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Corrib Gas Field Development

Environmental Impact Statement

Prepared in respect of the proposed Bellanaboy Bridge Gas Terminal and associated Srahmore Peat Deposition Site.

Volume 2:
Proposed Srahmore Peat Deposition Site
Bangor Erris
Co. Mayo

Prepared on behalf of
Shell E&P Ireland Limited
Corrib House
52 Lower Leeson Street
Dublin 2

by
TES Consulting Engineers
Unit 4B/5
Blanchardstown Corporate Park
Dublin 15

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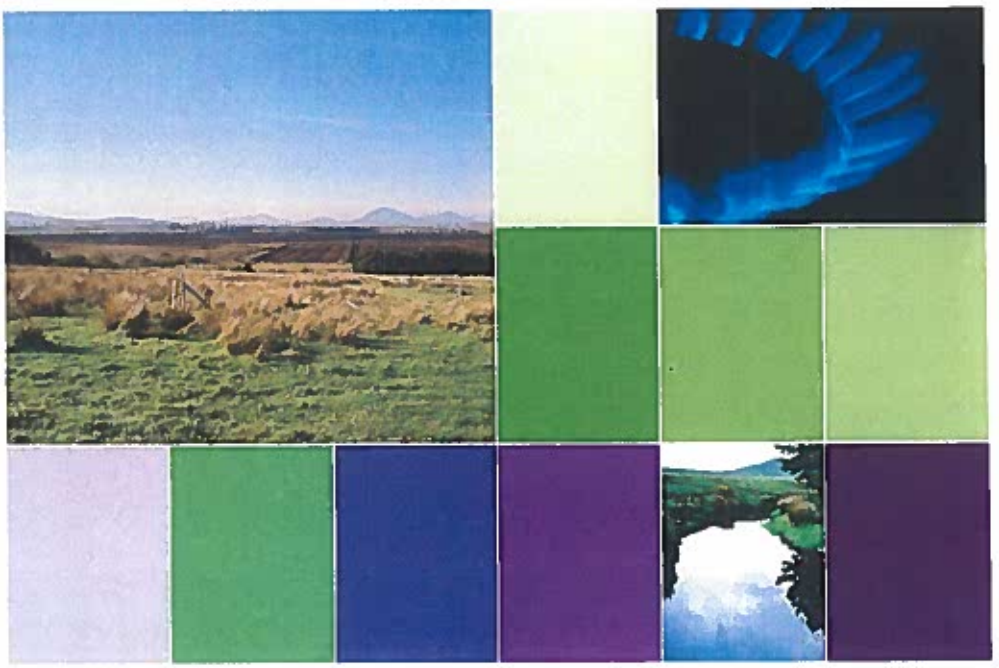

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1 INTRODUCTION

1.1 Background

Shell E&P Ireland Ltd (Shell), as operator of the Corrib gas field proposes to develop a gas terminal, the Bellanaboy Bridge Terminal, at Bellanaboy Bridge, Glenamoy, Co Mayo (Drawing No. 1169\01\201). In order to construct the terminal, it will be necessary to excavate up to 450,000m^3 peat from the terminal site. It is proposed that this peat is transported by public road from the terminal site to a cutover peatland at Srahmore, Bangor, Co Mayo (Drawing No. 1169\01\201). This peatland is operated by Bord na Móna as part of their Oweninny Works. The development of the deposition site, and an adjacent site, which will facilitate access, and loading/unloading of the peat, are the subjects of the Peat Deposition Site Volume of this EIS.

It is further proposed that the peat be spread over the lands at Srahmore, stabilised and allowed to vegetate naturally.

Shell's application for planning permission for the terminal includes the associated peat deposition site at Srahmore as outlined above. The environmental impact statement for the development is presented in two separate volumes, one covering the terminal site termed the Terminal Volume and this, termed the Peat Deposition Site Volume. Both volumes accompany the planning application to Mayo County Council.

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Bord na Móna and the Oweninny Peatlands

Bord na Móna currently owns 80,000 ha of peatland, employs approximately 2,000 people and operates out of 30 locations, mainly in Ireland, but also in the United Kingdom and the United States. The company has strong skills in resource management and development, manufacturing, distribution, science, engineering and human resource development. Bord na Móna has a wide range of services, products and operations: it supplies peat as a fuel for the generation of electricity; it produces a range of peat-based fuels; sells coal and oil for residential and industrial heating; it markets horticultural products for commercial horticulturists and home gardeners; and sells pollution abatement products, environmental consultancy and commercial laboratory services to industry and public authorities.

