact on the fishery would be negligible, it has been decided that the importance of the fishery and the restricted nature of the shellfish beds justifies a more in-depth analysis than would normally be expected within an EIA. While it is not deemed necessary to carry out a full scale fishing intensity study for the whole Irish Sea, an in-depth examination of the most vulnerable fishery allows an accurate assessment of potential interactions to be made. That examination is presented in Appendix B.

ii. Offshore

To gain an overall impression of the fishing effort in UK waters it is necessary to combine data collated by MAFF (for England and Wales) and SOAFD (for Scotland). Only ICES squares along the length of the pipeline route have been included. This should prevent patterns in other areas masking the true trends in relevant fishery activity. Although each square represents an area of approximately 3091km^2, these are the smallest manageable blocks for data analysis.

Figure 28 (English and Scottish fishing effort 1986-1990) shows the largest concentration of UK effort in squares 36E4 and 37E4, with 37E4 becoming progressively more important over the last five years. Effort for 36E4 has almost halved since 1987. Overall, the total effort over the combined ICES squares surveyed has declined. Not surprisingly, there is very little Scottish or English fishing in the squares directly adjacent to Ireland.

English and Scottish Fishing Effort
1986 - 1990



	1986	1987	1988	1989	1990
38E5	8437	12193	20907	8497	5392
37E5	29269	57861	52120	57848	40911
37E4	75508	86775	95925	110300	128454
36E4	132512	212044	168229	154349	114328
36E3	0	28	317	1512	39
35E4	6253	6012	6842	10825	15294
35E3	0	28	20	0	0

Figure 28

TABLE 6

ICES SURVEILLANCE DATA

Sightings in the Irish Sea 1984 -87
By Month

	1984	1985	1986	1987
JAN	4	64	36	44
FEB	11	65	38	47
MAR	14	61	47	48
APR	17	85	58	53
MAY	22	74	54	52
JUN	13	71	57	53
JUL	16	70	46	60
AUG	27	76	38	62
SEP	22	80	51	71
OCT	18	75	49	69
NOV	21	79	39	63
DEC	31	59	30	60

Sightings in the Irish Sea 1984 - 87
By Country

	1984	1985	1986	1987
BELGUIM	18	20	26	27
IRELAND	12	10	12	12
NORTHERN IRELAND		227		
ISLE OF MAN		42		
ENGLAND		339	328	401
SCOTLAND	186	221	177	242

Figures 29 and 30 and Table 7 (English and Scottish fishing effort by month 1990) show that the time of least effort, and therefore least fishing, is between December and March with less than 18000 hours being recorded. The peak fishing period is between May and October with > 25000 hours fished. There is a noticeable decline in activity during July. However, it must be noted that MAFF data for 36E4 and 35E4 is missing from the analysis. Despite that the graph does show a definite temporal pattern which is unlikely to be contradicted by the missing data.

Figure 31 (English demersal effort) generally shows the same pattern as graph 6 apart from a more pronounced decline in October before a slight peak in November.

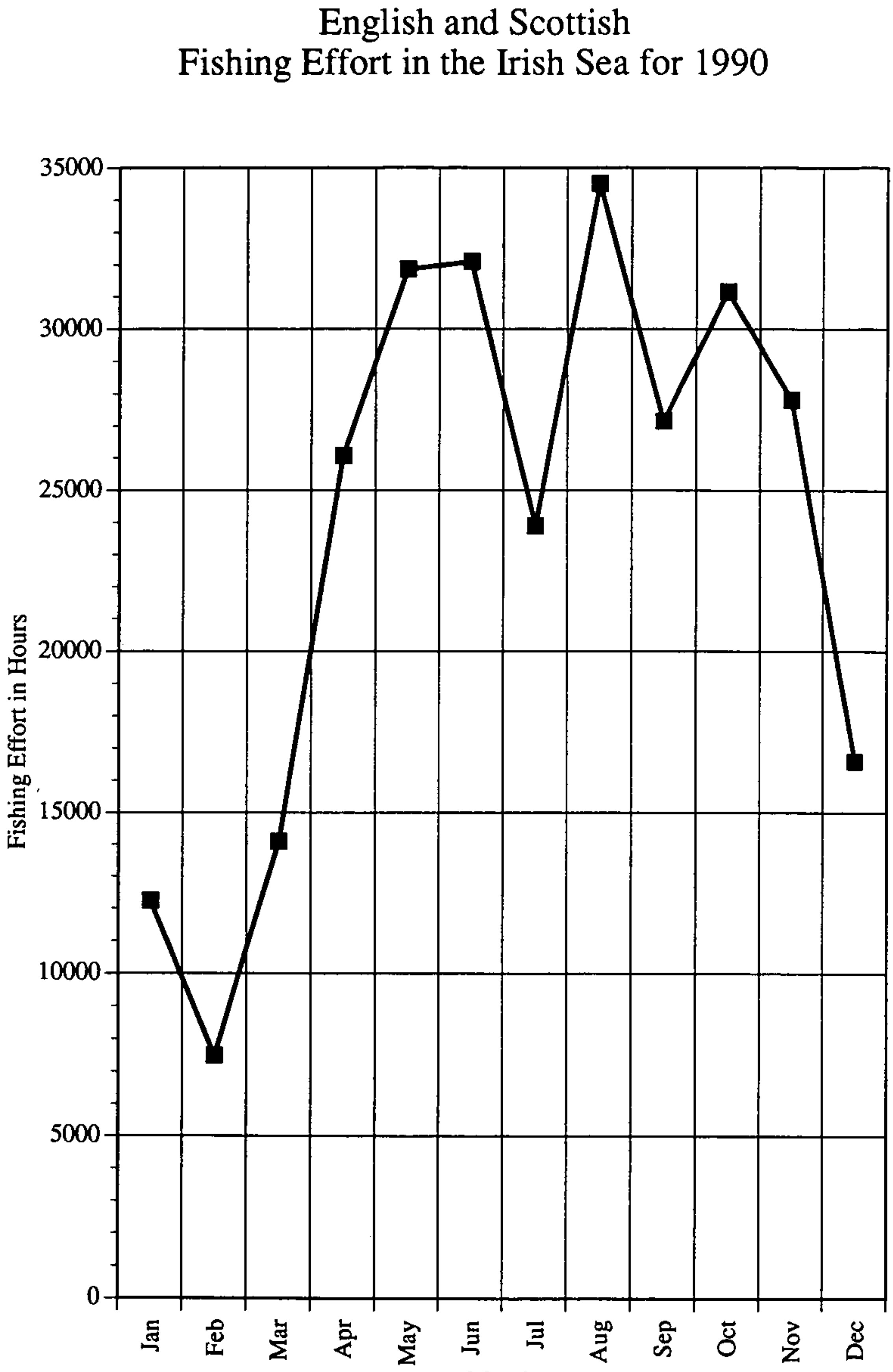
Figure 32 and Table 8 (English and Scottish fishing effort for gear types) show the importance of light otter trawls in the region around the pipeline. They also shows the gradual increase in the use of such trawls. Other trawls include *Nephrops*, single demersal and heavy trawls. The importance of dredging in the region is also indicated.

Figure 33 and Table 9 (English and Scottish shellfish landings) shows the steady growth in importance of 37E4 and decline of 36E4. It is important to note the trends near the Scottish landfall where landings from 38E5 and 37E5 are also showing marked declines over the last three years.

Figure 34 and Table 9 (demersal fish landings) illustrates the relative importance of square 36E4, even though it has declined in importance. 37E4 has remained consistently significant over the period examined with 37E5 declining slightly. 38E5 appears to have been less important to demersal fisheries than might initially be thought.

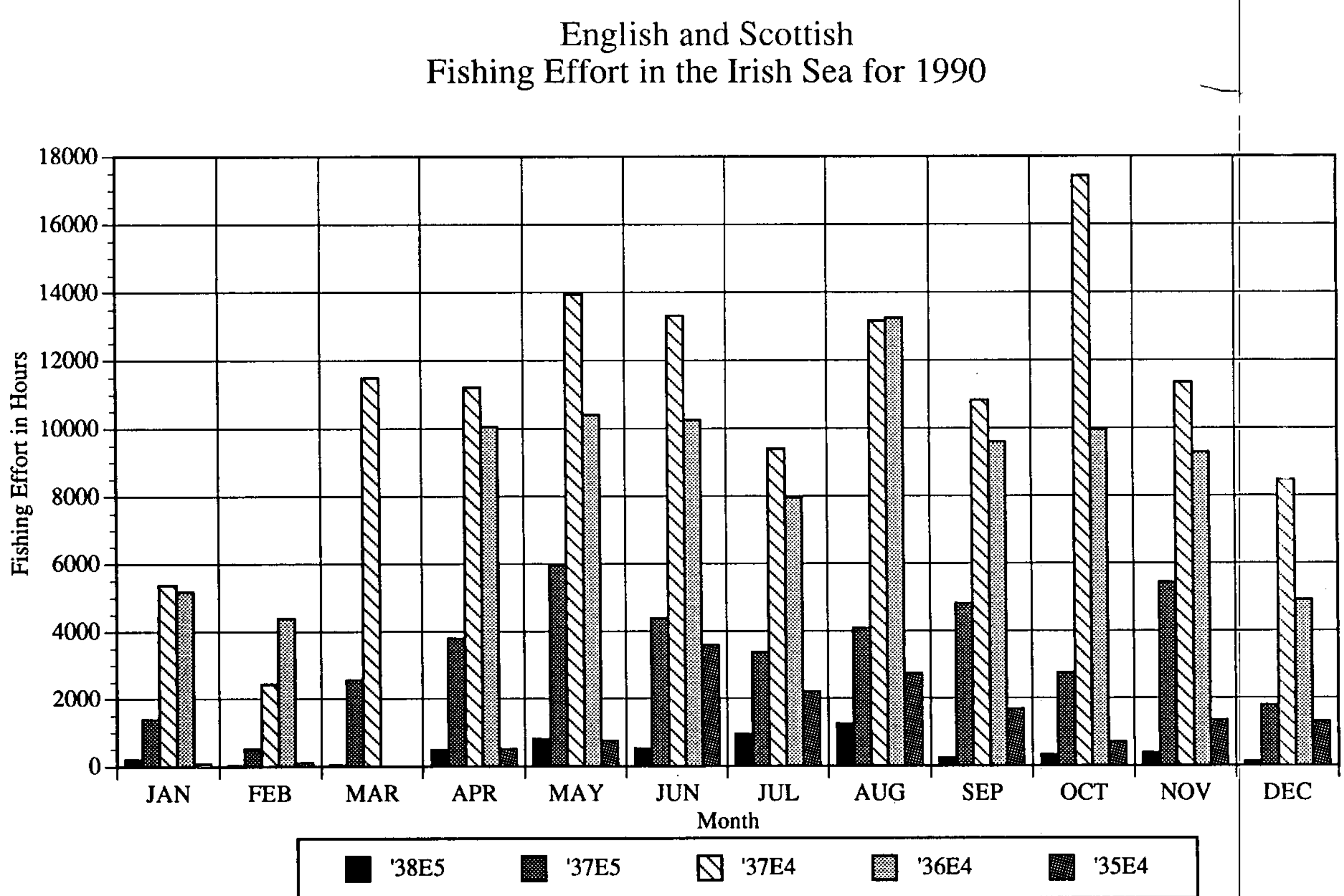
Figure 35 and Table 9 (pelagic landings) shows the domination of squares 37E5 and 37E4 significantly down on both these areas. The trends fluctuate considerably.

Figure 36 and Table 10 (MAFF surveillance data) shows sightings of fishing vessels in the project area to be falling; in 1987 262 sightings were reported. By 1990 this had fallen to 147. The majority of the sightings were noted between March and September with less than 10 sightings per month from October to February.



NB I. English data missing from 36E4, 35E4.
II. This includes ICES squares 38E5, 37E4,37E5, 36E3, 36E4, 35E4.

Figure 29



NB I. English data missing from 36E4, 35E4

Figure 30

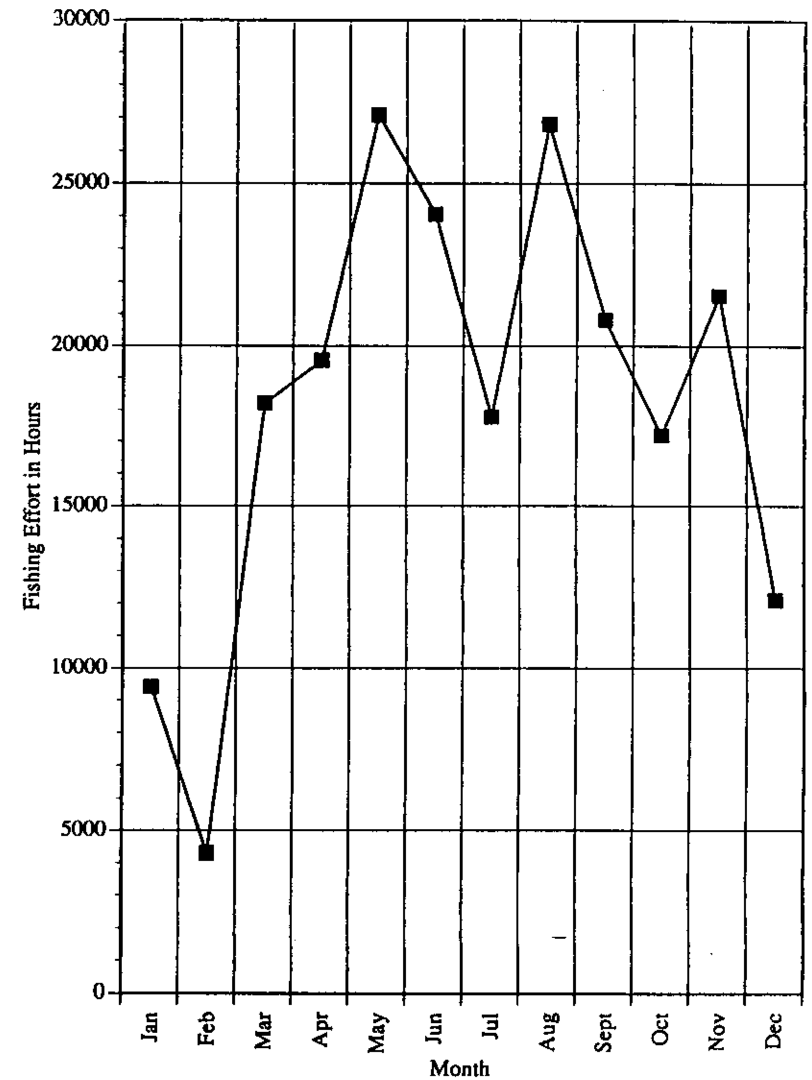
TABLE 7

English and Scottish Fishing Effort in the Irish Sea for 1990

	38E5	37E5	37E4	36E4	35E4	Total
JANUARY	212	1389	5380	5176	79	12236
FEBRUARY	23	519	2446	4384	117	7489
MARCH	35	2571	11496	0	0	14102
APRIL	482	3791	11207	10046	514	26040
MAY	800	5968	13943	10399	740	31850
JUNE	524	4389	13324	10248	3596	32081
JULY	941	3379	9397	7961	2217	23895
AUGUST	1238	4076	13176	13259	2746	34495
SEPTEMBER	236	4810	10834	9590	1682	27152
OCTOBER	324	2764	17422	9947	711	31168
NOVEMBER	383	5440	11354	9282	1340	27799
DECEMBER	131	1775	8475	4908	1296	16585

NB English data missing from 36E4, 35E4.

English Demersal Fishing Effort in the Irish Sea for 1990



NB This includes ICES squares 38E5, 37E4,37E5,36E3,36E4,35E4.

Figure 31

English and Scottish
Fishing Effort for Each Gear Type
1986 - 1990

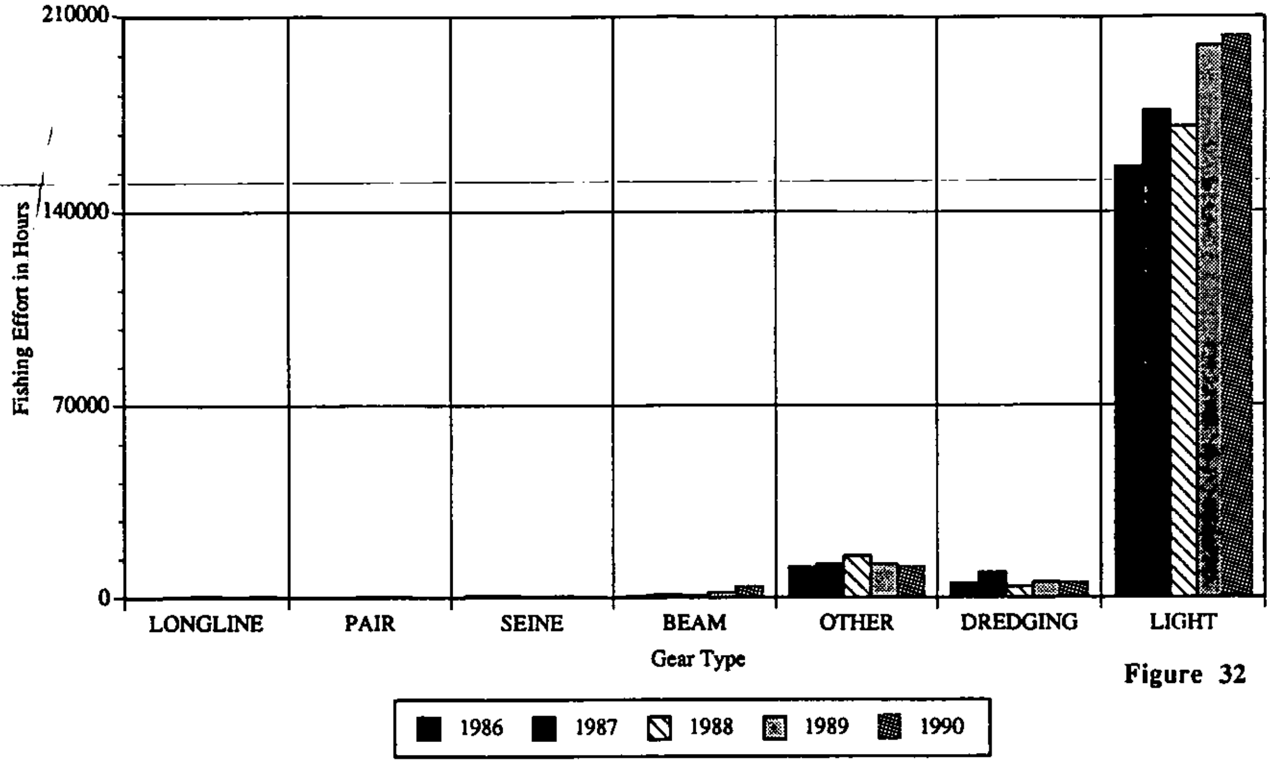


Figure 32

NB This includes ICES Squares 38E5,37E5,37E4,36E4,35E4.

English and Scottish
Fishing Effort for Each Gear Type
1986 - 1990

	1986	1987	1988	1989	1990
LONGLINE	0	397	703	285	410
PAIR	26	0	442	440	50
SEINE	650	871	498	634	405
BEAM	801	1393	879	1859	3716
OTHER	11097	12133	15214	12273	11292
DREDGING	5242	9128	4075	5703	5630
LIGHT	156381	176272	170679	199605	203161

NB This includes ICES Squares 38E5,37E5,37E4,36E4,35E4.

TABLE 8

Shellfish
English and Scottish Landings
1986 - 1990

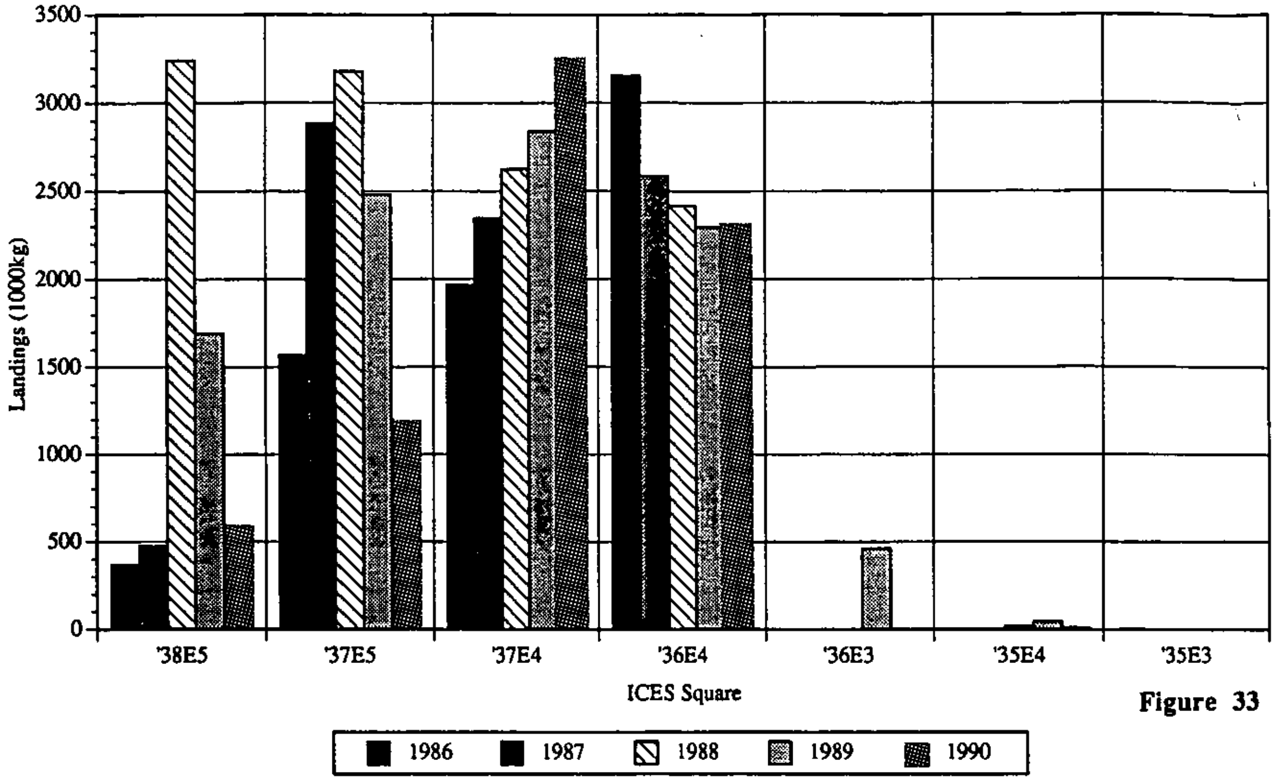


Figure 33

English and Scottish Landings
for the Irish Sea
1986 - 1990

	Pelagic Landings (1000kg)					Demersal Landings (1000kg)					Shellfish Landings (1000kg)				
	1986	1987	1988	1989	1990	1986	1987	1988	1989	1990	1986	1987	1988	1989	1990
38E5	2	19	41	0	1	520	711	486	311	241	369	474	3241	1693	597
37E5	400	1819	2698	1707	1451	1812	2768	2783	2290	1564	1570	2884	3178	2478	1203
37E4	2454	517	2046	780	2530	3486	3310	3697	3209	3612	1967	2346	2627	2838	3258
36E4	580	97	265	606	55	6098	4	5394	6419	4456	3154	2585	2416	2293	2326
36E3	0	0	0	0	0	0	0	36	3	0	0	1	1	462	0
35E4	1	0	0	1	5	474	0	553	851	935	2	3	19	46	9
35E3	0	0	0	0	0	0	0	3	0	0	2	0	0	0	0

TABLE 9

Demersal
English and Scottish Landings
1986 - 1990

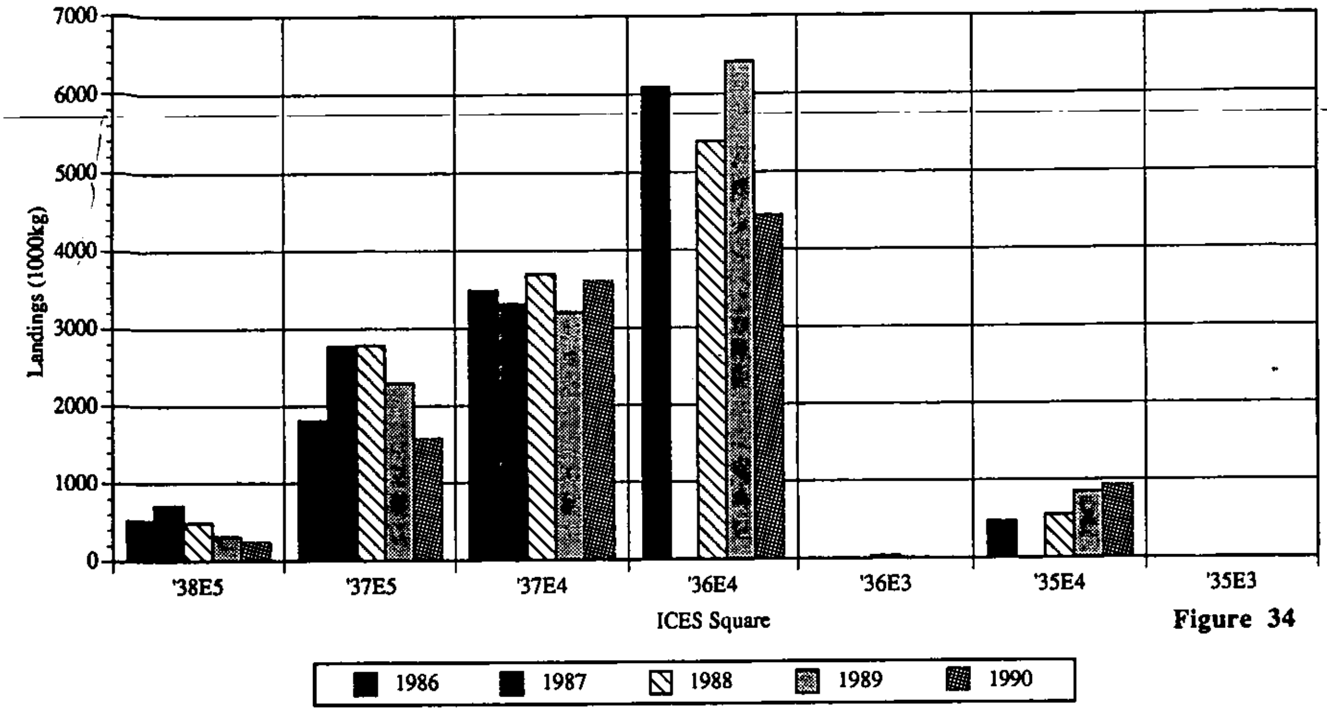


Figure 34

Pelagic
English and Scottish Landings
1986 - 1990

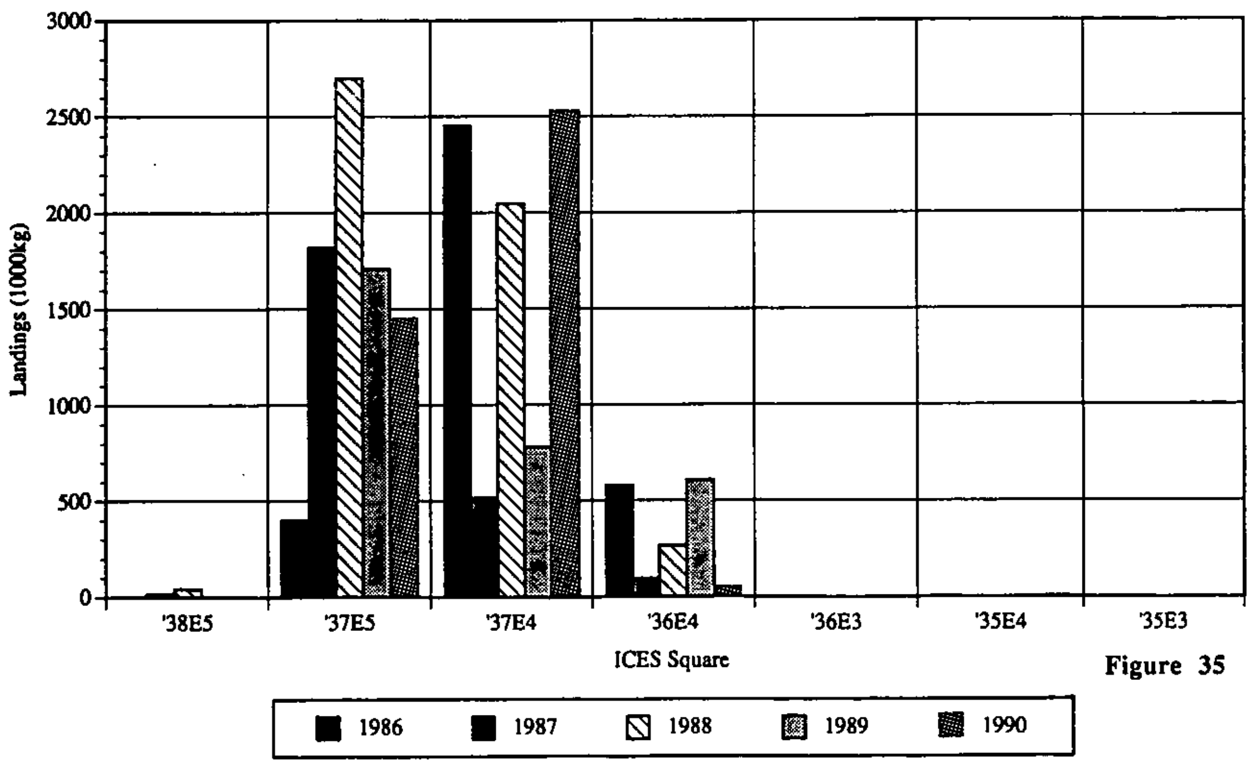
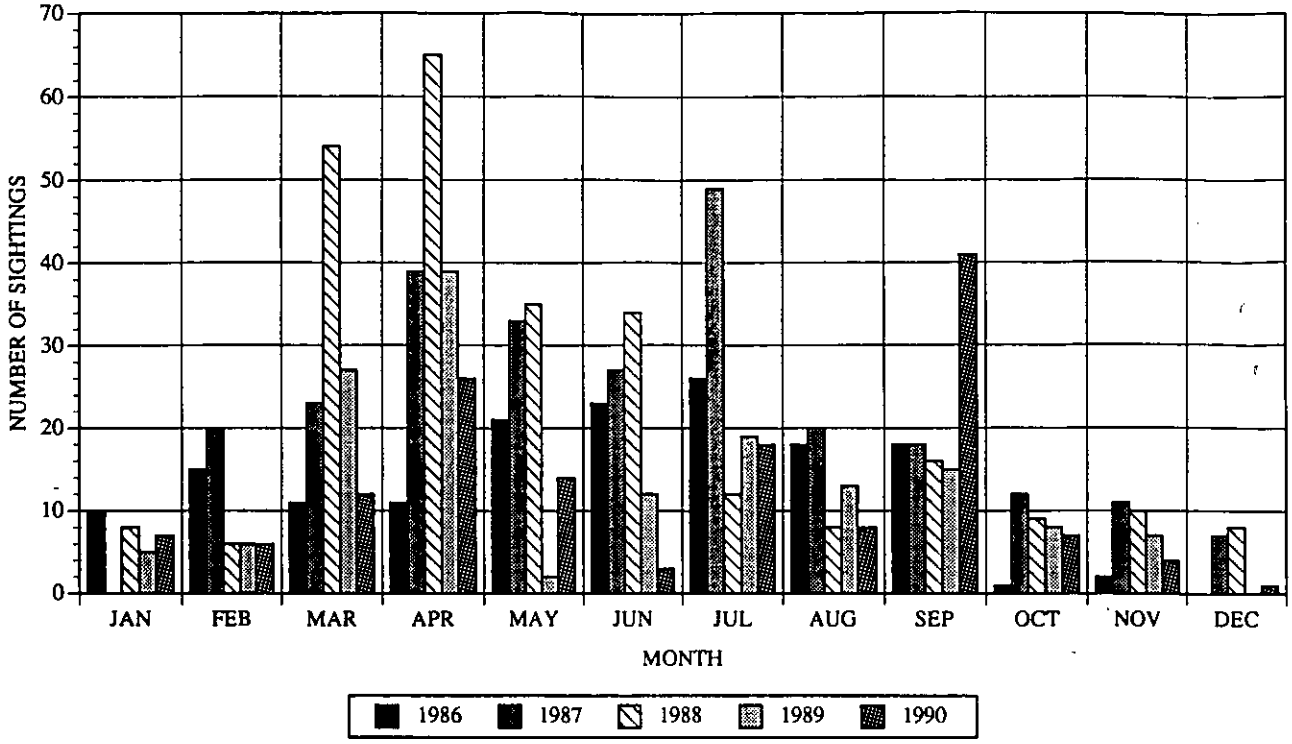


Figure 35

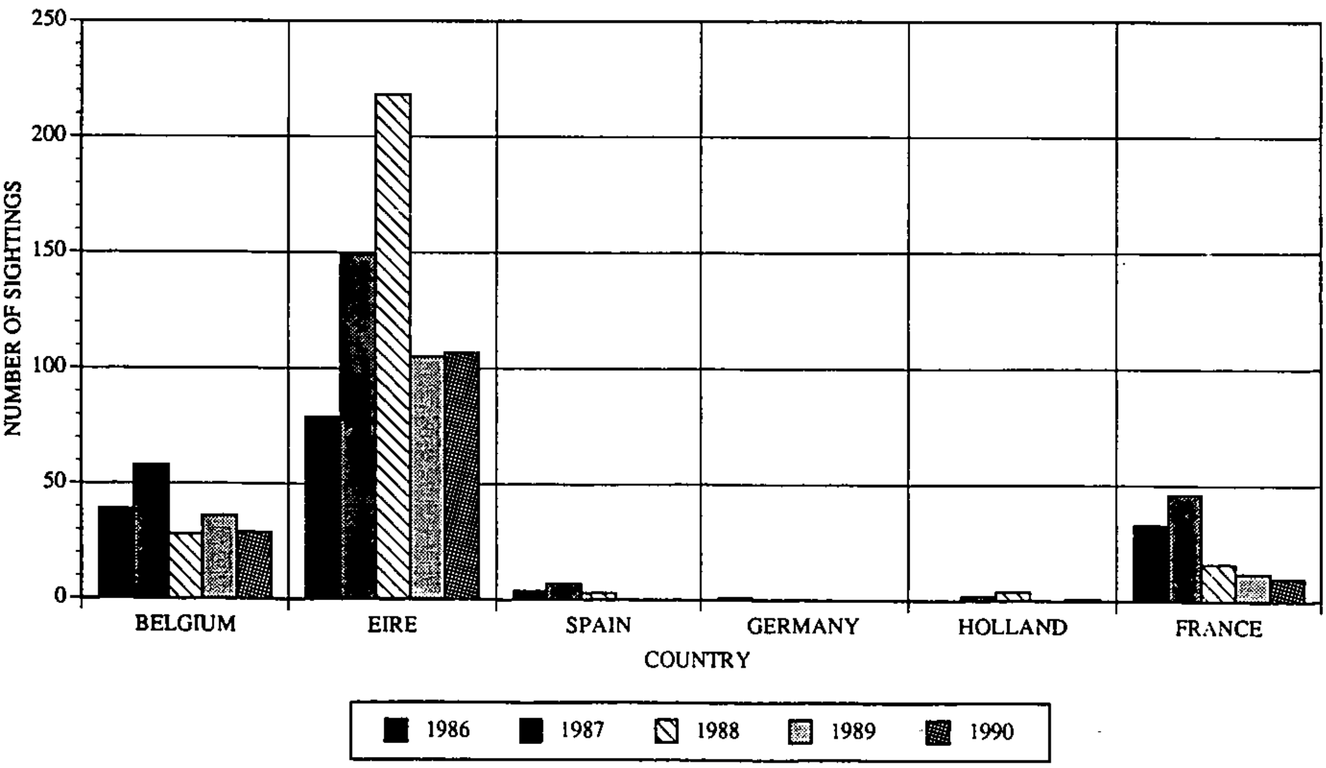
MAFF Surveillance Data
Sightings in the Irish Sea
1986 - 1990



NB This includes data from ICES Squares 38E5,37E5,37E4,36E4,36E3.

Figure 36

MAFF Surveillance Data
Number of Sightings in the Irish Sea for each Country
1986 - 1990



NB This includes data from ICES Squares 38E5,37E5,37E4,36E4,36E3.

Figure 37

TABLE 10

MAFF SURVEILLANCE DATA

Sightings in the Irish Sea 1986 - 90
By month

	1986	1987	1988	1989	1990
JAN	10	0	8	5	7
FEB	15	20	6	6	6
MAR	11	23	54	27	12
APR	11	39	65	39	26
MAY	21	33	35	2	14
JUN	23	27	34	12	3
JUL	26	49	12	19	18
AUG	18	20	8	13	8
SEP	18	18	16	15	41
OCT	1	12	9	8	7
NOV	2	11	10	7	4
DEC	0	7	8	0	1

Sightings in the Irish Sea 1986 - 90
By Country

	1986	1987	1988	1989	1990
BELGIUM	39	58	28	36	29
EIRE	79	149	218	105	107
SPAIN	4	7	3	0	0
GERMANY	1	0	0	0	0
HOLLAND	0	2	4	0	1
FRANCE	33	46	16	12	10

TABLE 11

IRISH SURVEILLANCE DATA

Sightings in the Irish Sea 1986 - 90
By Month

	1986	1987	1988	1989	1990
Jan	8	4	0	13	17
Feb	8	11	0	13	19
Mar	5	3	12	37	4
Apr	2	0	10	15	4
May	0	0	4	13	4
Jun	0	11	10	0	4
Jul	0	1	5	10	4
Aug	23	12	0	6	0
Sep	0	6	0	6	0
Oct	11	1	3	2	2
Nov	0	10	19	7	6
Dec	0	5	0	2	1

Sightings in the Irish Sea 1986 - 90
By Country

	1986	1987	1988	1989	1990
GREAT BRITAIN	15	7	16	26	23
BELGIUM					1
EIRE	37	57	47	93	41
SPAIN				3	
RUSSIA				1	
FRANCE	5			1	1

Figure 37 and Table 10 (MAFF surveillance data by country). This shows the nationality of non-UK vessels sighted during the surveys. The majority of sightings were for Irish vessels, reaching a maximum of 218 in 1988 and dropping to 107 by 1990.

Conclusions on MAFF and SOAFD data:

In the ICES squares through which the pipeline will pass it is clear from both effort and landing statistics that demersal otter trawling is the dominant fishery:

Demersal landings	10879 tonnes on average landed 1986-1990
Shellfish landings	8608 tonnes on average landed 1986-1990
Pelagic landings	3615 tonnes on average landed 1986-1990

From the English and Scottish data, it would appear that the most important areas for the fishery are areas 37E4 and 36E4. This corresponds to squares containing 11% and 43% of the pipeline length respectively.

However, it must also be appreciated that the shellfish industry is important along some areas of the pipeline route, especially in ICES squares 37E4 (See Figure 33). The trends in shellfish landings are shown on p52.

d) IRISH WATERS

i. Inshore

The commercial fishery along the coast from Skerries to Lusk is largely for crabs and lobsters. There are about twenty fishermen involved and these are on a regular part-time basis. There are four boats that fish out of Skerries and cover the area from St Patrick's Island, Shennick Island and Coate Island down to Loughshinny. There are two boats fishing out of Loughshinny that cover the immediate area and overlap with the Skerries and Rush fishermen. There are four boats fishing out of Rush and these cover the area from Rush (including Lambay Island) and the area from Rush to Loughshinny and further north. There are two similar fishermen based in Loughshinny and these fish the area off Rush and south to Portrane (including Lambay Island).

The Irish Sea Study Group Report list the following landings for 1986 as reported to ICES:

Howth (south of Loughshinny) - handled 9669 tonnes of fish in 1986 with the top four species being *Nephrops* (2151 tonnes), whiting (242 tonnes), cod (93 tonnes) and plaice (86 tonnes).

Skerries (north of Loughshinny) - handled 1553 tonnes in 1986. The top four species were *Nephrops* (985 tonnes), whiting (242 tonnes), cod (93 tonnes) and plaice (86 tonnes).

Balbriggan (north of Skerries) - handled 398 tonnes in 1986. Top two species landed were *Nephrops* (228 tonnes) and whiting (84 tonnes).

It can be seen that there is a great reliance on the *Nephrops* stocks lying off the Irish coast.

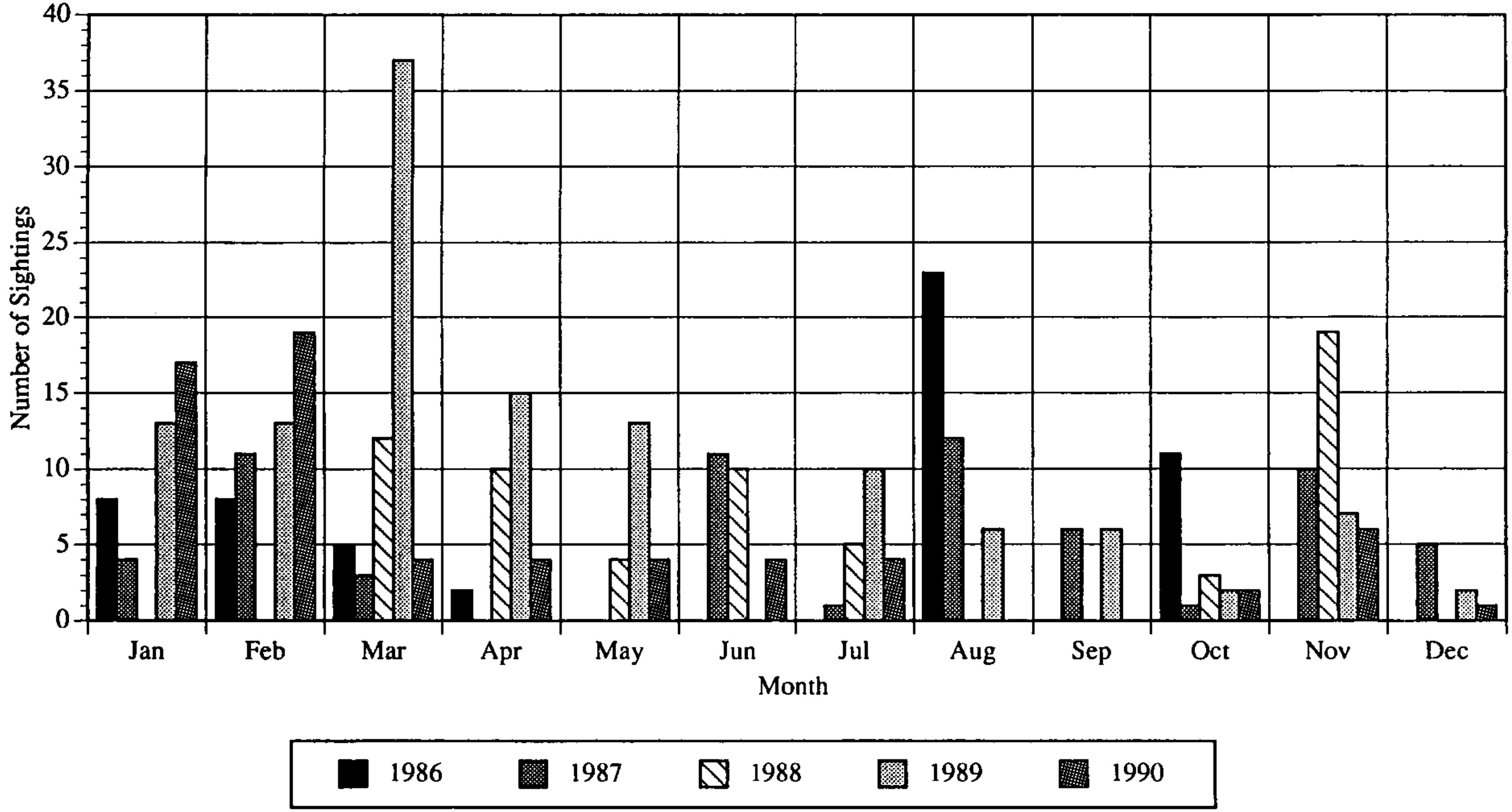
ii. Offshore

The Department of the Marine do not maintain effort statistics and analysis will be confined to surveillance data. The data only applies to squares 36E4, 36E4, 37E4 over the years 1986-1990. The information that can be gleaned from the data sets include the month of sighting of individual vessels and the country of registry.

Figure 38 (Irish Surveillance data: sightings in the Irish Sea) shows quite large fluctuations from year to year and month to month. In 1986 most vessels were sighted in August, by 1988 most were seen in March and April, in 1989 March-May and in 1990 January and February. The 1990 data set shows a steady low-level of vessel sightings in the area. However, overall it is difficult to draw any definite conclusions from the data.

Figure 39 (sightings in the Irish Sea by country) shows the importance of the Eire fleet in the waters around the squares 36E3, 36E4 and 37E4. Combined with the UK fleet, this accounts for 95% of total sightings in the area. However, Table 6 shows the numbers of vessels to be relatively low.

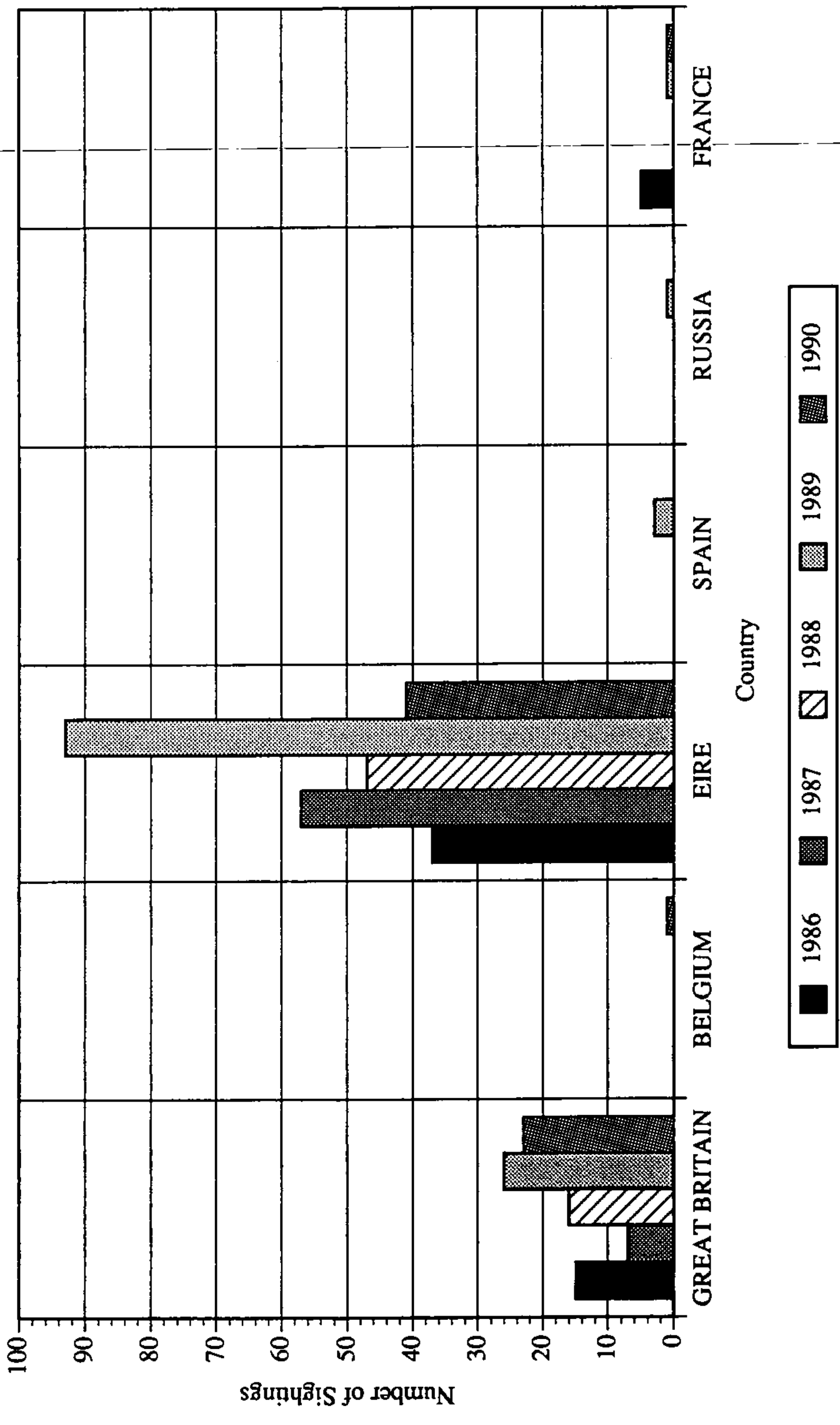
Irish Surveillance Data
Sightings in the Irish Sea
1986 - 1990



NB This data includes ICES Squares 36E3,36E4 and37E4.

Figure 38

Irish Surveillance Data
Number of Sightings in the Irish Sea by Country
1986 - 1990



NB This data includes ICES Squares 36E3,36E4,37E4.

Figure 39

Although effort and gear type data is not available, it is possible to see the importance of the Irish fleet in relation to stock landings, (see individual species accounts). It would be useful to conduct a fishing intensity study through the Irish Fishermen's Organisation to find an accurate measurement of the number, gear type, spatial and temporal trends in the Irish fleet fishing in the area of the pipeline. Without such information detailed assessment of potential interaction is impossible.

3.3.1.4.5 ISLE OF MAN WATERS

The Manx fishing fleet currently stands at 97 vessels divided up in the following size groups:

Length band	Number
Under 30ft	36
30ft-12m	15
12m-49.99ft	27
50ft-79.99ft	18
80ft and over	1
	97 (Carswell 1992)

50% of the fleet dates back to the 1960's or earlier, with a further 28% dating from the 1970's. Brand, Allison and Murphy (1991) note that the shellfish fleet has dropped from 70 boats in 1983-84 to about 55 in 1989 with the majority being less than 50ft in length. This reduction was blamed on poor catches and unfavourable markets.

In 1988 a total of 5625 tonnes of fish were landed in the Isle of Man, comprising 2962 tonnes of shellfish, 2373 tonnes of pelagic, mainly herring, and 290 tonnes of demersal fish. The shellfish was worth £1.88m, with scallops representing £1.4m and queens £379000.

In 1990 the total had dropped to 4085 tonnes being landed - 3206 tonnes of shellfish, 552 tonnes of herring and 327 tonnes of demersal species. The

value of shellfish was up to £1.98m with scallops representing £1.2m and queens £613000.

The importance of scallops and queens can be readily appreciated, with scallops representing 52% of the fishing industry income in 1990 and shellfish overall representing over 83% of industry income. (Department of Agriculture, Fisheries and Forestry 1991).

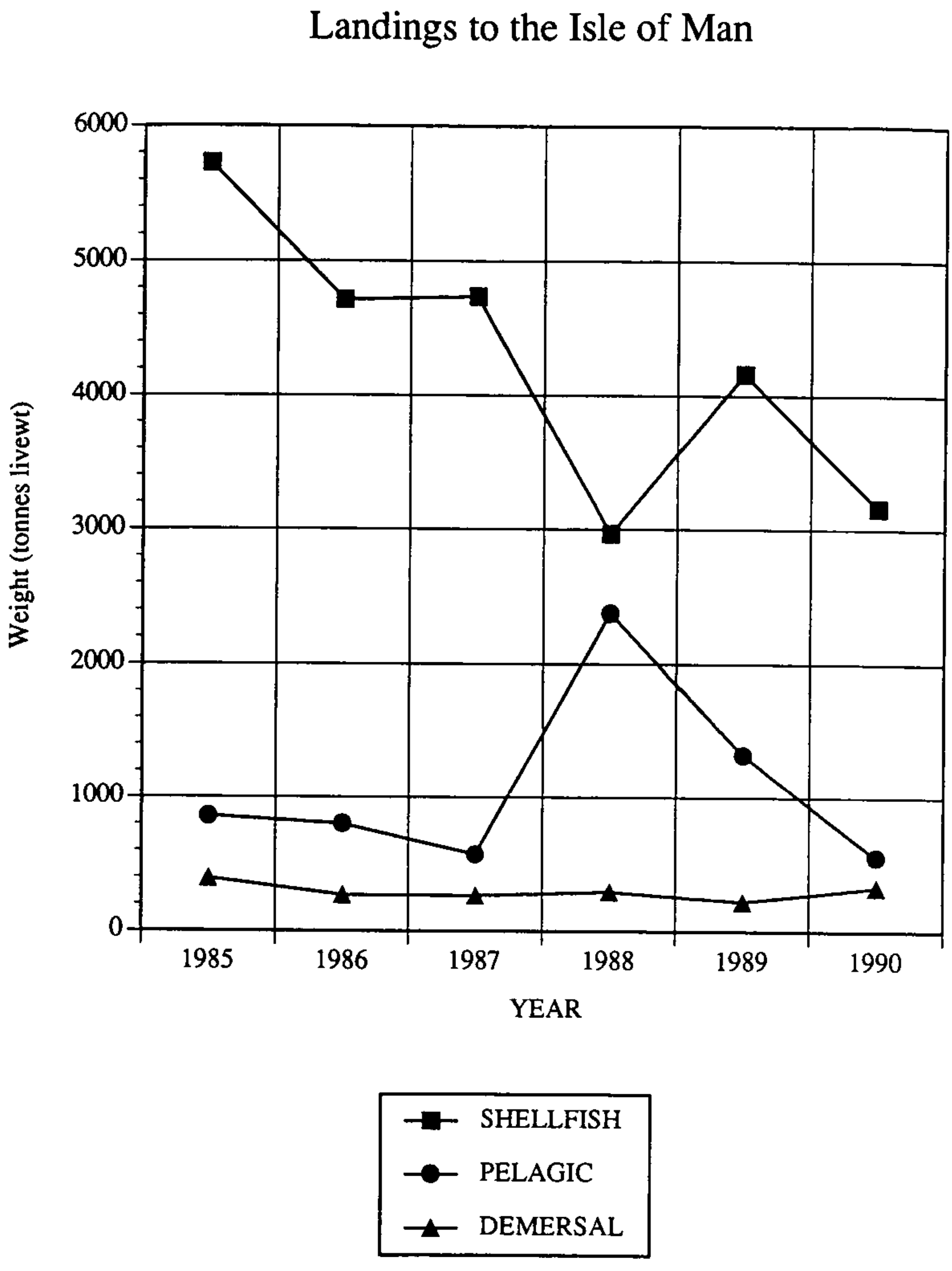
Since 1980-81 the Manx shellfish fleet has caught scallops with small 2.5 or 2.0ft spring toothed bar dredges, fished in gangs from a heavy steel pipe on large solid rubber rollers. It is believed these small dredges follow the contours of the seabed more efficiently than the older models. They are also rigged to fish for queens by shortening the teeth and altering some of the fittings. (Brand, Allison and Murphy 1991).

Figure 40 shows the landings to the Isle of Man. The importance of shellfish, from the extensive scallop and queen grounds between the Isle of Man and Scotland, can be recognized. However, the trend is downward for the Manx landings with a drop of 2570 tonnes from 1985-1990. This represents a drop of nearly 45% of total shellfish landings. The pelagic herring fleet remains relatively stable apart from the bumper landings in 1988. The demersal fishery remains stable.

f) FISHING TRENDS CONCLUSIONS

The available information is not sufficient to make definitive judgements as to the full extent of temporal and spatial patterns of the fishing industry. Only a full scale fishing intensity study could achieve such an in-depth analysis. A fishing intensity study is a formal consultation procedure with all fishing interests in the project area. The skippers provide information on types of vessels, characteristics of gear used, dimensions of gear used, operational procedures, areas fished, gear efficiency etc. The information, once collated, can identify the type, magnitude and frequency of any potential impact between the fishing industry and the project. This process allows:

i. An accurate indication of the greatest potential impact on the development. This can aid engineers in the design phase to ensure that the pipeline is designed to withstand fishing gear loads.



	1985	1986	1987	1988	1989	1990
SHELLFISH	5723	4710	4735	2962	4160	3153
PELAGIC	858	800	569	2373	1317	552
DEMERSAL	390	267	262	290	218	327

Figure 40

ii. The potential impact on the fishing industry is identified, with types, frequency and likelihood of gear snagging, loss of access and loss of stock being identified.

In this particular case it is felt that a full scale fishing intensity study is not required. The pipeline will be trenched where possible, in accordance with fishing industry wishes, and therefore any adverse impact will be minimized. Trawlers, beamers and prawn fishermen are unlikely to be impacted in the long term, apart from a short term loss of access which could be likened to natural fluctuations in the fishery. The only fishery likely to be impacted adversely is the shellfishery between the Isle of Man and the Scottish mainland. The local fishermen of Kirkcudbright expressed their fears for the impact on their industry and consequently a more detailed analysis of their particular situation has been carried out. This takes the form of a separate report on potential impacts to the Kirkcudbright fishing industry which is presented in Appendix B herein.

In the light of the nature of the project and the overall types of fishing in the area, it is seen as sufficient to highlight the broad areas of fishing activity.

From the analysis in the sections above, it appears that, outside the shellfish beds, the area most likely to be affected is 36E4. This used to be the most heavily fished zone in the project area. However, the fishery is declining in importance in this area and the effort appears to be moving into other areas such as 37E4. It would appear that because the effort can be seen to be shifting over recent history, any future changes in the spatial pattern of effort could not easily be blamed on the existence of the pipeline.

It is difficult to measure effort within the Irish fleet because of the lack of data. However, the landings for the Irish fleet up to 1988 are of similar orders of magnitude to the UK landings. It could be assumed therefore that the effort undertaken by the Irish fleet is likely to be at least as much as for the UK fleet. While such magnitude can be inferred, the spatial distribution of the effort is harder to predict. Not surprisingly, available surveillance data shows Irish vessels making up the bulk of vessels within Irish waters. Assuming this to be true it is likely that the following spatial distribution of vessels can be observed:

38E5 - mainly Scottish and Isle of Man vessels, fishing for queens and scallops with some light otter trawling for whitefish.

37E5 - mainly Isle of Man and Scottish vessels fishing for queens and scallops.

37E4 - mainly Northern Ireland, Scottish, Irish and English vessels fishing for whitefish with light otter trawls. There will also be some *Nephrops* catches by the Northern Irish and Irish fleets.

36E4 - mainly Northern Irish, Scottish and Irish *Nephrops* fishing with whitefish fishing by light otter trawls from England.

36E3 - mainly Irish inshore whitefish trawling, crabbing and shellfish.

Identifying the major areas of potential interaction depends upon three criteria:

i. The proportion of the pipeline in the area.
ii. The characteristics of the exploited fish species.
iii. The fishing effort expended in the area.

Obviously the greater the length of pipeline travelling through an area, the greater the potential for interaction. However, it is also important to consider the nature of the fishery undertaken in that area; a mobile fish species that can avoid the areas of pipelaying operation will be less affected than a shellfish bed where the stock cannot move out of the area. Also, the more sedentary the stock, the more sedentary the fishery; i.e. the fishermen have fewer opportunities for moving away from the impacted area because their target stock cannot move. Therefore, it is likely that shellfish fisheries would be more significantly impacted upon than pelagic fisheries. The third aspect is the amount of fishing that actually takes place in an area; a heavily fished area is likely to be more heavily impacted than an underfished area.

As such, the area through which the pipeline passes can be ranked according to the three listed criteria. By ranking each area 1-5 for each factor, an impression of potential for interaction can be arrived at.

Because effort is not recorded for the Irish sector, it has been decided to use landings to give an indication of effort. While the two are not directly comparable, for the purposes of the exercise it should be sufficient to give an indication of relative importance. It has been decided to use total landings rather than break them down into comparable species for the purposes of this exercise. This should be sufficient to give an indication of relative importance. This differential between species types has been identified by criterion 2 on biological mobility.

	MOST				LEAST
1. Pipeline length	36E4	37E4	38E5	37E4	36E3
2. Stock mobility	37E5	38E5	36E4	37E4	36E3
3. Total landings	37E4	36E4	37E5	38E5	36E3

Therefore if ranked 5-1 the following scores are found:

	1	2	3	Criteria Total
36E4	5	3	4	12
37E5	4	5	3	12
38E5	3	4	2	9
37E4	2	2	5	9
36E3	1	1	1	3

On the basis of the above analysis it would appear that the areas most likely to have significant interactions with the pipeline project are the *Nephrops* grounds in 36E4 and the shellfish grounds in 37E5.

3.3.2 AQUACULTURE

Although aquaculture is common around the south coast of Ireland and the north coast of Scotland, there is no mariculture activity near the landfall sites or along the route of the pipeline.

3.3.3 MILITARY ACTIVITY

The Irish Sea is extensively used for military exercise and testing, see Figure 41. Range serial number D405 is the Dundrennan tank testing range very close to the Kirkcudbright landfall. This is part of the Armament Wing of the Trials Branch of the Trials and Evaluation Division of the Military Vehicles and Engineering Establishment. The range covers nearly 5000 acres over which all tank weapons can be fired. Reports suggest that the range is heavily used in testing the accuracy and effectiveness of ammunition, fire control and night vision aids. A danger area of some 120 square miles extends out into the Solway Firth. This is being linked with test firings of depleted uranium anti-tank ammunition into the Irish Sea. (Spaven 1983).

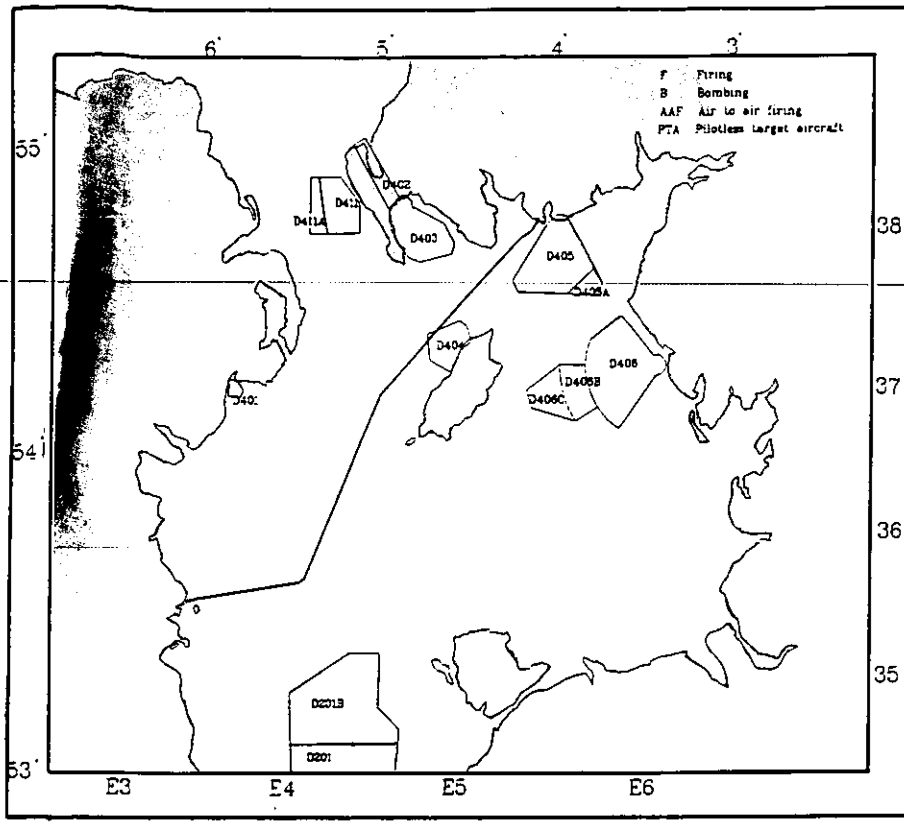
However, the landfall is outside the danger area and it is unlikely that any significant interactions could occur.

Off the Jurby Head of Isle of Man the pipeline passes through range serial number D404 which is used for bombing practice. The proposed route passes through the outer end of the designated range for a short distance.

The pipeline also passes through the navy exercise area listed as serial number X5402A, known as Sierra East, see Figure 42. This is listed as being used for submarine, aircraft and surface ship exercises. It is possible that the pipelaying operation could interact with the performance of military exercises and early warning of schedules and routes are recommended.

It can be seen that there is the potential for interaction between the pipeline route and military activity. It is recommended that negotiations be undertaken with the Ministry of Defence to offset any potential interactions.

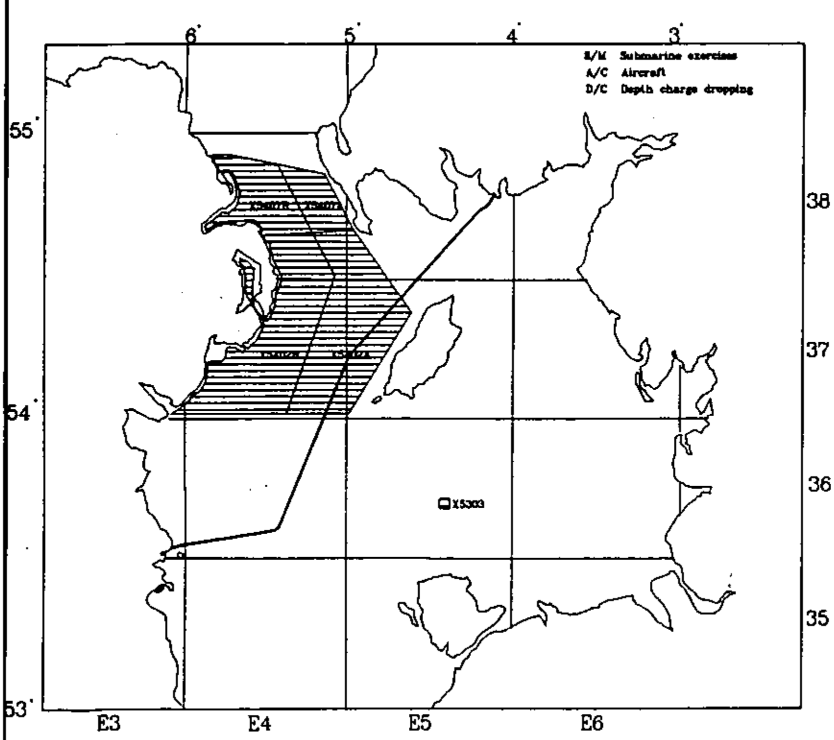
There are no known military activities operating on a regular basis at the Loughshinny landfall site.



Army, Procurement Executive and Air Force Department PRACTICE AND EXERCISE AREAS

Serial No.	Name	Type of Practice
D201	Aberporth	F:B:PTA
D201B	Aberporth	PTA manoeuvring
D401	Ballykinler	F
D402	Luce Bay	B
D403	Luce Bay	B.AAF
D404	Jurby	B
D405	Kirkcudbright	F
D405A	Kirkcudbright	F
D406	Eskmeals	F
D406B	Eskmeals	F
D406C	Eskmeals	F
D411	Portpatrick	Sonobuoy dropping

Figure 41



Navy Department Practice and Exercise Areas

Serial No.	Name	Type of Practice
X5303	Liverpool	D/C (live)
X5402A	Sierra East	S/M, A/C, H.M. Ships
X5402B	Sierra West	S/M, A/C, H.M. Ships
X5407A	Victor East	S/M, A/C, H.M. Ships
X5407B	Victor West	S/M, A/C, H.M. Ships

Figure 42

3.3.4 SHIPPING

Shipping is a major user of the Irish Sea. However, the main routes pass offshore of the landfalls (Figure 43). The only traffic anticipated near the Brighouse Bay landfall would be fishing vessels and occasional recreational yachts. The situation would be very similar for Loughshinny. The ferry routes in the Irish Sea are shown in Figure 44. From this it can be seen that the Dublin - Douglas ferry route is the only route close to the pipeline for any appreciable distance.

Figure 43 is from a study carried out for the UK Department of Energy in 1985. The information was gathered from questionnaires to deep-sea pilots, coastal radio station surveys and analysis of Lloyd's List Information Service data which lists voyages made, ports of departure and arrival. The report concedes that it is inevitable that some results, particularly for numbers of ships, will have wide error bounds associated with them. (Technica 1985). However, despite the risk of wide margins of error, the study remains the most comprehensive analysis of UK shipping lanes. Although the results are at least five years old, it is likely that the only changes would be density of shipping. The main routes will continue to be valid.

It can be appreciated from the map that all major vessels traffic occurs offshore. Technica (1985) identified two "gates" in the Irish Sea through which most Irish Sea traffic must pass:

Gate 6, an open water gate near the Saint George's Channel is 25 nautical miles wide. The main traffic recorded was from Atlantic and other deep-sea destinations, joined by Dublin, Bristol Channel and English Channel ports to Liverpool/Clyde and points north and south. The vessels were predominantly large ocean-going vessels, joined by some coastal traffic. The ships track the International Maritime Organization (IMO) Traffic Separation Schemes off The Smalls and Rosslare. The track is crossed by the Fishguard-Rosslare ferry.

Gate 7, an open water gate, is situated very close to the route of the pipeline. The main traffic recorded were the same as gate 6 minus Liverpool traffic and joined by traffic between Dublin and points north. The type of vessels were the same as for gate 6.

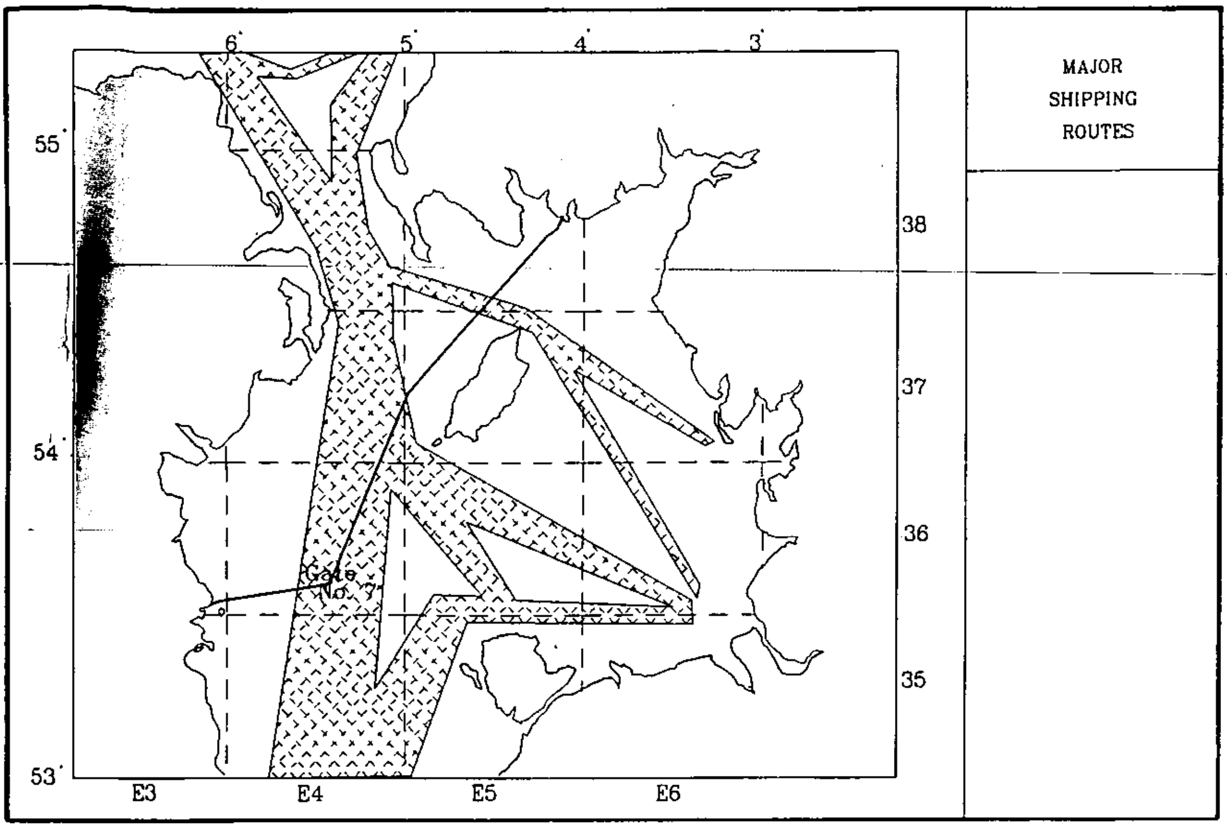


Figure 43

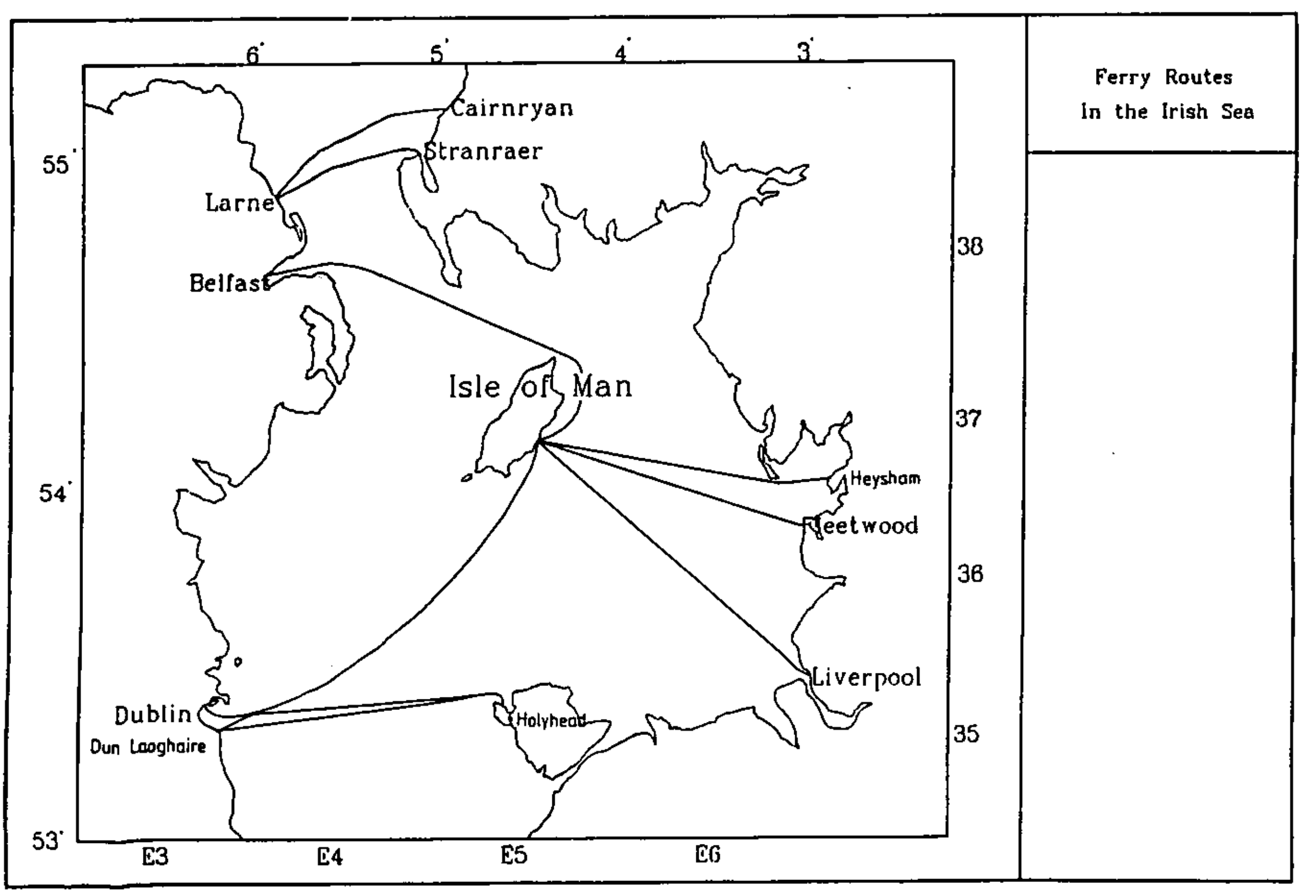


Figure 44

The distribution of ships recorded through the gates were as follows:

Gate	% Ship size groups (dwt tonnes)					Total
	0- 1499	1500- 4999	5000- 14999	1500- 40000	>40000	Ships/Years
6	30	52	10	6	2	2900
7	33	52	7	4	4	17000

Therefore, from 1985 results, at least 1700 vessels per year cross the pipeline routing. 85% of the vessels likely to cross the pipeline would be less than 5000 dwt.

3.3.5 CABLES

The pipeline passes through the route of one out-of-service cable and two possible new routes.

The out-of-service cable passes from the Isle of Man to Killard Point in Northern Ireland. This should present no problems for the pipeline.

There are two potential routes for new cables, (Figure 45) one from Peel on the Isle of Man to Ballywater in Northern Ireland. This is the LANIS submarine optic fibre cable planned for installation by Cable and Wireless (marine) Ltd in May 1992. They intend to plough the 30-50mm diameter cable to a depth of 60cm with post lay inspection and burial by Remotely Operated Vehicle (ROV). (Sturgeon 1991).

There is another potential cable routing being discussed between Port Erin on the Isle of Man and Killard Point in Northern Ireland.

Because of the potential new cable being laid in 1992 it is recommended that BGE negotiate with Cable and Wireless (marine) Ltd to reach a mutually agreeable solution to the routing conflict. This is a simple engineering problem and is unlikely to be a significant interaction.

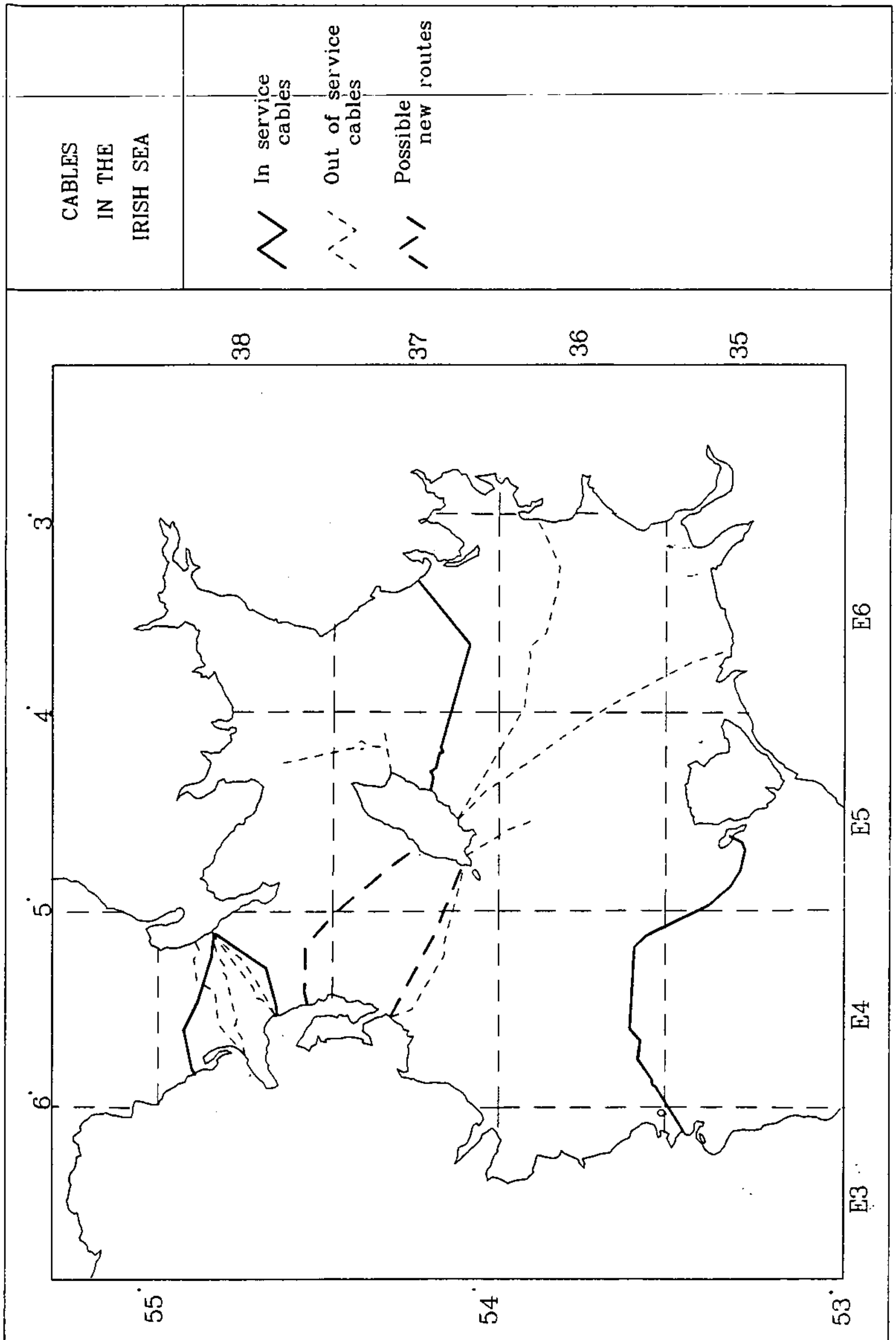

CABLES
IN THE
IRISH SEA
In service cables
Out of service cables
Possible new routes
38
37
36
35
3°
4°
5°
6°
55°
54°
53°
E3
E4
E5
E6

Figure 45

3.3.6 RADIATION AND POLLUTION

3.3.6.1 RADIATION IN THE IRISH SEA

The major potential pollutant in the Irish Sea is radioactive discharge from the Sellafield nuclear power station.

There are three main aspects to consider:

i. radioactivity in the fauna.
ii. radioactivity in the water column.
iii. radioactivity in the sediments.

Discharges from Sellafield have been falling over the last twenty years. The most significant discharges, because of their long half-life, are Caesium-137 and -134, Ruthenium-106, Strontium-90 and Americium-241. Caesium-137 remains in solution in the marine environment and has a half-life of 30 years. Other radionuclides, especially those of the actinides ruthenium and plutonium, tend to adsorb strongly onto particulate matter and so are carried to the seabed where they accumulate in fine substrata. Resuspension of particles and local hydrography can result in accumulation of particles in estuarine muds on the Solway coast. (Clark 1989).

As part of the statutory environmental monitoring programme scallops and queens, from commercial landings at Kirkcudbright or Whitehaven have to be sampled twice between January and June and twice between July and December each year. Shellfish bioaccumulate radioactive nuclides and so the edible parts of the samples are analysed for total alpha, total beta and gamma scan with all detectable gamma emitting nuclides being noted. The samples are also checked for Plutonium (alpha), Plutonium 241 and Americium 241. Tests in 1990 showed that Kirkcudbright queens, crabs and lobsters are not significantly affected.

In 1989 tests carried out on plaice landed at Kirkcudbright (four sampling observations) showed mean radioactivity concentration of 120 Bq Kg^{-1} with 0.4 Bq Kg^{-1} of Caesium 134 and 13 Bq Kg^{-1} of Caesium 134. The concentrations of Caesium in fish in the Irish Sea generally have been higher than recent discharges from Sellafield, would cause. BNFL suggest this is due to a contribution from aged radiocaesium being present due to remobilisation from the sediment of the Irish Sea. (MAFF 1990)

Routine testing of Caesium 137 in seawater has shown a decline over recent years. Ross Bay in Kirkcudbright Bay has been monitored and results show a significant decline as shown in Table 12.

Caesium 137 in shoreline seawater at Ross Bay (Bq m^{-3})

1980	1981	1982	1983	1984	1985
4520	5630	5000	2740	1330	1220

(source Jefferies and Steele 1998)

TABLE 12

However, in respect to the potential development it is the radioactive nuclides trapped within the sediment that is of importance. With levels of contamination falling every year there is a concern that nuclides trapped within sediment could be re-released into the marine environment. The area around the Solway Firth has been shown to have a curious radioactive sedimentation regime. Burrows (1986) demonstrated that a pocket of sediment around the outer reaches of the Solway Firth, extending as far west as Wigtown Bay, had between 26-50% of the silt contaminated with radioactive actinides. This was despite the surrounding regions nearer to Sellafield having contamination in the order of between <5 - 25% contamination. He explains the anomaly as being caused by surface currents travelling northwards from Sellafield taking the radioactive actinides north where they met the Solway Firth estuarine input which aids the actinides to fix onto the silt. (Burrows 1986).

Jeffries and Steele (1989) used a model to predict the seabed contamination over the whole of the Irish Sea. They divided the Irish Sea into six large regions. The Solway area, extending from the Isle of Man east to the English coast and north to Luce Bay in Dumfries and Galloway, was calculated as having the following parameters for the purposes of the model:

Volume:	1.2×10^2 km^3
Mean depth:	26m
Sedimentation rate:	5×10^{-3} t.m^{-2}. year^{-1}
Suspended sediment load:	3×10^6 t.m^{-3}
Seabed surface area:	4.6×10^3 km^2

They predicted that the Solway area would have a Caesium 137 concentration of 2.5×10^5 Bq.m^2 and a total Caesium 137 inventory of 1.1×10^3 TBq (Tera bequerals = 10^{12}).

The important aspect is the potential for release of such radioactive contaminants. Hunt and Kershaw (1990) examined the remobilisation of radionuclides from Irish Sea sediment. They concluded that bioturbation (where animals mix the sediments) occurs and therefore that contamination is very extensive throughout the Irish Sea. As seawater concentrations decline, the relative difference in concentrations could cause the sediment based caesium to remobilise into the water column. Experiments have shown that concentrations of radionuclides in sea water are greater than would be expected on the basis of extrapolation from the steadier discharge rates in the past. It has been estimated that in the Sellafield offshore vicinity (an area extending 30km along the coast and 3.5km offshore) the following amounts of radionuclides have been remobilised:

i. 600TBq of Caesium 137 1983-1988.
ii 8 TBq of alpha-emitting plutonium nuclides from 1979 - 1987.
iii. 2.5 TBq of Ammercium 241 1976 - 1987.

In the whole of the Irish Sea it has been estimated that 1300 TBq of Caesium 137 were remobilised from 1983 - 1987. (Hunt and Kershaw 1990).

3.3.6.2 WASTE DISPOSAL

There are no major dump sites within the range of the pipeline inside the three mile limit. There are sewage outfalls at Brighouse Bay as well as along the Loughshinny coast at Skerries, Loughshinny and Rush. These all discharge raw sewage into the sea. As part of a Dublin Council initiative each of these sewers will have secondary treatment facilities within five years.

3.3.7 RECREATION

A report for the Dumfries and Galloway Regional Council in 1990 outlined that about 30 yachts moor at Kirkcudbright although there are 55 with permits for permanent moorings. In 1983 35 yachts were quoted as visiting Kirkcudbright. The report concluded that in 1990 between 20 and 30 yachts visited, coming primarily from the Isle of Man. A survey carried out into the potential for yachting development in Kirkcudbright suggested that there was not a great deal of interest in Kirkcudbright, mainly because of its location upstream the River Dee. However, they concluded that the number of visiting yachts would probably increase to between 80 and 100 per annum. (Mackay Consultants 1990).

A 1983 study suggested that Kirkcudbright could house a yacht station - that is, provision of rubbish disposal, water supply and floating pontoon providing shore access. Ross Island, close to the projected landfall, was suggested as a useful area for moorings. This is seen as one of the very few sheltered spots on the Scottish shore of the Firth accessible at all states of the tide. This was recommended as being ideal for a mooring site with access to shore by dinghy and primarily aimed at cruising yachtsmen for overnight stops.

Brighouse Bay itself was seen as being too exposed to play any part in future recreational development. (Leisure and Recreation Consultants 1983).

The Loughshinny landfall is within easy cruising distance of Dublin and yachts from Howth, Malahide, Rush, Skerries and Dun Laoghaire. The presence of Lambay Island with it's rich wildlife also attracts bird watchers as does Rockabill to the north which is so popular with birdwatchers because of the extensive Roseate Tern colony that a resident warden is employed during the summer to protect the colony.

Dun Laoghaire is the principal yacht centre for Dublin and is home to four yacht clubs - the National, the Royal St George, the Royal Irish and the Dun Laoghaire Motor Yacht Clubs. At Howth good shelter is available at all tides and in almost any conditions. Facilities include a marina with 220 berths and the Howth Yacht Club.

Closer to the Loughshinny outfall, Malahide also provides a safe haven for yachts of up to 2m draught. It is also home to a Yacht Club. (MacMillan and Silk Cut 1991).

Tourism is an expanding business generally and the Irish Tourist Board have earmarked Skerries as a development area. As such tourism traffic can be expected to increase.

SCUBA diving is also a growing sport. The area around Lambay Island is already well established as a sports diving site containing a wide variety of marine life.

In Wigtown Bay the wreck of the 1000 ton coaster "Jasper" lost in 1941 lies in 22m of water in Portyerrok Bay. This is one of the most popular wrecks in the area and is listed in the UK Diving Directory. The wreck site is 16km distant from the landfall site at Brighouse Bay. Generally the area is not heavily dived with visiting divers tending to travel to the more popular west coast dive sites.

3.3.8 ARCHAEOLOGY

There are no wrecks listed under the Protection of Wrecks Act 1973 or its Irish equivalent around either of the landfall sites. (Dean 1991). However, sites protected by legislation are only a tiny proportion of the total number known. Following the Government White Paper "Our Common Inheritance", the National Archaeological Record in England and equivalent bodies in Scotland, Wales and Northern Ireland are expanding to cover sites within UK territorial waters. Even when all known sites are listed, this will only represent a very small percentage of the probable archaeological sites on or in seabed sediments. (Dean 1991).

Under 1987 legislation all wrecks in Irish waters more than 100 years old are automatically protected. However, there are no records of any such wrecks near the Loughshinny landfall. (Manning 1991).

The Hydrographic Office of the UK Ministry of Defence indicate that the Irish Sea contains 163 charted wrecks and 116 uncharted wrecks. However, preliminary seabed surveys indicated that there is only one identified wreck site on the pipeline route. The routing has been altered to avoid the site. Therefore there is expected to be no interaction with archaeological sites along the route of the pipeline.

3.3.9 MINERALS AND DREDGING

Although hydrocarbon exploration and exploitation occur within the Irish Sea, such activities are limited to the Manx-Furness Basin between the Isle of Man, North Wales and Lancashire/Cumbria. These areas are remote to the project site and are insignificant in relation to any potential interactions.

The Kish Bank Basin, off the Dublin/Wicklow coast, has been the subject of exploratory drilling with no significant result. The area licence was relinquished in 1986 and is therefore currently not under licence for exploration purposes.

However, coal deposits have been found in the Kish Bank area. Reserves estimated at 215M recoverable tonnes would provide employment for 1000 people per one million tonnes extracted plus an additional 200 workers above ground. (Breathnach 1989).

However, the site of any coal workings, even if accepted in the future, are at least 15km from the pipeline and are thought to be insignificant in relation to any potential interactions with the completed project. In addition, as the pipeline would already be operational at such time as mineral exploitation would be feasible, it is suggested that the onus would be on the mineral extractors to accommodate the pipeline rather than *vice versa.*

The Solway Firth Basin is a restricted basin at the northeast extremity of the Irish Sea, elongated in a northeast-southwest direction, extending to the north coast of the Isle of Man. As such it corresponds with the pipeline route from off Burrow Head to just off Jurby Head on the Isle of Man. However, it is thought that the limited reserves that would be contained in such a small basin would be unattractive to exploration companies compared with other, larger fields. Therefore the potential for interaction is thought to be insignificant at present.

In terms of dredging potential there are extensive and accessible sand/gravel deposits off Dublin Bay and south to County Wexford. However, no significant offshore gravels have been identified north of Dublin Bay and therefore there is unlikely to be any direct interactions between the pipeline and future dredging. (Warren and Keary 1989). However, any alteration of the seabed through dredging could have significant impacts on the pattern of sediment transport and it is suggested this would need consideration on the part of any sediment extraction licensee.

3.3.10 CONCLUSION OF SEA USES

It can be appreciated that the project area is subject to many existing sea uses, some of which may result in significant interactions at construction and/or operational phases. It is important in the context of an EIA to identify the areas where significant interaction could occur. While this document is not a specialist risk assessment, i.e. a quantitative evaluation of the likelihood and magnitude of any interaction, a broad classification of areas of likely interaction and a general indication of potential significance can be addressed on the basis of professional experience, analysis of available data and characteristics of the project. This assessment is carried out in Section 5.

4. INTERACTION MATRIX

The physical and biological environment of the project area has been examined; users of the marine resource in the vicinity of the project have been identified. It is the aim of the remaining sections of the report to identify the potential interactions between the project and the environment and other users, assess their importance and make recommendations as to aspects that need further consideration by the client.

This matrix presents a summary of the environmental interactions identified and assessed in Section 5.

The matrix "scores" potential interactions based on the degree of significant of impact. As explained in Section 5, the ranking is from 0 which indicates a negligible impact through to 3 which is a major impact. There are also options to indicate a positive impact and nil impact.

The matrix is constructed to show the stages of the project development alongside the potential recipients of any impact; the junction of the two parameters is marked with a score that, on the basis of quantifiable data and professional experience, is deemed to best represent the potential impact.

The far right column totals the impacts listed for each phase of the project. This allows the identification of stages of the project that are of particular significance and would require special consideration by the client.

It can be seen that the potentially most significant phase could be the hydrostatic testing and discharge of the chemically treated water. This aspect is covered in more detail in Section 5. This would be of particular concern on environmental grounds, and although having a potential impact on the spawning and nursery grounds of commercial fish species, would have limited impact on other sea users. The most significant potential impact on sea users would come from the use of rockfill techniques to stabilize the pipeline. Trenching has a much lower potential impact rating. Pre-lay dredging of the seabed could also have a significant impact in the vicinity of the operations.

It must be appreciated that this does not identify aspects of the project as planned; it provides an indication at a relatively early stage that can be used to identify areas of particular concern that can be addressed by the client in the

final decision making process as to the methods and technology used in the project.

5. ENVIRONMENTAL IMPACT ASSESSMENT

Each phase of the development will be assessed in turn with analysis of the major potential interactions that could be expected given the environmental conditions and method of construction/operation. Such analysis will inevitably be subjective to a certain degree, but will be based on professional experience and lessons learned from similar developments in the North Sea. It will be appreciated that the greatest potential interactions will be on the fishing industry, especially the inshore industry near the landfall sites.

5.1 PRE-LAY DREDGING

This operation is locally destructive by its very nature; some organisms will be buried or crushed by machinery. All fauna within the area of dredging will be stressed even if not killed through potential increases in turbidity, Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD). There is also a risk that contaminants within the sediment could be remobilized by the disruption of the seabed. Birds and mammals might be disturbed by the presence of the machinery which could be significant during the whelping, nesting, brood rearing and moulting season.

However, in our opinion those communities directly affected are not ecologically fragile or rare. They are representative of the range of fauna and flora found in similar environments. As such the overall community impact will be negligible, especially for the motile species such as zooplankton and finfish. Research has shown that the effect of sediments suspended during pipeline operations are of short duration and not of concern in the context of long-term effects. (Boesch 1987). Recovery of macrobenthos from small scale disturbance ranges from a period of weeks for temperate, shallow water communities to a year or more in continental shelf environments. Recovery of hard substrate communities which are biogenically structured, such as coral reefs, may require longer periods than sediment-dwelling communities in comparable depths. The long-term effects of offshore pipeline emplacement are therefore greatest for hard substrate communities, and near the shelf edge or deeper. (Boesch 1987). Therefore, it can be appreciated that the impact from the pipeline on the environment from sediment

resuspension is likely to be short-term. However, because of their sedentary nature shellfish are likely to be the main group affected.

The importance of the shellfish industry near Kirkcudbright is such that a separate assessment of potential impact has been prepared. Other fish stocks and fisheries are likely to suffer negligible, short term interactions caused by temporary loss of access.

Other sea users will be subject to a negligible impact. Recreational activity is limited around both landfalls and any loss of access will be both temporary and over a relatively small area. There is potential for contaminants to be remobilized from the sediment. However, the area is comparatively uncontaminated compared with other regions of the Irish Sea and this possibility is unlikely to have any serious implications. When compared with the potential remobilization impact caused by a large scale dredge fishing industry operating over many years, the impact of a single pipeline is likely to be insignificant.

5.2 PIPE-LAYING

The main pipe-laying operation will have a very limited impact on the benthos, restricted to a narrow margin along the length of the route. The area affected by the pipeline operation is likely to be very localized. However, there has been very little research conducted on the width of the swath affected by pipeline trenching although estimates from the Beaufort Sea suggest 15m. (Boesch and Robilliard 1987). It is unlikely that an area wider than 15m would be affected along the length of the route.

The operations will however disrupt the local fishing industries. The laybarge will be surrounded by an exclusion zone around the full extent of the anchors and therefore access to an area of seabed will be temporarily denied.

However, the main potential risk is of entrapment of mobile fishing gear on debris dropped from the laybarge. This could comprise warps, bits of machinery etc. which is non-biodegradable and easily snagged. This led initially to a poor relationship between fishermen and the oil industry in the North Sea. Therefore debris management must be carefully considered.

To offset this it is planned that a fishermen's representative will be carried on the lay-barge to liaise with the local fleet. He would also confirm the control

of debris loss and generally act as a bridge between the client and the local fishermen. This is now standard practice in the UK sector of the North Sea and has been described as being the single most important policy for improving relationships between the two industries.

The installation contract requires the contractor to perform a full corridor seabed survey following all installation activities to confirm the absence of significant anchor mounds which could be a hazard to fishing activities. Other policies that could improve relationships between the fishing industry and the project would be to hire local vessels to carry out a post construction sweep to level any mounds discovered during the survey.

Another aspect needing consideration is the temporary loss of access to a 15m strip along the nearshore fishing grounds. To enable the pipeline to be laid all fixed gear such as creel pots, will have to be moved and mobile gear such as trawling will be restricted in their operations. This may have an impact on the income of the local fleet. Whereas the demersal fishery can generally move to other areas temporarily , the shellfish fleet operating out of Kirkcudbright will be limited along the strip in terms of alternative fishing sites.

To offset this the fishermen will be given early notice of the timing of this work and are contracted to lay the approach channel buoys. This would help offset costs to the fishermen arising from the laying operations for loss of access while providing a service to the laybarge.

When the pipeline is laid there will be at least one month before the post-lay trenching can begin. Therefore for a short period of time a 24" diameter pipeline plus weight-coat will stand proud of the seabed. Whilst most trawl gear will pull over such a rounded obstruction there is an obviously increased chance of gear getting trapped, especially in areas with free spans.

Dredges used for scallop and queen fisheries will probably hit the proud pipeline, possibly causing damage to the weight-coat if multiple impacts occur. Notices to Mariners and clear marking of the pipeline route through issues of maps and warnings are recommended to offset any potential interactions. Timing could also help reduce potential conflicts; if the laying could coincide with fishing down-periods, the potential for interactions would be reduced. The best time for laying in the area of the shellfish grounds would be between June and August when the queens are difficult to

catch and the scallop fishery is closed. Any later in the summer could impact on the sensitive spat development time.

When the final post-lay survey has been completed it is recommended that a GPS tape of the pipeline be provided to all fishermen. This will allow the boats to trawl with maximum opportunities for knowing the exact position of the pipeline.

Whatever method of avoiding interaction is chosen, fishermen will still have to be excluded from the area during the pipelay operation. As such, there will be some socio-economic impact.

5.3 POST LAY ROCK DUMPING AND TRENCHING

The main impact resulting from the limited rockdumping operations is the destruction of surrounding soft sediment and the consequent loss of habitat for commercially important shellfish. However, it is anticipated that the effect will be minor providing standard rockdumping procedures are followed. It is anticipated that the standard side-slope of 1:4 to a height of 1.5m means a loss of 6m each side of the pipeline. Therefore, approximately 12.5m of sediment is expected to be lost. This issue is further considered in Section 5.7 and the impact on shellfish recolonization is the same as 5.1.

There is also the probability of heavy dredging gear dissipating the rockdump. The armour stone is only 8" in size and impacts with heavy trawl gear could redistribute the rockfill. Annual surveys, as stipulated in law, could offset this problem and allow maintenance to solve a problem before it arises. However, such a policy is likely to be expensive. It is recommended that trenching could be more cost-effective if technically feasible.

However, in view of the minimal rockdumping expected, it is thought that there is likely to be sufficient surrounding habitat that will remain unaffected to offset the loss of the pipeline area over most of the pipeline length. Any potential significant interactions are likely to be in the hard seabed areas where any rockdump is most likely to be required and the most heavily fished areas where there are few opportunities for alternative sites. This area is primarily the shellfishery between the Isle of Man and the Scottish mainland.

There is, however, the chance that a positive impact from the existence of the pipeline and rockdump may be the creation of a niche for hard stratum organisms such as lobsters *Homarus gammarus* and biofouling species. This could potentially provide opportunities, albeit limited, for expanding the range of the local fishing industry to exploit the species that would not be usually found in the area.

Another potentially positive impact is the reef effect of the pipeline. This is a well documented phenomenon whereby fish are attracted to structures providing shelter. Some pipelines in the North Sea have similar effects and fishing vessels trawl the length of the pipelines, exploiting the new resource. This is unlikely to occur in this instance as the pipeline will be effectively trenched throughout its length.

Trenching, although more beneficial to the fishing industry compared with rock-dumping, also has an environmental effect. The ploughing of the trench will disturb sediments beyond the immediate area of the pipeline. However, it is unlikely to have a long-term impact. Research has shown that the impact depends on the duration of the substrate modification and the inherent recovery rates of the disturbed communities. Assuming no lasting modification to the sediment substrate, recovery of benthic communities should proceed similarly to that following natural sediment disturbances by storms or following the disposal of unpolluted dredged material. (Boesch 1987). It has been shown that many invertebrates can survive a sediment coverage of up to 30cm. Up to that limit of "overburden stress", the animals can burrow up through the sediment. (Nichols et al 1978). The lingering effects of trenching on benthic substrates has not been studied widely. The effects would depend on the amount of bottom sediment transport available to fill the trench and the nature of the excavated substrate. (Boesch 1987).

5.4 PRESSURE TESTING AND OPERATIONS

The hydrostatic testing and discharge of the water could potentially be a problem. The use of biocides invariably kills organisms. It is important that toxic additives are not allowed to build up to toxic concentrations following release. It is important to note that although the oxygen scavenger, corrosion inhibitor and biocide are rated relatively low on the Department of Energy Chemical Notification Scheme (see Section 2.6.4), the rating is for releases per year. This would be a single point discharge and the impacts could well

be of greater concern. Consideration must be given to the toxicity of the chemicals used, their discharge method and discharge location.

The recommended discharge method is to release the testing mix in water of sufficient depth and current that dispersal can be accomplished quickly. The ideal method is by using a diffuser pipe 1-2m above seabed to prevent the discharge bathing the seabed with toxic chemicals. The diffuser also increases the pressure of release which helps to disperse the chemicals.

5.5 OTHER DISCHARGES AND POLLUTANTS

Effluents from the ships and machinery should not pose a significant environmental threat as long as releases are within the regulations. Any oily waste will have to be disposed of at a landbased facility, as will as refuse from the ships. Debris will also have to be contained and disposed of at a landbased facility. The fishermen's representative on board the laybarge should ensure compliance with the operating procedures as agreed.

Contamination remobilization. It is very unlikely that a significant level of contaminants will be released from the sediments. The natural cycle of storms and wave action are just as likely to release any contaminants. Other long established industries such as scallop dredging and other bottom fishing gears probably turn over the sediment of the Irish Sea far more significantly than a single pipeline route.

Noise is a pollutant in its own right; mammals and seabirds could well be disturbed by noise, especially at nesting, brood-rearing and whelping times. This could be potentially significant for the colony of Roseate Terns *Sterna dougalli* on Rockabill Island to the north of Loughshinny.

The terns represent one of the rarest breeding seabirds in the entire UK/Ireland region. As such they are afforded protection by wardens during the nesting season. The pipeline runs three nautical miles to the south of the island. Anchor fixing for the laybarge will bring smaller vessels closer to the colony. The operation is scheduled between March and June 1993 and will therefore coincide with the nesting season. However the only anticipated impact would be disturbance from noise and presence of vessels. It is recommended that a voluntary exclusion zone is placed around the island to

restrict the movements of vessels within the area. This will show an acceptance of the importance of the colony and the desire to minimise impact.

5.6 CONCLUSION FOR CONSTRUCTION PHASE

It is our opinion that the pipeline project as shown will only have a minor overall impact on either environment during the construction phase. There are two potential impacts which would affect the local fishing industry; a short term loss of access and a longer term loss of cacheable shellfish during recolonization. The first potential impact can be minimized by careful timing of operations and negotiation with the fishermen. The second potential impact is addressed in detail in Appendix B.

5.7 OPERATIONAL IMPACTS

The biggest and arguably most important user of the Irish Sea is the fishing industry. As such it is expected that the potential interactions between the pipeline project and the fishing industry will be more significant than between most other sea users.

Interactions between the project and the fisheries have already been detailed during the construction phase. The following assessment is concerned with the operational interactions.

In examining potential interactions between the pipeline as proposed and the fishing industry in the Irish Sea, there are several aspects to consider:

i. The interaction of fishing gear with the pipeline.
ii. The interaction of fishing gear with rockfill.
iii. The interaction of fishing gear with debris.
iv. The temporary loss of access to fishing grounds.

5.7.1 INTERACTIONS OF FISHING GEAR WITH THE PIPELINE

In a series of consultations with fishermen from the Scottish Fishermen's Federation, Irish Fishermen's Organization, National Federation of Fishermen's Organizations, Northern Irish Fishermen's Federation and the Isle of Man Fishermen's Association, a common concern was the entrapment of trawl gear on the pipeline. Fishermen are worried that otter boards could get trapped under a proud standing pipeline thereby endangering the vessel and crew.

This has been a source of concern among fishermen from countries bordering the North Sea since the beginning of the offshore oil and gas development. Consequently a large number of experiments have been carried out with differing gear types to fully ascertain the real rather than imagined interaction problem.

In early laboratory experiments with otter trawls it was found that upon impacting upright otter doors quickly passed over the pipeline and resumed their upright orientation. Problems occurred when the otter door was lying flat (rather than in the normal upright position) and hooking of the line occurred. Hooking also occurred on a few occasions where the angle of incidence of the approaching upright otter door to the pipeline was very small. While hooked, the warp was stretched elastically with the otter door being released by the deflection of the line (or failure of the surrounding soil). On release the elastic effect of the warp accelerates the board which on landing again may dig deeply into the seabed. The behaviour of upright otter doors was noted to be surprisingly similar whether the pipeline was trenched, sitting on the sea bed or spanning. (Carstens et al 1976).

To test the laboratory findings three field test cruises employing vessels of 145, 697 and 1,123 GRT were conducted. The gear used included otter doors up to 1,800 kg and a beam trawl weighing 1720kg which were pulled across a 300m length of 40cm (16") pipeline. For otter doors the laboratory results were confirmed, in all cases of hooking subsequent unhooking occurred but where the angle of incidence was less than 45^{o} the trawl door shot deeply into the seabed on release causing on two occasions the warp to snap. The fear that a wide-spanning pipe would be very prone to hooking was not substantiated though hooking of a fallen (flat orientation) door was observed.

Carstens concluded that hooking without subsequent unhooking is a dangerous but remote event which would require:

i. An improperly oriented otter door lying flat when hitting the pipeline.
ii. A spanning pipeline with a small bottom clearance.
iii. Restraints that prevent horizontal deflection.
iv. A stiff bottom material.

He notes that factors i and ii are prerequisites for hooking of otter doors and iii and iv are necessary to prevent unhooking. Further work in Norway between 1974-1979 concluded that:

i. Trawl doors of the three main types considered show little difference in behaviour during passage and in pull over load level.

ii. Spanning pipelines are given higher pull over loads than pipelines on the seabed.

iii. Trenches with side slope 1:4 and 1:10 give no significant reduction in the pullover forces. Some cases even showed higher loads for the trenched case.

iv. Skew passing gives lower pull over force for trawl doors than a perpendicular one, but may favour digging the V-door into the seabed after passing.

v. Pull forces for beam trawls increase by about 20% when the pipe is spanning, compared with a pipeline on flat bed.

vi. Pull forces for beam trawls are higher on the 16" pipe than on the 36" pipe.

vii. Pull forces for beam trawls increase by about 25% when passing takes place at 60^{o} angle to the pipe, compared with the 90° case.

viii. Trawl gear impact loads are of importance to pipeline design.

ix. The damage to the 16" pipeline concrete was considerable, while the pipes were practically undamaged by the trawling gear impacts.

x. Contact loads from sliding trawl warps and sweeplines are of the same size as the steady trawling pull force, and of less importance to pipeline design.

xi. Pipeline hooking by trawl doors is unlikely. The V-doors may be hooked by soft beds after passing.

More recent experiments concluded that with beam trawlers a high towing speed (7Kn) resulted in a heavier (10%) impact on the pipeline than a slower speed (4Kn). However, there was hardly any difference between the impact forces at the two towing speeds for otter trawls. (De Groot 1986). They also noted that the direction of the attack was important since one side of the pipe was more embedded into the seabed than the other, (due to main bottom current,sand movement and scour). The more embedded side was far less of an obstacle for the passing gear. (De Groot 1986). The forces measured on the warps during normal trawling operations and when the nets are pulled over the pipeline are reproduced in Table 13.

The experiments concluded that pipelines can withstand the impacts of trawl gear, beam or otter trawl, without ill effect:

> The pipeline is not displaced by the gear which may strike it; though it is well known that this can occur with small flow lines. Only superficial scratches were observed in the concrete coating and mastic protection of the field joints. These scratches in no way presented danger or risk to the pipeline. (De Groot 1986).

It also concluded that the forces measured during the experiments:

Forces measured on towing warps

	Trawling (Tonnes) Port	Stbd	Pull over (Tonnes) Port	Stbd
Beam Trawl Nonadapted, low speed	12.0	9.0	29.0	16.5
Beam Trawl Nonadapted, high speed	12.0	10.5	31.5	28.5
Trawl Board, low speed	5.0	3.5	8.5	7.5
Trawl Board, high speed	7.0	6.0	11.0	8.0

(De Groot 1986)

TABLE 13

> do not exceed those encountered during normal fishing operations when the gear hits boulders or gets stuck in sand dunes. It is evident that the relation between the size of the vessel and the towing speed, and the weight of the fishing gear and its rigging, is related to its use on a certain type of bottom. This explains why the experiments with a towing speed of 4 knots were, in fact, not representative for a normal fishing operation with the vessel used on a soft muddy clay bottom. A lighter vessel with a less heavy beam trawl might have fished on this type of ground with this towing speed without any problem. (De Groot 1986).

Therefore, the extent of potential damage depends on the gear type, magnitude, angle and frequency of the impacts, in addition to the ability of the pipeline and its coatings to resist such forces. In the Irish Sea situation the overall factors are important:

i. The importance of light otter trawls and dredge fishing in the area of the pipeline.
ii. The angle of attack of the trawls to the pipeline.
iii. The magnitude of the interactions.
iv. The number of interactions.

5.7.2 IMPLICATIONS IN SCOTTISH WATERS

The Scottish waters are particularly important for shellfish. As such the use of heavy dredges predominates the local gear types. The scallop dredges, described in the separate report on the shellfishery impact, would certainly hit a proud pipeline with what can be described as an "axe-head" type impact. Therefore the full force of a boat travelling at 3 knots pulling gear weighing 3 tonnes and concentrating that force within an axe-head impact may damage the weight-coat. Laboratory experiments have shown that weight-coats can usually survive three impacts on the same point before damage occurs. Once damage has begun, each successive impact will increase the damage until the steel pipeline is exposed. While it is extremely unlikely that the steel pipeline could be directly damaged, it is certain that corrosion would be encouraged by the damage to the weight-coat. While this could be remedied by regular maintenance, this could prove to be an expensive option. However, it is unlikely that the dredge itself would be harmed or snagged by such an interaction.

The light otter trawling used in the rest of the Scottish fleet should behave as predicted by experimental and operational experience in that the gear will cope with the pull-over forces as long as the doors remain upright in the normal towing position as detailed above.

5.7.3 IMPLICATIONS IN ISLE OF MAN WATERS

The Manx waters are especially important scallop and queen grounds and therefore the comments for the Scottish landfall will be important.

5.7.4 IMPLICATIONS IN IRISH WATERS

The Irish fleet is characterised by the importance of the large *Nephrops* area between the Isle of Man and Ireland. This is an important area for the local fishery which uses lightweight otter trawls to catch the *Nephrops.* There are several characteristic aspects of the *Nephrops* fishery which must be considered:

i. The gear is light and designed for use over mud rather than hard substrate. Also distance between the otter boards and the net is between 90-120m and although the doors might pull over the pipeline there is concern that the net would fall behind and be trapped. Consequently many Irish fishermen are concerned about a free standing pipeline in the mud area.

ii. A large portion of the route passes through the *Nephrops* grounds. Therefore considerable amounts of interactions between the fishermen and pipeline are anticipated.

iii. The fishermen trawl alongside each other with between 50-60 vessels all trawling in line within a five kilometre distance. Any interactions could therefore consist of multiple and possibly simultaneous impacts.

iv. The fishermen trawl in a north-south direction. Therefore over part of the route they will cross the pipeline at 90° and at other areas at a more acute angle.

From the experiments carried out on otter board trawls it is unlikely that the pipeline would cause a snagging problem, especially on the eastern leg from Loughshinny where the angle of incidence is ideal. There is more likelihood of snagging on the north east leg of the route where the angle of incidence is such that contact with one otter door could destabilize it causing it to fall flat and hence be susceptible to snagging.

The nets are lightweight and would therefore tend to "fly" more readily than heavy gear. Even if the distance between doors and gear is such that the net settles back on the seabed, the rig would allow the net to be pulled over with little chance of snagging.

Although the nets are of a comparatively light weight material they should be of sufficiently robust construction to survive repeated contact with the seabed. There might be an increased wearing on the gear fabric from the interaction with the concrete coating but it is difficult to quantify without experiment.

The ideal solution to prevent any interactions would be to bury the pipeline. However, the *Nephrops* area is stable mud and it is expected that the pipeline will sink into the sediment to some degree. The partially exposed form of the pipeline would present an ideal rounded section as detailed in the experimental data above.

5.7.5 IMPACTS OF FISHING GEAR WITH ROCKFILL

It is intended to avoid rockfill except in areas where trenching proves to be impractical and the extent of such areas are expected to be minimal. However, rockfill, if and where needed will have two effects on the fishery:

i Temporary loss of access to fishing grounds. A separate report examines such issues in more detail and is presented in Appendix IV.

ii Impact on the fishing gear.

Trawling in areas of rockfill could cause increased wear on footropes, warps and belly of the net by repeated abrasion. However, nets are generally designed for repeated interactions with a rough seabed and it is not thought likely to be a problem. It is also unlikely that nets picking up rocks would be a problem.

The rockfill would be dissipated by trawling to some extent, but the main impact would be from dredges. With the proposed rockfill of 8" armourstone surrounding 4" fill, the dredges would act as a rake and rapidly dissipate the rocks, exposing the pipeline and possibly threatening pipeline stability. However, damage to the dredge or vessel is unlikely.

There would be no way to avoid such dissipation where rockfill is used over shellfish beds. Therefore rockfill has been minimised to the greatest extent possible.

5.7.6 IMPACTS OF FISHING GEAR WITH DEBRIS

Debris is potentially destructive but unnecessary in an operation of this kind. Although the North Sea has suffered from considerable debris contamination, the north Irish Sea is still relatively untouched by subsea operations.

The best and simplest way to prevent potential damage to fishing nets would be to ensure that no debris is left behind. This should entail the use of a detailed inventory control system with possibly a fishermen's representative on the laybarge to oversee the operations and ensure compliance with company policy.

5.7.7 IMPACTS OF LOSS OF ACCESS TO FISHING GROUNDS

This argument depends on the nature of the fishery and the importance of the area lost. Aspects that must also be considered include loss of temporary access and loss of permanent access.

Pelagic and demersal fish, being mobile, will move away from the impacted site. Although fishing vessels will be denied access in the vicinity of the lay

vessel during construction operations, this will be short term and localized. Once the pipeline is complete some fishermen may exploit the reef effect of the pipeline and catch the fish that are attracted to it. The long term loss of access is therefore negligible, providing fishermen are able to carry on fishing as before.

Shellfish, being sedentary, are more prone to loss of access to habitat. The pipeline passes directly through queen and scallop grounds and therefore a considerable area could be lost to the fishermen. With dredge beams 6-7m long the loss of ground can be likened to the width of a single dredge tow. This is examined in a separate report.

On the positive side, the use of rockfill could create a habitat for new, hard stratum species such as lobster *Homarus gammurus*.. This could encourage a new fishery for such high value species in the new habitat created.

Overall, it can be seen that the impact of the pipeline on Irish Sea fishing operations is likely to be short term and localized for the pelagic and demersal fishery. It is possible that loss of habitat could have a greater effect on local shellfisheries.

Interactions with other sea users are likely to be negligible. Any future new user in the project area will have to take account of the existence of the pipeline rather than *vice versa*. Periodic maintenance operations will potentially require the implementation of a limited, short term exclusion zone which will have a negligible effect on sea users.

5.8 ABANDONMENT IMPACTS

At the end of the working life of the pipeline it will be abandoned in accordance with the works authorization under the Petroleum and Submarine Pipelines Act 1975 and the Petroleum Act 1987. The impacts to be considered depend on the eventual choice of abandonment option. The eventual policy chosen will reflect the political requirements of the time, the technical abilities of the age, the costs involved, the route and nature of the sediment and the impact on other users of the area.

The main potential impact will be the interests of fishermen. The concern of fishermen in the North Sea focuses upon the possibility of pipelines currently laid several decades ago, corroding within allowing pieces of pipe to be

scattered by storms and currents over a wide area of the seabed. This is currently a moot point because the offshore industry has only limited experience of long term corrosion of pipelines in seawater. However, as the concept of a pipeline not being a hazard to fishing is contained in works authorization, and the idea of consultations with interested bodies is part of the Petroleum Act 1987, abandonment plans must consider such very long term uncertainties. (Huntington 1988).

If the pipeline is removed entirely the impacts could be very localized and short term and will focus on the operations of the vessels required for such a task. This is the favoured option of the fishermen's lobby - known as the "clean sea-bed" option by the Scottish Fishermen's Federation.

A study carried out by John Brown Engineers and Constructors Ltd for the Department of Energy suggested the following options:

- all pipelines should be decommissioned and thoroughly cleaned at the end of their operational phase. The activities should render the pipeline safe and in such a condition that if the contents are released at some time in the future they will cause no threat to life or long term harm to the environment;

- if a pipeline is fully buried and the sea-bed is demonstrably stable then the pipeline may be left in situ full of water with the ends sealed;

- if a pipeline is fully trenched, then providing the pipeline, when it decays will not be swept from the trench, the trench profile is such as to exclude trawl boards from it and the trench profile is demonstrably stable, the pipeline may be left full of water in situ with the ends sealed;

- if a pipeline is resting on the sea-bed then if there is no fishing and there are no MOD concerns, the pipeline may be left full of water in situ with the ends sealed;

- in all other cases with a pipeline resting on the sea-bed the pipeline should be either trenched or buried in the sea-bed;

- however if an operator requests to leave a pipeline in place without mitigating the effects of long term break-up by some physical means then provision for financial compensation to the fishermen should be made;

- a means of providing fishermen with the status of abandoned pipeline needs to be established;

- a means should be established whereby the latest developments in echo sounders and sonar equipment in the oil industry can be applied to the fishing industry;

- the process of long term pipeline burial should be the subject of periodic review;

- the mechanism and consequences of pipeline span failure should be the subject of further investigation. (House of Commons Energy Committee 1991).

If the pipeline is deeply buried below the level that the deepest ships anchors could reach and is flooded to remain negatively buoyant it should never be seen again. However, some sections of the pipeline pass over very difficult terrain which with current technology would make deep burial extremely difficult and expensive. This problem is compounded by some areas of the Irish Sea sediment being very mobile and hence prone to make such a policy difficult.

The House of Commons Energy Committee report on the decommissioning of oil and gas fields conclude that:

> an acceptably low risk of debris is presented by a buried or trenched pipeline in a stable section of seabed. We recommend, however, that sections of pipelines resting on, buried or trenched in unstable sections of seabed should be removed to avert the danger of debris or obstruction to sea traffic (House of Commons Energy Committee 1991)

In the Government observations on the Committee's recommendations it is stated:

> The Government is still developing pipeline abandonment policy [and] recognises that sections of pipeline resting on, or buried or trenched in unstable sections of seabed will require special consideration and the Committee's views on this will be fully taken into account. (House of Commons 1991).

The ambiguity in these deliberations must be noted; legal arguments are currently underway to decide if the meaning of the recommendations imply that ALL pipelines resting on the seabed must be removed or if only those sections resting on unstable ground must be removed. This uncertainty could have important repercussions when finally decided.

It is recommended that detailed consideration be given to the options available as per the terms of the works authorization and an abandonment policy arrived at, subject to changes in future abandonment policy. It is recognized that international guidelines to ensure safety, viability and environmental acceptability for abandonment techniques are only now being established. A detailed plan should be drawn up once the requirements of these deliberations and the system of implementation have been completed.

5.9 IMPACT OF THE ENVIRONMENT AND OTHER USERS ON THE PIPELINE

A number of environmental features can affect an offshore development. Some are so regular and widespread that design specifications will take them into account. Examples of this are wind and wave stresses, seawater corrosion and corrosion enhanced by sulphur-reducing bacteria. These areas are therefore not considered any further.

Other environmental parameters which may have important implications for the pipeline routing are seabed scour, biological fouling of subsea structures, fish activity and fishing gear loadings.

5.9.1 IMPACT FROM SEABED SCOUR

A characteristic of sedimentary seabeds is that they can be resuspended and therefore become mobile under certain current regimes. The mud area between the Isle of Man and the Irish coast tends to be stable and unlikely to be affected by any such changes. However, the area between the Isle of Man and Burrow Head contains some sand wave areas that will need prelay dredging or pre-sweeping. These areas could conceivably be prone to shifting and causing either freespans or burial. The incidence of freespanning has been examined by the design engineers and incorporated into the design. Any future incidence will be noticed during the annual inspection and rectified.

5.9.2 IMPACT FROM BIOLOGICAL FOULING

The main impact in biofouling on water column structures is the increased force loadings that can result. However as the pipeline will be trenched into the seabed in the long term this is unlikely to present a problem.

5.9.3 IMPACT FROM FISH ACTIVITY

Experience in the North Sea has shown that fish may be attracted to untrenched pipelines to an extent that leads to fishermen trawling near to pipelines in order to exploit this behaviour. Video surveys in the North Sea have shown that some species, especially Ling *Molva molva* appear to burrow under the pipeline itself whilst others such as Saithe *Pollachius virens*, Haddock *Melanogrammus aeglefinus* and Cod *Gadus morhua* often sit in spans underneath the pipeline. It has been suggested that the burrowing of fish may be one of the initialising processes in span formation. As yet this suggestion has not been fully examined, however, it would seem at least possible that the erosion caused by the fish could enable further hydrodynamic activity to create spans. However, in view of the fact that the pipeline is trenched over its full length, this is not considered to be a significant concern.

5.9.4 IMPACT FROM FISHING GEAR LOADINGS

The ability of fishing gears to inflict damage on operating pipelines has been the subject of much detailed investigation. (Gjorsvick et al 1975; Groot 1975, 1977 and 1986; Morshagen and Kjeldsen 1980). These studies concur that it is only demersal trawl gear and dredge fishing gears which offers any potential hazard to submarine pipelines and that the potential impacts along a pipeline route depend on the intensity of fishing activities in the vicinity, the size and type of the trawl gear being used and the burial status of the pipeline.

It has been established that a trawl contacting and being pulled over a pipeline exerts three forces on it:

i. A bending force as the warp contacts the top of the pipe prior to contact.
ii An impact force as the otter door (or beam trawl) hits the pipeline.
iii. A pull over force as the gear is pulled over the pipeline.

The first of these is generally considered to be insignificant as is any abrasive effect of the warp on the pipeline.

The impact force is the greatest of the three and has been extensively studied in full-scale tests on pipe joints by several operators.

These tests simulate the energy which could be exerted by differing types of trawl gear to the pipeline and its weightcoat. These permit an evaluation of the possible degree of concrete loss and the severity of impact required to achieve penetration of the pipe. A variety of striker leads are employed to represent the leading edge of a beam trawl and the various types of otter door. Prior to testing the pipe joint is usually preconditioned by compressing and bending to simulate pipelaying conditions.

The results of these studies are conclusive and suggest that a single impact would at the most result in concrete loss of a coated pipeline.

The degree of concrete loss depends on the cumulative energy of impacts and the relative energy exerted on each successive impact. However, there are

strong indications that impacts spread over 0.5m of pipe result in a greater concrete loss than the sample impacts co-located.

Pullover force is that which occurs momentarily as the towing warp stretches and the gear pulls over the pipeline. It only occurs with the pipeline exposed on the seabed and is negligible (i.e. not significantly greater than normal towing forces) if less than 50% of the pipe diameter is exposed. The force is greater as the angle of incidence of the trawl to the pipeline approaches 90°. Pullover forces of up to 50-60 tonnes could be expected from the largest fishing gear but the exact force regime depends upon local fishing activity.

The pipeline will be designed to withstand the impacts of the heaviest fishing gear and regular monitoring and maintenance will be conducted. In areas where the pipeline is trenched the interactions will be zero. In areas of rockfill there is the possibility that the dredges used in the scallop and queen fisheries could dissipate the rockfill. While it would be ideal to use smaller rockfill material to allow "raking" rather than dissipation, the current regime is such that rocks smaller than 8" tend to be swept away. Therefore there is little option but to minimize the areas of rockfill as much as possible.

In the area between the Isle of Man and the Scottish mainland the concentration and importance of shellfishing for scallops and queens could pose problems for a proud-standing pipeline. The momentum of a dredging vessel interacting with the pipeline could cause damage to the weight-coat. Repeated interactions could cause the loss of weight-coat which can usually withstand three axe-head type impacts before showing damage. The area is so heavily fished that it is likely that points along the interacted section would receive sufficient hits to cause damage within the course of the year between maintenance. This would have the effect of weakening the integrity of the pipeline and exposing it to corrosion. However, the pipeline will be laid well below the level of dredging activities.

5.10 NON-ROUTINE INCIDENTS

The potential non-routine incidents which could have environmental implications include:

i. Pipeline fracture
ii. Collision
iii. Vessel spillage

5.10.1 IMPACTS FROM PIPELINE FRACTURES

The European Gas Pipeline Incident Data Group has collated the information on pipeline incidents covering the equivalent of 970,000 km-yrs.

Their data, while primarily of terrestrial origin, is relevant to conditions in the marine environment. They classify three categories of leaks:

i. pinhole/crack with diameter of defect < 20mm.
ii. hole with diameter of defect > 20mm but < pipeline radius.
iii. rupture where diameter of defect is > pipe radius.

They conclude that external interference is the main cause of loss of gas. This would primarily be caused by accidental puncturing by third parties. This will be extremely unlikely in the Irish Sea environment and would be most likely to involve snagging by a large ship anchor. This is also a function of the size of the pipe and therefore the wall thickness. A 24" pipeline, even in a terrestrial environment, appears unlikely to suffer a leak from external interference compared with smaller diameter lines.

Corrosion very rarely results in a "hole" or "rupture". This is a fundamental consideration in the design stage of any marine structure and is highly unlikely to be a problem. Rigorous testing of materials and welds will ensure that material integrity is of the highest possible order. Even the occurrence of pinhole/cracks is rare with a frequency of occurrence of 0.1 per 1000 km-year.

However, should a subsea leakage of gas occur for whatever reason it would not create a widespread impact and indeed there are natural processes in areas such as the North Sea and west of Scotland which lead to methane seeps being created. A subsea release of gas does present a serious threat to vessels immediately over the release site as the result of a loss of buoyancy in the water. However, the risk of this interaction is very low and as only isolated

cases have occurred throughout the world due to pipeline fractures it is therefore not considered significant.

5.10.2 IMPACTS FROM COLLISION

The snagging of anchors from merchant shipping is recognized as a significant potential source of pipeline damage in the North Sea. The factors that must be considered include:

- i The location of shipping routes.
- ii The type and size of vessel traffic.
- iii The depth of water.
- iv The mass, shape, behaviour and mode of anchor use.
- v The type of pipeline.

Shipping routes are covered in section 3.3.4. This shows that a major shipping route passes directly over the pipeline route. However, 85% of vessels tend to be less than 5000 tonnes dwt. and the water in the vicinity of the pipeline/shipping route junction is generally deeper than 60m.

Anchor Usage

All merchant vessels are required by their registering authority to carry anchors of a specified size and strength, correlated to the size of vessels. The anchor weights for vessels in each of the size categories used to describe shipping activity are shown in Table 14.

The most common anchoring method is to use one anchor, this being dropped to the seabed with the vessel almost at rest. Anchor chain is then paid out as the vessel moves slowly astern. It is common practice that the length of chain paid out is some 3-5 times the water depth, producing a shallow catenary from the seabed. The anchoring holding capacity is a combination of anchor burial or bight, anchor weight and chain weight.

In addition to simply providing a link between the anchor and the vessel, the anchor chain plays a large part in the mooring of a vessel itself. The holding capacity of an anchor is around five times the anchor mass. It can be seen in

Weight of Anchor for various size categories of Merchant vessels

	Ship Size group (dwt)				
	0-1499	1500-4999	5000-14999	15000-40000	40000-300000
Minimum Anchor wt (kg)	100	570	1590	4500	6000
Median Anchor wt (kg)	1000	2000	5000	9750	16000
Maximum Anchor wt (kg)	2280	4320	9900	13500	26000

TABLE 14

Anchor chain lengths for varoius size categories of Merchant vessels

	Ship size group (dwt)				
	0-1499	1500-4999	5000-14999	15000-40000	40000-300000
Minimun Chain length (m)	220	300	410	520	577
Maximum Chain length (m)	467	550	660	715	770
Range of safe anchoring depth	44-91	60-110	82-132	104-143	115-154
Weight of chain (tonnes)	6	13.5	44.3	95.5	180.7

TABLE 15

Table 15 that the weight of chain can exceed the holding capacity of typical merchant vessel anchors.

Therefore although the majority of vessels plying their trade in the Irish Sea are less than 5000 dwt, the safe anchoring depth is within the range of the maximum sized chain length carried on the smallest group size. However, most routine anchoring occurs in shallow coastal water near harbours or safe anchorages. To be dropping anchors in the middle of a shipping lane in water depths of greater than 60m would generally be an emergency response to loss of power or steerage.

The potential interactions between an anchor and a pipeline include:

i Dropping an anchor directly onto the pipeline. The probability of this occurring would be very remote. Damage would probably constitute breaking of the weight-coat and compression of the line. Rupture is unlikely.

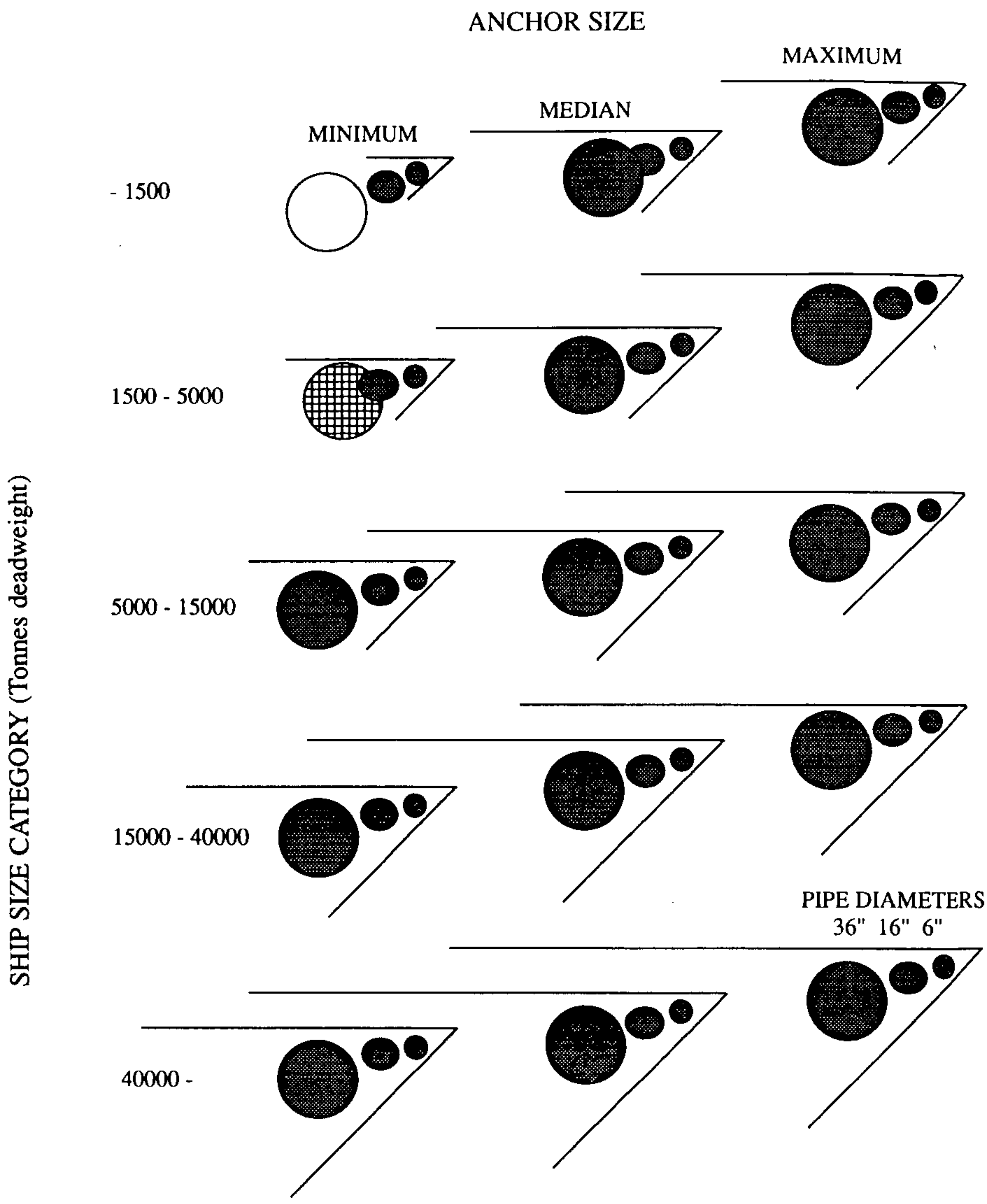
ii Resting of the anchor chain or cable over the pipeline. Motion of the vessel would cause the chain to rub over the line. Damage would probably be restricted to minor damage of the outer coating.

iii Dragging of the chain or cable over the line, possibly leading to snagging of the anchor on the pipeline. This would be the most likely cause of serious damage to any pipeline, possibly causing compression, bending, lifting or even breaking of the line.

An anchor has the potential to hook a pipeline if the distance from fluke tip to the shank of the anchor is greater than the radius of the pipe, or if damage to the weight-coat causes a pit or loop upon which the anchor flukes can catch.

Figure 46 shows the potential for hooking for three representative sizes of pipeline and the maximum, median and minimum anchor sizes in each ship size category.

It can be seen that almost all the anchors used by merchant vessels have the potential to hook onto a pipeline. Additionally, even without burial of the



Relative size of anchors in the ship size categories and pipeline of 8", 16" and 30" diameter.
Solid circles indicate likely hooking of pipeline.

Figure 46

anchor, the flukes of the larger anchors will penetrate considerable depths into the sediment, therefore interacting with pipelines buried in the sediment.

The main danger is rupture of the pipeline leading to release of gas. While this would have negligible environmental impacts (section 5.10.1) there would be a serious risk to any vessel above the release site caused by loss of surface buoyancy.

While it can be appreciated that rupture of the pipeline is a remote possibility, the potential for complete removal of a section of pipeline is very remote. Tests in the North Sea show that a pipeline of this diameter can hold together following an interaction with a 40000 tonne vessel. This is not to say a rupture would not result; gas may well leak as a result of the interaction by the line but it would be unlikely to break away.

It is obviously in the best interests of the vessel not to snag and rupture a pipeline; the potential danger to itself is thought to be high enough to deter dropping anchors even in an emergency situation. The water is deep with no risk of grounding in the vicinity of the pipeline and the pipeline will be clearly marked on navigational charts. Therefore it is anticipated that any vessel would wait until clear of the pipeline before dropping anchor. However, the temptation to drop anchor is further tempered by the disciplinary consequences on any such action.
Charts show the following warning:

> Mariners risk prosecution if they anchor or trawl near a pipeline and so damage it. Gas from a damaged pipe could cause fire or loss of a vessels buoyancy.

Even under emergency conditions it is likely that risking an anchor catching on an operational line would be considered unacceptable. Nevertheless, some incidents of merchant vessels rupturing operational pipelines with their anchors have occurred.

In conclusion damage from interactions with merchant shipping is a possibility; albeit a remote one. The main danger of rupture and hence gas loss would probably require a large vessel dragging its anchors. The type of vessel found in the area, the distance of the shipping lanes from land and the depth of water combine to make this a remote possibility. The potential for a full breakage in the pipeline resulting in tearing away sections of the line

would need a vessel generally much larger than those regularly found in the vicinity.

All merchant vessels are required by their registering authority to carry anchors of a specified size and strength, correlated with the size of the vessel. The types of interaction possible would be:

- Dropping an anchor directly onto the pipeline. The probability of this occurring would be very remote. Damage would probably constitute breaking of protective coating and compression of the line.

- Resting of the anchor chain or cable over the pipeline. Motion of the vessels would cause the chain to rub over the line. Damage would probably be restricted to minor damage of the outer coating.

- Dragging of the chain or cable over the line, possibly leading to snagging of the anchor on the pipeline. This would be the most likely cause of serious damage to the line, possibly causing compression, bending, lifting or even breaking of the line.

The most common anchoring method is to use one anchor, this being dropped to the seabed with the vessel almost at rest. Less commonly, where greater holding power is required, two anchors may be deployed, one off each bow. Whilst anchoring the anchor chain will alternatively rise and fall from the seabed, owing to the surge, heave and pitch of the vessel. The anchoring holding capacity is a combination of anchor burial or bight, anchor weight and chain weight.

If the required catenary for efficient anchoring is to be achieved the safe anchoring depth will be restricted by the length of chain carried. Under normal circumstances coasters and small ocean-going vessels would not anchor in depths greater than say 40m and larger ocean-going vessels in depths exceeding say 75m. There is the possibility that in extreme circumstances anchoring would be attempted in deeper waters.

Emergency situations involving loss of power or steerage or severe weather may require the rapid deployment of anchors to avoid grounding or collision. This is more important in congested areas such as port approaches and shipping lanes. Although the Irish Sea shipping lane runs directly over the pipeline route it is suggested that the depth of water and size of pipeline makes snagging by a dragged anchor a very remote possibility.

5.10.3 IMPACTS FROM VESSEL DISCHARGES

The most likely source of a spill of significant quantities of liquids such as oil could be from supporting vessels. Routine discharges of sewage and water can be expected, though only in negligible amounts. It would only be a major accident leading to spillage of fuel oil that would have a significant impact. Stringent safety and operational controls will ensure the risks are minimized.

Solid waste discharges from supporting vessels such as debris could be significant if not carefully controlled and thereby causing a potential hazard to fishing operations. A stringent inventory control of all such potential wastes will ensure that no debris is discarded into the marine environment. A fisheries representative on board the laybarge will be able to ensure compliance with such inventory management. A post trench sweep of the route would ensure the seabed is clear and fishable.

5.11 ENVIRONMENTAL INTERACTIONS SUMMARY

CONSTRUCTION IMPACTS

Project Component	Group Affected	Impact	Severity	Mitigative Measures	Long Term Impact
Pre-Lay Dredging	Microbiota Phytoplankton Zooplankton Benthos Demersal fish Shellfish	Habitat dislocation, topographical alteration, burial/dislocation of sedentary species, stress on all fauna through increased turbidity potential rise in COD & BOD, possible remobilization of contaminants. - short term and localized.	0 0 0 1 0 1	Utilisation of ploughing technique.	None
	Birds Mammals	Disturbance from vessels - short term and localized.	0 0	Scheduling activity to avoid nesting periods at either land-fall.	
	Fisheries	Loss of access from fishing grounds. Burial of sedentary species of shellfish - short term and localised.	1	Notice to Mariners. Chart of route provided.	
	Recreation	Loss of access - short term and localized.	0		
Pipe Laying	Microbiota Phytoplankton Zooplankton Benthos Demersal fish Shellfish	Burial of sedentary species by pipeline.	0 0 0 0 0 1	None	None
	Birds Mammals	Disturbance from vessels. Especially near sensitive sites eg Rockabill island.	0 0	Scheduling activity to avoid nesting/whelping periods at either landfall. Exclusion zone around Rockabill Island.	

CONSTRUCTION IMPACTS

Project Component	Group Affected	Impact	Severity	Mitigative Measures	Long Term Impacts
Pipelaying (cont.)	Fisheries	Loss of access to fishing grounds with large exclusion zone around laybarge.	1	Scheduling activity for off season times.	Negligible
		Risks of trapping gear on debris.	0	Notice to Mariners.	
		Delay between laying and trenching, therefore large obstruction for at least 1 month.	1	Fishermens rep. on laybarge. Fishermen used to buoy the landfall channel to offset loss of earnings. Careful control on debris disposal. Provision of maps to all fishermen with GPS tape of final route.	
Post Lay Trenching/ Rockfill	Microbiota	Dislocation/burial of organisms.	0	None.	None
	Phytoplankton	Increased turbidity from suspended sediment;	0		
	Zooplankton	possible remobilization of contaminants,	0		
	Benthos	increased COD, BOD.	1		
	Demersal fish	Impacts localized, short term.	0		
	Shellfish		1		
	"Hard-Stratum species"	Colonization of new habitat created by both pipeline and rockfill.	+		New localized hard stratum communities
	Birds	Disturbance by equipment - vulnerable during nesting and whelping periods.	0	Scheduling to avoid breeding season.	
	Mammals	Impacts localized, short term.	0		
	Fisheries	Disruption of fisheries temporarily during operations.	1	Notice to mariners, route maps provided.	Removal/change of fishery. No problem if trenched.
		Removal of fisheries area where rock dumped - long term impact.	2	Use trenching where possible.	
		With heavy gear and dredges could dissipate the rockfill - long term impact.	1	Regular surveys/maintenance. - use small size rockfill.	Negligible but may be expensive to repair.

CONSTRUCTION AND COMMISSIONING IMPACTS

Project Component	Group Affected	Impact	Severity	Mitigative Measures	Long Term Impact
Post Lay Trenching/ Rockfill (cont)	Recreation	Short term disruption	0	None	None
Atmospheric emission from vessels and equipment	Microbiota Terrestrial vegetation	Negligible residues precipitated into water and sediments where some biodegradation will occur. Remainder will become part of background.	0 0	None needed beyond meeting regulatory standards.	None
	Birds	Potential brief contact with birds.	0		
Liquid/solid releases - ship effluents	Microbiota Phytoplankton Zooplankton Benthos Fish	Grey water, sewage, engine cooling water. Trace contaminants. Negligible nutrient enhancement, no effect or negligible toxicity.	0 0 0 0 0	Releases at or below regulatory standard.	None
	Marine birds Mammals Marine ecosystem	If any oily waste could contact birds/ mammals with slicks.	0 0 0	Restrict discharge of oily waste to onshore treatment facilities.	
Solid waste/debris	Microbiota Biofouling Benthos Fish Fisheries Marine ecosystems.	Metal, other solid wastes, much of which is not biodegradable. If disposed of at sea is possible source of toxic contamination. Supports biofouling. Possible fouling of fishing gear.	0 0 0 0 1 0	Ensure debris returned to land for disposal. Fishermen's rep on board lay-barge to confirm good practice. Post lay debris sweep. Establish mechanism for dealing with damage claims.	None
Noise Ships/equipment	Fish Marine birds Mammals	Disturbance of whelping seals nesting, brood-rearing and moulting birds.	0 1 0	Schedule operations. Route selection.	None
Remobilization of contaminants eg. radionuclides	Microbiota Fish Marine mammals Man.	Remobilization of sediment contaminants by disturbance of seabed.	0/1	None	Negligible

COMMISSIONING/OPERATIONAL IMPACTS

Project Component	Group Affected	Potential Impact	Severity	Mitigative Measures	Long Term Impact
Pressure Testing/ commissioning	Microbiota Phytoplankton Zoo plankton Benthos	Oxygen Scavenger - suffocation of biota in immediate vicinity of discharge.	1 1 1 1	1) Sufficient pressure of discharge. 2) Discharge in area of reasonable current to facilitate dispersion.	None
	Fish - demersal - pelagic	Corrosion Inhibitor - coating gill membranes of demersal and pelagic species.	0 0	3) Disperse through small bore diffuser pipe 1-2m above seabed.	
	Shellfish	Biocide - poison biota in vicinity.		4) Use Rhodamine B dye to track the dispersal plume.	
		Mix - can 'bathe' the seabed with discharge if water denser than ambient (caused by colder in-pipe water compared with surroundings).	1	5) Disperse in sufficient water depth.	
Operation	Biota	New Habitat	+	Routing	
	Fisheries	Obstruction; potential for gear entrapment.	1	1) Trench pipeline. 2) Ensure pipeline sinks in mud. 3) Rockfill, trench, to ensure no free spans. 4) Monitoring. 5) Ensure no debris.	
	Cables	Crossing cables	-	Engineering solution.	None
	Archaeological	None.	-	None.	None
	Recreation	Disturbance of Leisure activities.	0	Scheduling of activities.	None
	Military	Disruption of exercise.	0	Clear route marking warnings.	None
		Interaction with Explosive ordanance.	0	Pre-lay sweeping/survey.	None
	Shipping	None within 3 mile zone.	0	Notice to Mariners.	None

IMPACT OF ENVIRONMENT ON PIPELINE

Environmental Parameter	Project Component Affected	Impact	Severity	Mitigative Measures	Long Term Impact
Seabed Scour	Pipeline on unstable seabed.	Cause freespan therefore, increased stress which leads to threaten integrity of pipeline burial of pipe.		Routing, regular monitoring.	
Biological Fouling	Whole length of pipeline.	Make joint identification difficult.		Use standard NDT monitoring techniques in addition to mud.	
Fish Activity	Pipeline on sandy sediment.	Initiating free span formation. Increased fish populations because of reef effect leads to increased fishing effort along pipe length		None None	
Fishing Gear Interactive					
- Heavy Trawls	Whole pipeline.	Impact with pipeline leads to removal of concrete coating.		Design loading for heaviest gear. Regulatory monitoring and maintenance.	
	Snag on pipe ends prior to tie-in.	Bend, compress pipe.		Tie-in as soon as possible.	
- Light Trawls	Whole pipeline.	Impact with pipeline leads to removal of concrete coating.		As above.	
- Dredges	Areas of shellfish beds.	Teeth digging into pipeline and chipping weigh-coat. Dissipating rockfill.		As above.	
- Creels	Rockfill areas.	None.		None.	

NON-ROUTINE INCIDENTS

Incident	Group Affected	Impact	Severity	Mitigative Measures	Long Term Impact
<u>Pipeline Fracture</u> - Rupture	Marine Biota Seabirds Mammals	Stress but very localized and short term.	0	Design and meeting highest construction standards.	None
	Vessels	Massive release of gas could destabilize vessels in immediate vicinity with major impact-extremely unlikely	(3)	Contingency planning.	-
	Pipeline integrity	Massive failure of pipeline integrity	(3)		-
- Hole	Marine biota Seabirds Mammals	Negligible	0		-
	Vessels	Negligible unless very small vessels which could be destabilized very unlikely.	(1)		-
	Pipeline integrity	Threatens integrity.	(1)		-
- Crack/pinhole	Marine boita Seabirds Mammals	No impact.	(-)		-
	Vessels	No impact.	(-)		-
	Pipeline integrity	Threatens integrity.	(0)		-

(x) = Impact on sea users.

NON-ROUTINE INCIDENTS

Incident	Group Affected	Impact	Severity	Mitigative Measures	Long Term Impact
Collision					
- Snagging	Pipeline integrity	Could threaten integrity depending on size, strain of anchor. Could bend, compress or break the pipeline leading to rupture (see above).	(1-3)	Charting of route. Burial of pipeline.	-
- Chain dragging	Pipeline integrity	Minor damage of weight coating.	(1)	Design for impact. Burial of pipeline.	-
- Dropping anchor	Pipeline integrity	Compress pipeline - very unlikely. Break weight coating.	(1)	Design for impact. Burial of pipeline.	-
Vessel Discharge					
- Liquid	Marine biota Seabirds Mammals	Spill of fuel oil leading to smothering, ingestion of toxic pollutant.	(2)	Meeting standard operating procedures. Contingency planning.	-
- Solid	Fishing industry	Snagging of trawl gear on debris.	(1)	Inventory control scheme	-
		Snagging of trawl gear on pipe ends prior to tie-in - destroys gear and bends pipe.	(1)	Exclusion zone. Tie-in as soon as possible.	-

(x) = Impact on sea users.

6. SOCIO-ECONOMIC IMPACT

The evaluation of the socio-economic impact of the sub-sea pipeline can be divided into three main areas of concern:

1 effect on employment.
2 effect on population.
3 effect on revenue.

There are three main locations where such potential impacts will be concentrated:

1 The site of the Scottish landfall and local fishing communities such as Kirkcudbright.
2 The site of the Irish landfall and local fishing communities such as Skerries.
3 The inshore shellfish fleet from the Isle of Man.

Any potential interactions will affect the entire fishing industry, but these highlighted areas are likely to be subject to more significant potential socio-economic interactions.

The impacts will be spread over the two major operational phases of the project: the construction and the operations.

The construction phase will involve temporary loss of access to areas of seabed; this will be short term and very localized. However, small communities relying on discrete fishing grounds for shellfish could be proportionately more significantly affected than fleets that can move to other areas temporarily. However, the extent of such potential impacts depends on an accurate assessment of the scale and nature of local fishing patterns so that the characteristics of the project can be seen in the light of existing sea use.

It is likely therefore that consideration must be given to those communities that are likely to be most significantly affected; even if interactions are short

term and localized, where those impacts are found in areas where no other fishing opportunities exist, some members of that community will suffer to a greater or lesser extent.

The situation in Kirkcudbright is particularly relevant; not only would individual fishermen suffer loss of earnings; the West Coast Sea Products is the largest employer in the area. It is possible that this would also face a down-turn in revenue. However, the state of the markets could easily cause a similar effect and it must be remembered that any impact from the pipeline is likely to be short term and very localized. This aspect is further considered in a separate report, presented in Appendix IV.

It is also important to note that fishing is very much a risk occupation; catches cannot be guaranteed by the nature of the fish stocks. Effort is increasing in the Irish Sea; catch per unit effort is falling. Therefore fishermen are generally suffering from heavy fishing already; they are having to put more time into their work to realise their wages. Because fishing is so variable, it is difficult to predict the effect of an outside influence. That is, although it is predicted the project would have a deleterious effect on the fishery, it would be difficult to prove the origin of any fall in catches.

It is also unlikely that the construction phase could provide much opportunity for alternative labour; pipelaying is a specialist technique requiring experienced specialist staff; the majority of labouring opportunities or employment of skilled local labour will probably be confined to the terrestrial project.

It is likely that service industries in the localities would benefit from the project; accommodation, catering and pubs would presumably see increased trade which would be especially important during the shoulder months of the tourism season. There could also be opportunities for supply of equipment, transport and delivery of goods as the project develops. The full range of business opportunities has been covered in the terrestrial EIA. While the potential impacts on the local fishing fleet must be appreciated, it must equally be appreciated that the community could well benefit as a whole.

At a nationwide perspective, the overall benefits of transporting gas to Ireland far outweighs the potential costs to a local community. While this does not diminish the potential impacts on local fishermen, it must be seen in the context of the overall long-term perspective of the project.

7. ENVIRONMENTAL MANAGEMENT

There are two levels of environmental management that can be considered; the implementation of a formal environmental management system within the company ethos and project specific recommendations that could help alleviate any potential interactions.

7.1 ENVIRONMENTAL MANAGEMENT SYSTEM

The implementation of an environmental management system as an integral part of the corporate identity is becoming increasingly important in large companies, especially offshore development companies. The adoption of a cradle-to-grave philosophy of environmental responsibility and awareness implies a commitment to best environmental practice from project conception to eventual decommissioning. The environmental management system needs to be integrated within the management structure at all levels, not compartmentalized into a separate department. The concept of integration is vital to the overall success of such a policy and ensures that employees are aware and involved in the environmental management system.

Core elements of an environmental management system include:

Policy Formulation

The provision of sound policy guidance is the precursor to a sound management system. Conversely, the management system is the instrument to implement policy. Because of this interdependence great care is needed in formulating the policy objectives. They need to contribute to the fundamental aims of the organization and must be understood to achieve the necessary high level of internal and external credibility. The policy must also be achievable given the commitment and technological capabilities available.

Management System Design

Although the system should be sufficiently flexible to evolve as experience is gained, it is critical that the initial design is efficient. It should take account of current levels of technology, awareness,

technical ability and resources available, but should provide challenging and effective targets and goals. It should utilize sound practices already established within the organisation and should be simple to understand and easy to administer and monitor.

Liaison and Consultation

Communication is of paramount importance, especially where an environmental management system is being introduced into an existing operation. Special note should be taken of any experience in establishing similar systems in areas such as quality and safety management which are, and will be, closely allied to the environmental management programmes. Information should be provided early to staff, and feedback, both spontaneous and elicited, should be valued and carefully assessed.

Training

Training at both a technical level, and to improve general awareness, is one of the most important aspects of any environmental management system. Personnel play a pivotal role in most activities and are often the cause of system malfunction. Training helps enhance knowledge of the environment and the consequence of particular actions.

It is unlikely that training requirements will be universal throughout an organization other than it is required in some form at all levels. It may take the form of information seminars, day-courses, residential courses, informative documentation or practical exercises. It will be an ongoing activity and can be closely linked to the recruitment process, ensuring suitable expertise is selected.

System Management

It is likely that in most operations a person or team will be responsible for ensuring implementation of policy. It is important that they have adequate knowledge of relevant environmental issues as well as in-depth knowledge of corporate activities and the human relations skills to deal with staff throughout the organization as well as outside professionals.

Monitoring

This must be carried out for the operational process and activities, and includes performance of the management system. It is likely to be a costly activity and early scoping is required to target the areas that need monitoring and determine how the data will be collected, collated and presented to maximum management benefit. Legislation often ensures some monitoring is undertaken, but it should not be taken as absolute; monitoring provides the basic data upon which the functioning of all the systems associated with the activity can be measured. It should be seen as a priority activity.

System Review and Correction

The management system should and will develop; the review and correction process should therefore be seen as a positive activity helping to improve the overall system performance. Feedback will obviously play a major role in such a process. Environmental auditing, as part of the cradle-to-grave approach, can play an important part in fine-tuning the environmental management system.

There are, however, some direct benefits that will accrue from such a policy:

Compliance

The legislative framework within which marine development activities are undertaken is becoming increasingly comprehensive and stringent. To be able to function effectively in such a regime requires awareness, planning, monitoring and reporting activities which are integral parts of an environmental management system.

Regulator Confidence

Although non-discretionary standards apply to many factors within a regulatory regime there are always elements which are administered with a degree of subjectivity. Showing commitment to an effective environmental management programme will help to develop a positive image with regulators and may also improve the level of influence achievable in the establishment of new and forthcoming regulations.

Reduced Insurance Premiums

With the present increasing levels of responsibility being placed upon those responsible for environmental damage, insurance premiums against risk associated with the environment are escalating. It should be possible to get effective preventative management systems taken into account when premium levels are being established. Indeed, it may become necessary to implement a system before cover is even provided in some cases.

Reduced Remedial Costs

Many projects which do not take full account of environmental interactions at an early stage become involved in costly remedial measures once a crisis develops. Environmental management provides the framework for identifying potential problems at an early stage enabling alterations at minimum cost and delay to schedules.

Market Image and Public Confidence

Efforts by industries towards improving their market image are often seen as a facade rather than a deep-rooted commitment. Nevertheless, it will only be possible to break down such misconceptions by being able to demonstrate a commitment to the environment. An effective environmental management system will help establish a level of credibility particularly when the success and failures of the system are publicised and when as much information as possible is fed into the public domain. The use of full and early conclusion with other resource users who might be affected by company development is a vital ingredient in such a system.

Environmental Protection

Such a management system will contribute in a major way to protection of the environment, sensible utilization of resources, reduction of wastes and materials usage and reduce the risk of accidents as well as encouraging effective management response in user conflicts. This is, of course, the most important benefit of environmental management, and as pressures on the environment increase it is likely to become an increasingly important factor.

In short, an environmental management system integrated within the corporate framework provides an opportunity for an organization to reduce its effects, improve its image and possibly reduce its costs. This cannot be achieved for nothing, but it will become increasingly required and worthwhile.

1) **It is recommended that BGE adopt a policy to introduce an integrated environmental management system within the existing corporate framework.**

7.2 PROJECT SPECIFIC ENVIRONMENTAL MANAGEMENT

The environmental recommendations that follow are based on the potential impacts identified by the EIA process. For each stage of the development a list of potential interactions will be identified coupled with policy recommendations. A brief examination of the costs involved will also be highlighted where necessary.

7.2.1 DESIGN PHASE AND TIMING OF OPERATIONS

2) **It is recommended that present consultations be extended with all potential interest groups, especially those who may be adversely affected by the development.**

3) **Timing of the operation should be scheduled to minimise potential interactions with existing sea-users.**

The pre-lay dredging is scheduled to occur in January. This will interact with the scallop fishing season off Brighouse Bay. Therefore the operation should be as quick and efficient as possible. The pipelaying is scheduled between February and May. This should be acceptable to the shellfishermen. Queen scallops are difficult to catch from April-August and with queens making up 80% of the Scottish landings, interactions could be minimized by operating during this time. The ideal time, however, would be between June and August when both scallop and queen fisheries are at a low ebb. However, the prawn fishery will be directly affected by such timing. It would be ideal if this section could be completed over winter. However, the benefits of such a policy are unlikely to outweigh the economic realities of the project and it is recognized that such timing, although ideal, is not realistic.

However, avoiding the nesting and whelping periods at either landfall would prevent any disturbance to bird and marine mammal populations.

7.2.2 PRE-LAY DREDGING

There is likely to be localised alteration in the topography of the seabed along the pipeline route. While the communities are not rare or fragile, there are important commercial shellfish stocks which could be affected.

4) **Pre-lay dredging should only be used where absolutely necessary.**

This obviously also makes good economic sense; the less dredging needed, the less it will cost.

5) **It is recommended that any spoil arising from the dredging operations should be disposed of carefully, paying full regard to the potential movement of the spoil.**

Such spoil should be dumped offshore, away from any shellfish beds and beyond the limit of residual currents carrying the spoil back to shellfish areas. This will ensure that any disturbance to the shellfishery is kept to a minimum. This will be more expensive than dumping on site, but again potential future remedial action will be averted and BGE's commitment to good

environmental practice and minimum impact on other users will be demonstrated.

7.2.3 PIPE-LAYING

6) An inventory management system should be introduced at the outset to ensure efficient debris management.

Debris is one of the biggest potential dangers to mobile fishing gear. As, such debris needs to be firmly controlled. This will need the setting up of inventory management systems, including the designation of responsibility for compliance. Local reception facilities will probably need upgrading. This will not only minimize waste, it will also engender good relations with the fishing industry by a demonstration of commitment to good practice.

A post -lay survey of the entire pipeline lay corridor should be carried out to prove that the area is clear of debris. A dedicated survey vessel would be suitable from a technical viewpoint. However, localised sweeps of the seabed to flatten anchor mounds could be performed by fishing vessels.

While everything should be done to minimize debris, formal consideration should be given to procedures to be adopted in the event of a claim for damage. The pipeline is not covered by the UKOOA compensation fund which is applied to in the event of damage from unattributable oil-related debris. Therefore if fishermen damage their nets on debris that cannot be categorically identified as coming from the pipeline, there is at present no course to be followed save a claim to BGE. An integral stage of the debris management plan must be options to deal with such eventualities, however much is done to minimize debris and however remote such a scenario may seem.

7) A fishing industry representative should be present on board the laybarge at all stages of the pipe-laying operation.

This will ensure compliance with good practice and also provide an effective link between the fishing industry and the laybarge. The skipper should be selected from the most relevant fishing communities as the pipeline progresses.

8) Work areas should be kept to a minimum.

The work areas around the laybarge will obviously have to be sufficient to prevent potential interactions with fishing gear. However, it is important that these areas be as small as possible to minimize the loss of access to fishing grounds. The anchor spread should be adequately buoyed to avoid interactions. However, a voluntary operations exclusion zone should be established around Lambay and Rockabill Islands to avoid disturbance of breeding birds.

9) Charts of the route and schedules of the operations should be distributed to all interested parties. Regular updates on progress should be issued through fishing representatives.

10) Post-lay operations should be undertaken as quickly as possible.

It is anticipated that at least one month will be required between laying the pipeline and trenching or rockdumping.

11) Rock-dumping should be kept to a minimum.

It is likely that rock-dumping would cause significant interactions with dredging vessels, causing redistribution of the rock-fill and potential damage to the pipeline. It would also change the seabed ecology locally. As such, trenching is preferred as an option.

12) As much of the pipeline as possible should be trenched.

The stated commitment to trench the pipeline throughout its length is endorsed. While the potential for snagging of fishing gear is estimated to be negligible, trenching the pipeline will certainly prevent any potential snagging, will protect the weight-coat from damage which could cause enhanced corrosion of the pipeline and enable the seabed to recolonize back to its former ecology. In the *Nephrops* grounds the pipeline is expected to sink into the seabed. This should cause no danger to the prawn trawls used in the area. They are also unlikely to harm the pipeline. As such, it is believed

trenching need only be undertaken if the pipeline fails to sink adequately under its own weight.

It is suggested that initial trenching will save more expensive remedial measures in the future, will engender good relations from the local communities dependent on the fishing industry and will also protect the pipeline from damage.

13) Careful consideration must be given to the method of discharge of test water from the pipeline.

The chemicals used in the pressure-testing must be carefully selected with due regard to their toxicity, bearing in mind that the Department of Energy Chemical Notification Scheme is based on average discharges over the year rather than a single point discharge. It is also suggested that the site of eventual dewatering is selected on the basis of an adequate hydrographic regime to ensure rapid and sufficient dilution.

14) Operational use of the pipeline must be complemented by regular monitoring and maintenance programmes.

Regular inspections of the pipeline will allow any deterioration to be detected and mended. The data from ROV examination should be made available to scientists as an aid to research into recolonization following offshore projects. The state of knowledge in this area is very limited and active co-operation in this manner could be very useful. Costs will be negligible, mainly for administration.

15) Consideration should be given to abandonment policy.

Although it is too early to decide exactly how the pipeline will be dealt with at the end of its working life, it is important to consider the potential options at the outset of the project. The implications of construction options will have a bearing on such abandonment policy e.g. the decision to trench the pipeline totally would suggest an eventual option for complete abandonment whereas areas of the pipeline proud of the seabed could become subject to partial or even total removal. It is accepted that it is too early to commit the project to a specific abandonment policy apart from agreeing to abide by future government guidelines. However, it must be stressed that such a policy is integral to the cradle-to-grave philosophy that is becoming so prevalent.

8 DISCUSSION

The Irish Sea is characterized by a great diversity of coastal and marine habitats. This Sea area contains important examples of habitats of regional, national and international conservation importance. It is also a very heavily pressurized Sea. However, the project area is environmentally neither rare nor fragile. Overall, the potential impacts on the environment are thought to be minor in that interactions will be localized and/or over a short period of time and will not affect other trophic levels or the integrity of the population itself. Such an impact may be noticed by those utilizing the resource but will not generally affect their well-being.

However, there are localized exceptions to this; the impact on the shellfishery between the Isle of Man and Scotland could suffer a moderate impact. This has been defined as affecting a portion of the population resulting in a change in abundance, and/or distribution, or size of genetic pool over one or more generations of that portion of the population depending upon it, but does not change the integrity of any population as a whole. A short-term effect on the well-being of those who utilize the resource also constitutes a moderate impact.

Therefore, it is possible that the shellfishery could be affected in the short-term, although not sufficiently to endanger the long-term viability of the industry. The area should recolonize assuming bottom conditions remain the same. A more detailed assessment of the impact of the development on the shellfishery is presented in Appendix IV.

The *Nephrops* beds between the Isle of Man and Ireland provide the largest fishery related income in the Irish Sea. Although mobile, it is inevitable that some *Nephrops* will be lost to the fishery. However the grounds are large and the *Nephrops* population stable and it is expected that the impact will be negligible in that the population is affected in a localized area for a short period of time similar in effect to small random changes in the population due to environmental vagaries. It is likely to have no discernible effect on the population as a whole and is likely to go unnoticed by those who utilize the resource. The demersal fishery will also be subject to a negligible impact.

The potential for snagging of mobile gear on the pipeline is thought to be small. This small risk is diminished with the trenching of the pipeline. This

will also reduce any potential damage from dredging gear on the weight-coat of the pipeline.

Therefore although the overall environmental impact is likely to be negligible, there are specific cases of potential user interactions where a moderate impact could be predicted.

There are methods that can be used to minimize any impact, especially in relation to the fishing industry. The methods and recommendations are covered in Section 5 on environmental impact assessment and Section 7 on environmental management recommendations.

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APPENDIX A

LEGAL REGIME IN THE IRISH SEA

APPENDIX A
THE LEGAL REGIME IN THE IRISH SEA

There are several aspects to be considered.

1 Law relating to the marine environment and rights to use its resources.
2 Law relating to access to fishery resources.
3 Law relating to the laying of pipelines in the marine environment.

The coastal zone is subject to numerous laws of ownership and rights to use. Each coast can be divided into territorial waters, exclusive economic or fishery zones and the high seas.

The territorial waters of a state used to be measured by the distance of effective protection that could be afforded; that is the limit of cannon-shot from shore. Therefore territorial waters were seen as being three miles. As technology developed this reasoning became outdated. However, the three miles limit continued to be accepted.

The recent trend has been towards increasing state control of coastal waters. In 1987 the UK extended it's territorial waters to 12 miles from the baseline. The Irish Republic similarly extended its territorial limits in 1988. The Isle of Man, although a possession of the Crown, has its own territorial waters. Last year the rights out to 12 miles were purchased from the Crown except in areas where the distance between the UK and the Isle of Man are less than 24 miles; in which case the median line is used.

On the Continental Shelf outside territorial waters coastal states have sovereign rights in international law for the purpose of exploring and exploiting the natural resources. Both the UK and Irish Republic have passed Acts designating uses of the continental shelf. However, the delimitation of the continental shelf between the two countries has still not been fully agreed. In 1988 an agreement was reached under which two dividing lines have been fixed involving concessions by both parties. This agreement came into force on 11 January 1990. The intended pipeline route has been selected to avoid the areas of dispute.

The foreshore is defined as the area of land between the high and low water marks. However, Scotland is alone in using the range of spring tides. The other Irish Sea countries use the range of medium tides. In England, Wales, Scotland and Northern Ireland the foreshore belongs to the Crown unless privately owned. The proposed landfall site is within the ownership of the Crown and all users have to receive permission and lease from the Crown Estate Commissioners. They are also responsible for administering the territorial seabed out to 12 miles. Under the Crown Estate Act 1961 the Commissioners are tasked with maintaining and enhancing the value of the Crown Estate, on land and in sea. As such any developments on Crown property are subject to charges for leasing.

The Crown Estate replied to the proposed subsea pipeline as follows:

> There is unlikely to be any Crown interest directly affected by the proposed pipeline other than its proprietary interest in the seabed and any ancillary excavation and or dumping works associated with the pipeline track. There is a small slipway and outfall pipe currently regulated at Brighouse Bay but the pipeline should not affect these - they are well over to the western side and principally on the foreshore. Also affecting the foreshore area is SSSI notification for the Borgue Coast SSSI, the designation being in respect of the flora, fauna, geological and physiographical features. Again only the intertidal zone is affected by the notification (so far as the interests of the Crown are concerned) and thus, for the purposes of your study, there is no conflict of interest. (CEC 1991).

Therefore, assuming permission is granted by the Crown, the proprietary interest would be satisfied with a negotiated lease of the seabed out to the territorial limits.

In the Irish Republic the foreshore and seabed out to 12 miles is owned by the Department of the Marine and subject to the Foreshore Act 1931. This empowers the Department of the Marine to grant leases and licences for up to 99 years and to acquire private land. As such the proposed landfall site falls within the Holmpatrick estate with private rights to the foreshore.

THE LEGAL REGIME OF IRISH SEA FISHERIES

As the major sea user in the Irish Sea, it is important to understand the legal complexities surrounding the sea fishery regime. The sea is bounded by the different laws of Scotland, England, Ireland, Northern Ireland and the Isle of Man coupled with the additional complexity of the influence of the EEC Common Fisheries Policy.

Because of the 200 mile fishery zones of the five jurisdictions involved, the whole of the Irish Sea region consists of national fishing waters. However, Symmons and Churchill (1990) identify five areas where the different jurisdictions have common features:

i Restrictions on landing, sale, etc., of types of fish (e.g. undersized) within the relevant jurisdiction and prohibition on the landing of fish caught in specific illegal circumstances;

ii Regulation of nets and fishing gear;

iii Prohibitions on fishing in specified areas or for specified periods, for all or certain types of fish; or fishing by specified methods, including by boats over a certain size;

iv Measures providing for enforcement of the various regulations. (Symmons and Churchill 1990).

a) England and Wales

Six principal British Acts apply to the Irish Sea for general fishery regulation, of which the Sea Fisheries (Conservation) Act 1967 is the most important. Two more cover the regional fisheries of Northern Irish and Scottish waters; and three more cover specialist fisheries in the area - Shellfish (Sea Fisheries (Shellfish) Act 1967), and the salmon and freshwater fisheries (The Salmon Act 1986 and the Salmon and Fresh Water

Fisheries Act 1975. The latter can apply to the 6-mile coastal waters of England and Wales).

For the seas off England and Wales there is the additional regulation by bye-laws to be taken into account. These are laid down by three Sea Fisheries Committees - Cumbria, North West and North Wales. Such bye-laws do not apply in Scotland or Northern Ireland. Because the proposed pipeline route does not pass through English or Welsh water, this aspect of Irish Sea fisheries law will not be considered further.

b) Scotland

In general UK fishery legislation applies in Scotland. However, Scotland does have its own Salmon (Scotland) Act 1986 which provides for 3-mile wide fishery districts and the Inshore Fishing (Scotland) Act 1984. This empowers the Secretary of State to prohibit fishing within the Scottish 6-mile limit. Under consultation papers stemming from this Act, fishery restrictions have been placed in Luce Bay.

c) Northern Ireland

Like Scotland, Northern Ireland has a centralised fisheries jurisdiction under the Fisheries Act (Northern Ireland) 1966. Most of the Act deals with inland fisheries, but it does empower the Department of Agriculture Northern Ireland (DANI) to make conservancy regulations "within British fishery limits which are adjacent to Northern Ireland". Under the Act's implementing Order of 1981, a median line is laid down to delimit Northern Irish waters and will not be considered further.

d) The Isle of Man

The Isle of Man has always had jurisdiction up to 3 miles from the land but recently the Manx government acquired jurisdiction from the Crown out to 12 miles. While this means the Manx government can draft bylaws governing actions out to 12 miles, at the moment the UK and EEC legislation is in force as around UK waters. The future legislation for the Manx territorial waters is currently under discussion by the Territorial Waters Committee.

Under the Fisheries Act 1927 the Manx government has been able to grant fishing permits within the 2 mile zone. In 1943 they introduced the Escallop Control and Maximum Prices Order which introduced an annual closed season. The scallop fishery is still subject to the Order, with the closed season running from 1 June-31 October. In 1984 and 1986 reciprocal legislation was adopted by the UK government so that the same closed season and minimum landing size of 110mm now operates throughout the whole of the Irish Sea, apart from within the Irish territorial waters.

No such laws exist to restrict queen fishing.

e) Ireland

Under the Irish Maritime Jurisdiction (Exclusive Fishery Limits) Order 1976, Irish fishery waters take in all areas 200 miles from the coast. However the boundaries between British and Irish waters are disputed. Ireland advocates an "equitable" equidistance line and the British take a strict median line taking full account of all British islands, including the Scillies and the Smalls (off Pembrokeshire). As a result of this dispute, the present 200 mile fishery limits overlap in three parts of the Irish Sea. The position remains unaffected by the 1988 Anglo-Irish Agreement on the Continental Shelf Boundary which only sorts out the seabed regime in the Irish Sea.

f) ACCESS OF FISHING VESSELS TO THE IRISH SEA

It is important to distinguish between the zone 12 miles of the baseline and the sea areas beyond the 12-mile limit (Symmonds and Churchill 1990).

Within 12-Mile Zone

Article 6 of EEC Regulation 170/83 provides that Member States may establish a 12-mile zone off their coasts, access to which is limited to "vessels which fish traditionally in those waters and which operate from ports in that geographical coastal area". Both the UK and Ireland have established such zones.

Article 6(2) of the Regulation gives other States some limited rights to fish in the outer part of the 12-mile zone (usually the outer 6 miles). These rights, which are based on traditional fishing practice, are shown below:

Member State	**Coast**	**Species which maybe caught**
Belgium	Cork-Carnsore Point	Demersal
Belgium	Wicklow Head - Carlingford Lough	Demersal
France	Cork-Carnsore Point	All species
France	Carnsore Point - Haulbowline	All except Shellfish
Netherlands	The Stags - Carnsore Point	Herring and Mackerel
UK	Mine Head-Hook Point	Demersal, Herring and Mackerel
UK	Hook Point- Carlingford Lough	Demersal, Herring, Mackerel, *Nephrops* and Scallops
Germany	Old Head of Kinsale - Carnsore Point	Herring
Germany	Cork-Carnsore Point	Mackerel

(From Symmonds and Churchill 1990)

Fishing Rights of EEC Member States in the 6-12 mile zone of the coast of the UK in the Irish Sea

Member State	Coast	Species which may be caught
France	Lundy-Cardigan	All species
France	Point Lynas-Morecombe	All species
France	County Down	Demersal
France	Mew Island-Sanda Island	All Species
Ireland	Point Lynas - Mull of Galloway	Demersal

(From Symmonds and Churchill 1990)

As seen, the Isle of Man appears to be outside the EEC's Common Fishery Policy as far as access agreements are concerned. Nevertheless, it has a 12-mile fishing zone from which foreign vessels are in general excluded. (British vessels appear, for this purpose, not to be foreign). However, three EEC Member States - Belgium, France and Ireland - are given the right, again based on past fishing practices, to fish in the outer six miles of the Manx zone. (Symmonds and Churchill 1990).

Outside the 12-mile Zone

This area is subject to the EEC quotas on certain stocks. The quotas are divided into Total Allowable Catches (TACs) which are allocated to Member States. The Common Fishery Policy advocated the concept of equal access for all Member States to waters outside the 12-mile limit on the same conditions as its own vessel.

The equal access principle also means that in respect for which the EEC sets a TAC each year but does not divide the TAC into quotas (in the case of the Irish Sea these stocks are horse mackerel *Trachurus trachurus* and blue whiting *Micromestius poutassou*) or fish stocks for which no TAC is set (probably no such stocks of commercial interest in the Irish Sea), all EEC Member States can fish anywhere in the Irish Sea beyond the 12-mile limit.

The EEC does not set quotas in respect of shellfish, though these are of commercial importance in the Irish Sea. (Symmonds and Churchill 1990).

The TACs and UK quotas for 1992 are reproduced below:

Species	TAC	UK Quota 1991	UK Quota 1992	% Change
Cod	10,000	3,355	3,355	-
Sole	1,350	295	430	-31
Plaice	3,800	1,840	2,300	-20
Whiting	10,000	3,865	3,865	-
Herring	7,000	5,180	4,440	+17
Nephrops	8,900	6,565	8,530	-23

Pipelines in the International Law

The four Geneva conventions on the Law of the Sea signed in 1958 expressly include the freedom to lay pipelines beneath the High Sea. This freedom must be exercised "with reasonable regard to the interests of other States in the exercise of the freedom of the High Seas". This freedom has been mirrored in the 1982 United Nations Law of the Sea Convention (LOSC) under articles 87 (High Seas), 79 (Continental Shelf) and 57 (Exclusive Economic Zone). Under Article 79 the coastal state's rights have been increased. Under paragraph 1 the coastal state's obligation not to impede pipeline laying is now subject to its right to take "reasonable measures for...the prevention, reduction and control from pipelines" and under paragraph 2 the delineation of the route of the pipeline is also subject to the consent of the Coastal state. These are seen as having clear implications for international pipelines. (Sas 1988). While LOSC is not yet in force, many of its provisions such as the right to a 200 mile Exclusive Economic Zone have entered into customary international law. Although the UK is not a signatory to the treaty, the EEC has signed its agreement.

Under LOSC there are also coastal state rights and duties. Article 192 imposed a general obligation to "protect and preserve the marine environment". The right of a sovereign state to exploit their natural

environment" (Article 194) requires all states to take all necessary measures to ensure that activities under their jurisdiction are conducted so as not to cause damage by pollution. Article 208 requires coastal states to adopt laws and regulations to "prevent, reduce and control pollution of the marine environment arising from, or in connection with, sea bed activities subject to their jurisdiction and from artificial islands, installations and structures". Therefore the commissioning, use and abandonment of a pipeline falls within the scope of Articles 194 and 208.

Generally legislation concerned with protecting the marine environment is of more relevance to oil rather than gas pipelines. As indicated in Section 5 the environmental impact of the gas pipeline would tend to have a limited environmental impact, notwithstanding that the impact on any vessels could be disastrous.

Pipeline legislation in the UK

BGE have committed themselves to operating within the guidelines set down under UK legislation whose experience in the development of the North Sea industry has led to very stringent procedures and regulations.
The Continental Shelf Act 1964 protects pipelines from damage by making it an offence to wilfully or negligently damage a submarine pipeline.

The Petroleum and Submarine Pipelines Act 1975 makes it an offence for anyone to construct or use a pipeline in or under the territorial waters of continental shelf without authorisation from the Secretary of State for energy. (art 20).

Section 21 (3) gives the terms under which an authorisation may be issued. These will include the route, the design and capacity, steps to be taken to avoid or reduce interference by the pipeline with fishing or other seabed users and steps to be taken to ensure available funds for any pollution damage.

Schedule 4 notes the considerations which the Secretary of State should take into account. These include "avoiding or reducing danger to navigation, fishermen and to marine fauna or flora".

As part of the authorisation process full and early consultations are required with all interested parties.

The Submarine Pipelines Safety Regulations 1982 lays down that all parts of a pipeline must be designed, constructed, operated and maintained so as to ensure, as far as it is reasonably practicable, that every part is protected from damage. The pipeline is to be inspected annually to ensure its condition and position. There must be provision to shut the pipeline down at either end and the means to detect significant changes in pressure or flow rate. (Sas 1988).

The Petroleum Act 1987 provides a framework for the abandonment of redundant offshore installations and pipelines. However, this issue is still subject to a great deal of debate and is considered in more depth in Section 5.8.

APPENDIX B

IRISH SEA GAS INTERCONNECTOR PROJECT ASSESSMENT OF IMPACT ON SHELLFISHING INDUSTRY OF KIRKCUDBRIGHT

EXECUTIVE SUMMARY

INTRODUCTION

Bord Gais Eireann (BGE) commissioned the International Centre for Island Technology (ICIT) of Heriot-Watt University and MCS International to undertake a detailed assessment of the likely effects of the Irish Sea Gas Interconnector Pipeline on the shellfishing industry of Kirkcudbright, the site of the Scottish landfall.

The fishery for scallops (*Pecten maximus*) and queens (*Chlamys opercularis*) is locally very important, employing 120 full time fishermen and 300 processing workers. The shellfish beds are already seen as being heavily exploited and the fishermen have little opportunity to fish elsewhere. There is also increasing competition from vessels from outside the area utilizing the beds.

The sub-sea Environmental Impact Assessment for the pipeline suggested that the characteristics of the local shellfish industry were such that the development could have a potentially significant impact upon it. The concern was that the pipeline could cause:

* a short term loss of access to fishing grounds during the construction phase;
* temporary loss of catcheable stocks because of initial mortality caused by pre-lay dredging, pipelaying and post-lay trenching;
* sterilization of the beds if rockdumping were to be used.

ASSESSMENT OF IMPACT

Representatives of the local fishing and processing industry were interviewed to provide basic data on the operations of the fleet; these data were compared with auditable Government statistics for the port and an assessment of the likely impact was arrived at. It is very difficult to identify the full extent of the shellfish beds, the Kirkcudbright fishermen identified their main fishing grounds, the identified areas of potential interaction were measured and

converted to metres for assessment purposes. Based on this information, the pipeline transverses the fishing grounds over two areas as follows:

Off the Scottish coast south of Burrow head, say zone A, over a distance of approximately 12.05km.

West of the Isle of Man coast, say zone B, over a distance of approximately 21.31km.

It must be stressed that the areas were identified by representatives of the Kirkcudbright fishermen. Published maps of shellfish distribution were felt not to be sufficiently site-specific for assessment purposes.

Bottom conditions in the southern half of the fishery off the Isle of Man have been identified as soft silts and therefore not a particularly suitable environment for scallops or queens which prefer sand-sandy gravel substrates. Nevertheless, assuming a width of potential impact of 15 metres along the length of the pipeline the areas of impact would be approximately 180700 sq.m for zone A and approximately 319700 sq.m for zone B. Thus the area affected by the pipeline in zone A is approximately 0.05% of zone A, whilst the area affected by the pipeline in zone B is approximately 0.06% of zone B. Using catch and operations data provided by the fishermen, an assessment of catch per unit area and therefore potential catch loss was arrived at.

One of the main issues to be addressed is whether the loss of scallops and queens will have a discernible impact on the industry; if the likely impact is un-noticeable against the natural fluctuations of the fishery, then the impact can legitimately be called "negligible". If, however, it is likely the development will have a significant effect on loss of profit, then a call for a full-scale fishing intensity study could be seen as justified. To examine the likelihood an assessment of annual loss of product caused by the development was arrived at using the Proportional Loss method.

This assumes that a loss of geographical access can be translated into a proportional loss of catch and hence a proportional loss to the industry. Proportional Loss is often recommended as an assessment method by the fishing industry and while there are concerns as to its applicability in motile stocks, it can be seen as providing a useful insight when applied to a sedentary fishery such as this.

CONCLUSIONS

1. TEMPORARY LOSS OF ACCESS

This can be seen as having a "negligible" impact on the fishery in that it will affect "a specific group of individuals at a localized area and/or over a short time period in a way similar in effect to small random changes in the population due to environmental vagaries." The use of early notice of operational schedules through the standard Notices to Mariners will enable fishermen to target the area before the temporary exclusion zone is imposed. This would be particularly important if operations were scheduled between June and August when the scallop fishery is closed, queens are very difficult to catch and consequently fishing effort is at a minimum.

2. TEMPORARY LOSS OF ACCESS BY INITIAL MORTALITY

The potential effect of the pipeline could be:

* smothering of the seabed by soft sediment remobilized by the operation;
* destruction of the sediment structure.

Both could potentially have an impact on the shellfish population. Recolonization of the area would take, at the worst case, 8 years to recolonize a stable scallop fishery and 5 years to establish a stable queen fishery. However, this is the worst case scenario. The characteristics of local recruitment, presence of a spawning stock refuge, the current regime, and the impact of heavy fishing on the shellfish population indicate that recolonization could occur earlier.

CONCLUSIONS

It is estimated that the shellfishing industry could suffer a loss of product of approximately £326 per annum for the queen industry and £175 per annum for the scallop industry. It is estimated that the shellfishing industry in zone B could suffer a loss of approximately £577 per annum for queens and £310 per annum for scallops. It is important to note that this represents lost product, not lost profit. No assumptions have been made as to the profit margins of the industry, but it is obvious that in an industry of 21 full-time vessels and 120 professional fishermen such annual loss of product will be un-noticeable against the natural fluctuations of the fishery.

On the basis of the data provided by the fishermen, auditable Government statistics and the Proportional Loss method adopted, it is clear that any potential impact on the Kirkcudbright fishing industry is likely to be short term, localized, and not discernible against the natural fluctuations as long as the seabed remains suitable for recolonization after operations.

As such the potential loss of profit is likely to be too low to warrant a full-scale fishing intensity study.

CONTENTS

INTRODUCTION

Bord Gais Eireann (BGE), as developers of the Irish Sea Gas Interconnector Project, commissioned the International Centre for Island Technology (ICIT) of Heriot-Watt University to undertake a detailed analysis of the impact of the proposed pipeline on the local shellfishery between the Isle of Man and the Scottish mainland. The sub-sea Environmental Impact Assessment, carried out by MCS International and ICIT, identified potentially significant impacts on the local shellfishing industry by the pipeline. These concerns were a function of the limited opportunity for the fishermen to move elsewhere and the uncertain impact of the pipeline development on locally important scallop beds. BGE decided that a more detailed report was required to identify and evaluate the potential for interaction and assess the potential impact on the industry. This report is the result of interviews with fishermen and fish processors, as well as a desk study of the literature relating to loss of access to fishing grounds.

1. BIOLOGICAL BACKGROUND

Scallop (*Pecten maximus*), and queen scallop (*Chlamys opercularis*) constitute the major proportion of the fishing activity in the vicinity of the project. The *Pecten* scallop, while only representing 20% of the catch for the Kirkcudbright fishermen, is dominant in the Manx fishing industry. It is also more fully researched than the queen scallop.

The main scallop beds occur in water depths of 18-46m. The scallop, having one flat and one convex shell, scoops a hollow in which to live. This restricts their general range to clean, soft sediment. Research on Irish Sea stocks is being carried out by the Liverpool University Research Station at Port Erin on the Isle of Man. While there are still many uncertainties about scallop biology and ecology, two distinct phases have been identified in recruitment to the population; that of recruitment to the fishable stock and recruitment to the commercial fishery. Brand (1991) suggests that the first phase occurs at spatfall, as there is no evidence of any significant post-settlement migration of scallop spat. However, there is no conclusive proof and scallops in other locations have been shown to migrate by the action of currents. The second phase occurs on reaching 110mm, this being the minimum landing size which occurs at ages 3-5 years.

The annual variation in recruitment can be assessed from the population age structures. (Brand 1991). Strong year classes, which can be followed through the fishery for several years in most areas, were those spawned in 1980 and 1982 (in recent years). In other years there has been variation in recruitment; some grounds being more successful than others. Some authors have noted differences in the strength of particular year classes between grounds to the east and to the west of the Isle of Man which could result from variations in the northerly flowing currents affecting larval dispersal from the extensive grounds to the south. (Brand 1991). As such, it has been suggested that strong year classes have been the result of good spat settlement.

Brand notes that recruitment to the Isle of Man inshore scallop grounds is regular compared with other scallop fisheries. Even offshore, recruitment is noted as being constant. This has been linked to the wide distribution of scallops in the north Irish Sea, occurring in dense fished concentrations in some areas and economically unfishable areas in others. Brand suggests these unfished areas may provide a spawning stock refuge and prevent recruitment overfishing by maintaining larval production in years of heavy stock depletion on the fished grounds. (Brand 1991). It is important to note that the areas of heaviest fishing also tend to have the best recruitment. This could be because the local tidal currents are strong over the inshore grounds so it is likely they bring large numbers of potential settlers into the area. This will be important in assessing recolonization of any areas significantly disrupted by the project.

It has also been suggested that fishing enhances the spat settlement, either by removing the adult stock and therefore reducing predation by adults on larvae or by changing the nature of the substrate, making it more attractive to settling larvae. It is further suggested that dredge fishing tends to make the ground harder by eroding soft sediments after disturbance. This may in turn increase the hard substrata available for the attachment of erect hydroids and polyzoans on which scallops and queens attach during the post-settlement phase. (Brand 1991). It has also been noted that the prevalent northward residual currents in the north Irish Sea, and the 4-6 weeks larval stage of both species suggest that larvae settling around the Isle of Man originate from the extensive beds between Anglesey and the Isle of Man.

Queen scallops have a similar range to the scallop, but because they do not excavate a hollow in which to eventually live, they can be found on harder

sediments. The queen is also capable of swimming, albeit for a limited range. The populations are more sporadic in their occurrence and stocks are less predictable than scallops. They also have a much shorter lifespan which is compensated for by a very rapid initial growth phase. The marketable size of 55mm occurs within 14-18 months. Brand (1991) notes that beyond 4-5 years old natural mortality is high and individuals older than 6 years are rare. He also notes that having only two or three age classes well represented in the commercial fishery makes it difficult to detect effects of fishing on population structure.

2. DESCRIPTION OF THE LOCAL FLEET

2.1 Kirkcudbright fishing activity

The main industry in Kirkcudbright is fishing; both catching and processing are at the hub of the community. The population of Kirkcudbright is approximately 3,500, of which 420 are directly involved in either catching or processing fish. Although Kirkcudbright is a small fishing port in the context of the UK fishing industry it is the major port in Dumfries and Galloway. The port is tidal with the channel drying out to a depth of 2.12m.

In 1988 the town was the 15th biggest port in Scotland in terms of landings value with a total value of £2.9m.

The success as a landing port is attributed to the increasing popularity of the extensive shellfish beds between the Scottish coast and the Isle of Man.

It can be seen from Table 1 that during 1986 to 1991 the landings of queens and scallops at Kirkcudbright rose by 28% and 44% respectively, with an increase in value of 44% and 52% respectively.

Table 1 Total Landings Value at Kirkcudbright (queens and scallops)

Year	Landings/Tonnes		Value/£		Total value
	scallops	queens	scallops	queens	£
1986	273	3016	431,000	1,060,000	1,491,000
1987	416	4677	761,000	2,086,000	2,847,000
1988	520	3339	873,000	1,094,000	1,967,000
1989	424	3690	860,000	1,202,000	2,062,000
1990	391	3678	683,000	1,217,000	1,900,000
1991	349	4334	621,000	1,613,000	2,223,400

The shellfishery is by far the most important fishery to the community, and the only source of potentially significant impact due to the pipeline development. However, it is important to note that the area is host to other fishing activities. Kirkcudbright vessels also catch cockles, periwinkles and lobsters in the Solway Firth but do not usually land locally. Small quantities of whitefish are landed, notably Dover Sole which is a by-catch of the queen fishery. Wigtown Bay is fished by up to six cockle dredgers at various times of the year; this is not a main fishing ground for them, but it does provide alternative grounds to the main areas in the Solway. Brighouse Bay, where the pipeline is projected to come ashore, is fished by up to eight small creel vessels. They operate mainly on the west side of Wigtown Bay, but lobster and crab creels are used within 0.25 miles off Brighouse Bay.

On the west side of the Isle of Man three Ayr district seiners fish for whiting and cod particularly in the late spring and early autumn. There is also an extensive *Nephrops* fishery prosecuted by vessels from Northern Ireland and the Isle of Man. They are joined by 12-14 Ayr based vessels mainly during the months of June to September. However, by far the most important fishery in the Kirkcudbright area is the shellfishery. This is considered to be of particular importance because the stocks are localized with little opportunity for the fishermen to move elsewhere and the area is already very heavily fished.

2.2 The Kirkcudbright fishing fleet

The port is home to 21 full-time shellfish boats and 5 whitefish boats. 120 professional fishermen service the local industry. The vessels vary from 40-70 feet in length with the larger vessels tending to specialize in the dominant queen fishery. The queen vessels carry a crew of 8-9 with the scallop boats only needing 4-5 crew. Most of the fleet date from the 1970s and 1980s. The power range of the boats in the fleet is from 300-600hp.

2.3 Fishing Methods

The vessels use dredges to catch the shellfish; Figure 1 shows the basic arrangement of a single scallop dredge. The rigid frame and tooth-bearing bar is made of steel. At the apex of the frame is a towing ring. The tooth bar is spring loaded to reduce snagging on obstructions and damage from impacts. A mat made of linked steel rings called the belly is secured behind the tooth bar. A cover made of heavy netting is joined to the side and back of the belly and carried forward to the base of the frame to form the bag in which the catch is retained. As the dredge is towed the scallops are raked out by the teeth and swept into the bag by the flow of water. The principle for queen dredging is similar. The scallop dredges measure 2.5' x 4' with 3" teeth. Between 7-9 dredges are towed on each side of the beam. The teeth will only disturb sediment to a maximum of 4". Each side of the towing array will weigh 1.5 tonnes for 9 dredges including chains and beam. Each dredge operates independently with the security chain passing through the towing shackle and back to the boom rather than between dredges. The end of the boom is protected by large rubber fenders to keep the beam off the seabed as it advances in front of the dredges.

The queen dredge is bigger - 4' x 6' with each dredge weighing 392lbs (178kg). Four dredges would be carried on each side. The main difference is that the tooth-bar is missing and the chain links in the belly are smaller to accommodate the smaller queens.

Each tow lasts between 30-40 minutes for queens and 60-90 minutes for scallops with the vessel towing at a speed of 2-3 knots. The precise time varies depending on bottom conditions, the more rugged ground for queen causing more debris to be accumulated in the dredge and therefore tows must be shorter. Basically the cleaner the bed, the longer the tow. Fishermen

estimate that they can haul the full dredges aboard, empty them and have the beam back out within 15 minutes under ideal conditions. Once on board the scallops, being bigger, are easier to sort out, grade and pack. The queens, being smaller and having more debris associated with the catch, are more difficult to sort and generally unpopular with crews who sort manually. Automatic grading machines are available, but are more efficient with the scallops catch.

Tow direction depends very much on the tidal conditions, but off Burrow Head NW-SE is a common direction.

Each good tow would catch 500kg of queens or 200kg of scallops. This allows for a 50% discard rate due to undersized animals being caught and assumes a dredge efficiency of 20%. This means that a dredge is only likely to catch 20% of the potential catchable stock with any one tow. Each kg represents 26-30 individual queens or 3-5 scallops.

2.4 Fishing trends - temporal

Each fishing trip starts on a Sunday night and continues until Thursday, fishing 24 hours a day when possible. The queen boats generally make two landings; one on Tuesday as well as Thursday. Scallop boats only land on Thursday.

Each four day trip would hope to land 15000kg of queens or 2500kg of scallop shellweight. With a ratio between shellweight and meatweight of 10%, each trip can expect 1500kg of queen meat and 250kg of scallop meat.

The fleet assumes a working year of 40 weeks with allowances for three months of bad weather. They can continue fishing up to Force 6 on the Beaufort Scale. In good weather the vessels tend to travel further away from port. This helps conserve the local stocks and allows them to have a reserve fishing ground when the weather deteriorates.

The scallop fishery is closed throughout the Irish Sea from June-October. This is in response to the heavy fishing effort that is expended and is timed to protect the beds during spatfall when the stocks are at their most fragile. The queen fishery is open all year round. This has given rise to three types of fishery activity:

* specialist queen fishermen who only catch queens all year round;
* scallop fishermen who move over to queens during the scallop closed season;
* scallop fishermen who move out of the Irish Sea during the closed season.

The last type of fishery occurs as a response to encourage a good scallop crew to stay with a vessel; queen fishing tends to be harder and less popular work than scallop fishing and a skipper with a good scalloping crew often migrates to scallop grounds which are not closed to avoid losing his crew who might otherwise be tempted to leave rather than participate in the queen fishery.

However, the queens are difficult to catch between April-August and the fleet often make only one landing per trip rather than the usual two. There is no satisfactory explanation for this. Fishermen often take any holidays during this overlap period between poor queen catches and the scallop closed season. Therefore fishing activity is at a minimum for a three month period from June-August.

2.5 Fishing Trends - spatial

From data supplied by the industry, the major fishing grounds for the Kirkcudbright fleet measure approximately 78 km^2 in the Solway Firth and 324 km^2 in the north Irish Sea.

Figure 2 shows the shellfish areas in the vicinity of the pipeline as indicated by the fishermen. Area A provides 25-30% of the entire annual catch while Area B accounts for 50% of the total annual catch. Area B, which provides the best fishing grounds, is shared with the Manx fleet; Scottish vessels are allowed to dredge up to three miles off the Isle of Man coast. At the height of last year's scallop season 45 vessels were fishing together on Area B.

3. IMPORTANCE TO THE LOCAL ECONOMY

Fishing is the major industry in the area. West Coast Sea Products (WCSP) is the largest shellfish processing station in the U.K., employing 300 processing workers.

3.1 West Coast Sea Products Ltd

The company was set up in 1971. At that time they employed 35 people with a turnover of approximately £250,000. At the end of 1985 the company employed 170-220 people with a turnover in excess of £5m. By 1991, 300 full and part-time employees were on the payroll and the turnover had risen to over £8m. WCSP control between 70-80% of the total UK industry for queens with roe.

The company pays £18 per 50kg of queens landed shellweight (36p per kg) and £120 per 50kg for scallops shellweight (£2.40 per kg).

The employees hand sort and prepare the clams for automated washing, freezing and packing. They are paid on a piece-work basis. The weekly wage bill is £27000. The company recently installed an automatic processing machine. This can process, grade, wash, freeze and package the clams 6 tonnes per hour compared with 3 tonnes per hour for the manual method. However, the machine strips away the roe. With the market already flooded with cheap clam meat without roe from China, the price differential of £1 per kg for roe makes it worthwhile to only use the machine when a particularly large consignment of clams have been landed.

3.2 The Markets

95% of the WCSP output is exported, with France being the major customer. Each week 30000lb (13608kg) of queen meat with roe is produced. With a 10% meat/shellweight ratio this is equivalent to a weekly catch of 136 tonnes, or 6480 kg per vessel.

The French market pays £5.80 per kilo for queen with roe. This means each weekly output is worth approximately £78926. The overheads are estimated at 60p per lb (27.22p per kg) for manual preparation.

Other companies in the UK also take clams from the Kirkcudbright fleet. Overall it is estimated that 600 people from fishermen to processors are involved in the Kirkcudbright shellfishery in some way.

3.3 Conclusion

It can be seen that the shellfishery is of vital importance to the Kirkcudbright economy and community. Up to 120 fishermen and 300 processors in Kirkcudbright itself rely on the future viability of the fishery and with outside processors buying a proportion of the Kirkcudbright fishermen's catch, up to 600 people are involved in the shellfishery.

The market, mainly for export, appears stable and there are further opportunities to develop into a wider European market in the future. Basically the industry appears healthy and viable, despite increasing pressure on stocks and vessels from outside the region coming to participate in the shellfishery.

4. ASSESSMENT OF POTENTIAL IMPACTS

Local communities such as Kirkcudbright which are heavily dependent on shellfishing could suffer a greater impact compared with other areas which are reliant on mobile fish stocks. It is important to consider the potential impact of the pipeline on the fishing industry and the community in general.

The industry will be faced with three potential interactions:

* short term loss of access to fishing ground during pipe-lay operations;
* temporary loss of catchable stocks because of initial mortality caused by pre-lay dredging, pipelaying and post-lay trenching;
* sterilization of the beds in areas of rockdumping.

4.1 Temporary loss of access to working zones

The temporary loss of access due to operational requirements for an exclusion zone around the vessels will have a negligible impact on the local fishery. The terms used to describe impacts are fully explained in the main sub-sea Environmental Impact Statement. A negligible impact is defined as affecting a specific group of individuals at a localized area and/or over a short time period in a way similar in effect to small random changes in the population due to environmental vagaries. By early notice of operational schedules through the standard Notices to Mariners, the fishermen will be able to target the pipeline route before the exclusion zone is imposed. That should go a long way to reducing any potential loss of catch. This would be particularly true if operations could be scheduled between June and August when the scallop season is closed and queens are difficult to catch and fishing effort is at a minimum.

4.2 Temporary loss of access by initial mortality

Obviously, sedentary species along the pipeline route will be impacted. However, it is difficult to accurately predict the width of the impact area along the route. This will depend on the sediment type, the technology used and the current profile of the area. Therefore effects can be expected to vary along the route. There is very little published work on the swath effect of pipeline operations, but considering the pipeline will only be 0.74m in diameter, including weight-coat, an area of over 7m either side of the pipeline would appear to be a reasonable estimate of swath. Therefore a swath of 15m has been used in the following calculations. This figure has been derived from American work in the Beaufort Sea, but it must be made clear that the swath is an estimate based on professional experience and is not definitive.

The main impacts will come from:

- smothering of the seabed by soft sediment remobilized by the operation;
- destruction of the sediment structure.

The smothering will affect the erect hydroids and polyzoans on which scallops and queens attach during the post-settlement stage in spat development. The amount of potential smothering depends on the current regime, the sediment type and requirement for dredging/trenching in relation to the shellfish grounds. The destruction of the sediment integrity will impact shellfish of catchable size.

4.3 Recolonization of impacted areas

Research is currently under way to estimate the time required for shellfish recolonization, but at the current state of knowledge it is difficult to make predictions with certainty. There are two extremes that can be considered; at the worst case scenario 100% mortality is achieved and recolonization would be reliant on spat settling in the area from outside at the following spatfall (early summer). This would mean that scallops, which take 4 years to reach marketable size of 110mm, would take at least 4 years after impact to recolonize with a single year class and approximately 8 years to re-establish a stable fishery. Queens, taking 3 years to reach marketable size and a single year class, would need at least 5 years to regain full stability.

The above scenario is the worst case. Bearing in mind the conditions prevailing in the northern Irish Sea, the best case scenario is that mortality might not reach 100% and that the following aspects that have been noted by research in the area could improve the rate of recolonization:

* best recruitment in areas of heaviest fishing effort;
* strong local currents bringing large numbers of potential settlers into the area from the large spawning grounds to the south;
* heavy fishing enhances spat settlement by removing adult predators and/or changing the substrate making it more attractive to settling larvae;
* dredge fishing removing the soft sediment and increasing hard strata for attachment of hydroids and polyzoans;
* the short lifespan of the queen means that only two or three year classes are represented in the commercial fishery;
* the presence of a spawning stock refuge in the commercially non-viable areas.

Under ideal conditions; i.e. if recruitment is good, post-settlement migration occurs and the year classes grow well because of reduced predation, the stable fishery could be reached much earlier. This would obviously depend on the conditions left behind after the pipelaying operation.

It can be appreciated that no definite conclusions can be reached at this stage; it is likely that the fishery will be affected to some degree from the loss of stock, but the impact is unlikely to be more than moderate in that the project could affect a portion of the population resulting in a change of abundance and distribution, but will not change the integrity of any population as a whole. A short-term effect on the well-being of those who utilize the resource also constitutes a moderate impact.

5 ASSESSMENT OF IMPACTS

This section assesses the potential impact of the pipeline project on the fishermen of Kirkcudbright who operate on the shellfish beds between the Isle of Man and Scotland.

It does not address the potential impact of any other fishing interest. As such it assumes that the Kirkcudbright fleet have sole access to the stocks. While similar figures might be applicable to other users of the resource, the Kirkcudbright vessels are particularly hard hit because of the great reliance on shellfishing in the community, the restricted access to stocks within the Manx 3-Mile waters and the relatively small area for the fleet to operate within. This report does not suggest that other fishing communities are not likely to be affected by the project, merely that the shellfishing industry is likely to face a moderate impact as a result of the project.

The assessment of the loss of catch to the Kirkcudbright fleet is based on the proportional loss method of access loss. This is explained further in section 5.1. The method attempts to place a realistic figure on the loss to the fleet based on catch data supplied by the fishermen themselves. Other fishing interests might have different operational characteristics which would influence the assessment. Therefore the figures should not be seen as applicable throughout the area, but as a situation specific assessment.

5.1 Methodology

The Proportional Loss method has been chosen as being the most appropriate to the situation. The loss of access to fishing grounds has been addressed by a number of authors over the last fifteen years. The earliest methodology, and that most often proposed by fishermen themselves, is the proportional loss method. The technique assumes that a loss of geographical access can be linearly translated into a proportional loss of catch and hence a proportional cost to the fishing industry. This assumption implies that if the yield value is considered to be constant for a particular area, the anticipated total earnings for that yield are composed of the yield by the fishery and the amount lost by restriction of access. This is very simplistic and has been the subject of debate when applied to mobile stocks. However, with shellfish the method is the most easily applicable.

This method can be applied to the current situation by assuming:

* density, as calculated from fishermen's data, is constant throughout the impacted area. While the scallops and queens are often found on different sediment types, for the purpose of the valuation the distribution is assumed to be equal for both species;
* catches are the same for all vessels and over the year;
* prices for the shellfish are constant at current rates;
* Kirkcudbright fishermen are the only operators in the area;
* the entire Kirkcudbright fleet is equally impacted.

Obviously, these are major assumptions and any change in the assumptions, or the data, could change the impact depending on circumstances.

5.2 Assumptions to be made

Data is based on submissions by the fishing industry and calculations of value are based on catch rather than stock. The fishermen were asked to indicate the areas where the shellfishery impacts with the pipeline route. On the basis of their submission, the total length of interaction measures 33.36km. Assuming a swath width of 15m, the total area impacted measures 500,400m^2. This has been assumed for all further calculations.

The proportional loss method assumes that:

$$V = XY(Z/A)$$

where:

V is value to the fishery of lost yield in pounds sterling
X is the price for the catch in pounds per kilogramme
Y is the total yield from area A in killogrammes
Z is the area lost by the development in m^2
A is the total area covered by the fishery in m^2

This method is generous by its nature; it assumes that the fishermen will not re-direct the effort that would have been expended in the development area elsewhere, nor does it take into account any reductions in operational cost by not fishing i.e.. the model assumes the fishermen do not fish elsewhere, but makes no allowance for reduction in fuel costs etc. Therefore, any prediction is likely to be higher than reality. However, it is the simplest and most readily applicable tool in these circumstances and the values will have to be seen as an expression of the value of lost product rather than lost profit.

The method is not a valuation technique *per se*. The total value of the loss would need detailed data on:

* profits for the primary fishing industry;
* profits for the secondary processing industry;
* impact on the service industry supporting both primary and secondary operations;
* multiplier analysis of costs/benefits within the community.

This is not feasible within the scope of the report; such a study could be recommended on the basis of the preliminary conclusions of this assessment. However, such a detailed examination could only be realistically warranted if the potential impact was identified as being of major significance.

The data used for this assessment has been gathered by an interview with representatives of the fishing and processing industry and published government statistics; the price is assumed as of the date of interview and the total fishable area is taken from a data sheet from West Coast Sea Products.

5.3 Assessment of loss of catch

The area fished has been estimated by West Coast Sea Products as 155 square miles; this is equivalent to $401.45 km^2$.

The latest government statistics indicate that in 1991 4334 tonnes of queens were landed at Kirkcudbright, with a value of £1,613,000. 349 tonnes of scallops were also landed with a value of £621,000. These figures have been assumed for the assessment of potential loss of product; unit prices used are current as of the calculation; i.e. 36p per kg for queens and £2.40 per kg for scallops.

Using the proportional loss formula above, the value of lost product for queens for zone A can be expressed as:

$$v = \frac{0.36 \times 1774 \times 10^3 \times 180.7 \times 10^3}{3.54 \times 10^8}$$

$$= £326$$

The value of lost product for scallops for zone A can be expressed as:

$$v = \frac{2.40 \times 143 \times 10^3 \times 180.7 \times 10^3}{3.54 \times 10^8}$$

$$= £176$$

The value of lost product for queens for zone B can be expressed as:

$$v = \frac{0.36 \times 2560 \times 10^3 \times 319.700 \times 10^3}{5.11 \times 10^8}$$

$$= £577$$

The value of lost product for scallops for zone B can be expressed as:

$$v = \frac{2.40 \times 206 \times 10^3 \times 319.700 \times 10^3}{5.11 \times 10^8}$$

$$= £310$$

5.4 The assessment in context

This report is not a valuation; the figures derived above are estimated loss of product to the fishing industry; not the estimated loss of profit. The areas affected by the pipeline have been shown to be approximately 0.05% in zone A plus 0.06% in zone B. To value the total loss to the community is beyond the scope of this report; however, the assessment does provide an indication of the magnitude of any potential loss. From this some obvious conclusions can be made:

* if profit, not product, is taken into account, the loss to the fishery will be much smaller than the above figures. The derived figures are based on an industry-wide loss; with 120 fishermen and 21 vessels operating in the area, this can be seen in context;
* it can be seen from the above analysis, based primarily on data provided by the fishermen themselves, that the impact from the pipeline will be unlikely to affect the local community in any significant way;
* it is certain that any damage caused by the pipeline will hardly be discernible against the natural fluctuations of the fishery, assuming the area is trenched, not rock dumped, and the seabed after operations remains a suitable habitat for shellfish;
* similarly, the processing industry is unlikely to be reasonably affected by the development, the impact of which will remain invisible, masked by the natural fluctuations of the industry;
* therefore it can be suggested that a full valuation of impact is not required.

5.5 Conclusions and Recommendations

It can be seen that a full-scale fishing intensity study/valuation of impact is not required to assess the impact to the fishery; it can be appreciated that the Kirkcudbright fishing industry is unlikely to be significantly impacted. The data used in the assessment has mainly come from the fishermen themselves, the method of assessment is usually advocated by the industry as valid and is generous in its assumptions. As such the impact could be even less than that indicated here.

Whilst it can be seen that the industry is unlikely to be impacted, for the efficient management of the development the following recommendations are made, based on the conclusions of the EIA:

* the use of Notice To Mariners to allow early targeting of the impacted area;
* the use of liaison skippers on the laybarge to oversee good practice such as debris management and liaise with fishing vessels operating in the vicinity;
* the provision of GPS tapes of the eventual route to allow efficient navigation around any potential obstacle;
* the use of trenching where at all possible;
* making the data from routine ROV/Diver monitoring available to researchers to use in investigations into recolonization of impacted habitat.

APPENDIX C

STUDY TEAM

APPENDIX C

STUDY TEAM

This report was jointly compiled and written by MCS International and ICIT. The structure of the project was as follows:

Project Management		MCS
Chapter 1	Introduction	ICIT/MCS
Chapter 2	The Development	ICIT
Chapter 3	The Environment	
	Physical	MCS
	Biological	ICIT
	Sea User	ICIT
Chapter 4	Interaction Matrix	ICIT
Chapter 5	Environmental Impact Assessment	ICIT
Chapter 6	Socio-Economic Impact	ICIT
Chapter 7	Environmental Management	ICIT
Chapter 8	Discussion	ICIT
Appendix A		ICIT
Appendix B		ICIT/MCS
Appendix C		ICIT/MCS
Planning and Consultation		MCS/ICIT

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