Its operations are divided into four constituent companies, limited in liability, and they are:

- Bord na Móna Energy Limited.
- Bord na Móna Horticulture Limited.
- Bord na Móna Fuels Limited.
- Bord na Móna Environmental Limited.

Bord na Móna Energy Limited has been providing fuel in the form of milled peat to the ESB's peat-burning electricity generating station at Bellacorick, Co Mayo. As this power station is scheduled to close at the end of 2004 Bord na Móna will no longer be in a position

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to continue providing peat-related employment at its Oweninny Works near Bangor Erris Co. Mayo beyond the end of next year.

Bord na Móna submitted a rehabilitation plan for the cutover peatlands of the Oweninny Works to the EPA in January 2002. This rehabilitation plan, under IPC Licence No. 505, was a generic plan that outlined the criteria defining successful rehabilitation at the Oweninny Works (to include both the Bellacorick and Bangor peat extraction sites) and described a number of test programmes that incorporated the principles and methods of rehabilitation. The EPA approved the rehabilitation plan in June 2002 (IPC License no. No. 505). The condition that refers to cutover peatland rehabilitation within the IPC Licence (505) is Condition 10 (Appendix 1).

1.2 Waste Licence, Planning and Environmental Impact Assessment

Waste licence

Appendix A: Glossary of Terms of the National Waste Database Report 1998 published by the EPA defines waste as: "any substance or object belonging to a category of waste, specified in the First Schedule or included in the European Waste Catalogue (EWC), which the holder discards or intends or is required to discard and anything which is discarded or otherwise dealt with as if it were waste shall be presumed to be waste until the contrary is proved."

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The peat excavated from the terminal footprint at the proposed terminal site is surplus to requirements and as such will be removed from site and placed at the lands at Srahmore. It is considered a waste, for which a waste licence is required for its deposition.

The Waste Management Act, 1996 designates the Environmental Protection Agency (EPA) as the sole licensing authority for landfills, above a certain threshold level of activity. The Waste Management (Licensing) Regulations, S.I. No. 133 of 1997 provide for the commencement and operation of the system of licensing by the EPA of waste disposal activities. The Waste Management (Licensing) Regulations, 2000, S.I. No. 185 of 2000 specify the classes of activity that are subject to licensing by the EPA and prescribes the information to be addressed in the licence applications.

An Environmental Impact Statement (EIS) is required to accompany a Waste Licence Application, where the volumes for disposal are above a certain threshold volume (greater than 25,000 tonnes per annum), as outlined at class 11(c) in Part 2 of Schedule 5 of the Planning and Development Regulations, 2001. The capacity of the proposed peat deposition site is above the threshold value and therefore an EIS will accompany the Waste Licence Application to the Environmental Protection Agency.

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Environmental Impact Assessment (EIA)

An EIA is a process that examines the environmental consequences of development actions, in advance. The emphasis is on prevention with the resulting information taken into account by the appropriate planning authority when forming their judgements on whether the development should go ahead.

In the case of significant impacts being identified, appropriate recommendations for the prevention and/or mitigation measures are highlighted. Where it is found that an impact cannot be prevented or mitigated against, or where additional monitoring is deemed necessary, this is also highlighted. The outcome of the Environmental Impact Assessment process is an Environmental Impact Statement (EIS) and an accompanying Non-Technical Summary.

Environmental Impact Assessment (EIA) requirements derive from European Communities Directive 85/337/EEC (as amended by Directive 97/11/EC) on the assessment of the effects of certain public and private projects on the environment.

Part X of the Planning and Development Act, 2000 requires that an EIS be submitted with a planning application for certain developments. Those developments, which must be accompanied by an EIS, are referred to in Part 10 and set out in Schedule Five of the Planning and Development Regulations, 2001.

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Planning

An application for planning permission is being made in respect of the proposed terminal development at the Bellanaboy Bridge site and the associated peat deposition at the Srahmore site. An EIS has been submitted in two volumes in support of the application for planning permission: namely the Terminal Volume and the Peat Deposition Site Volume.

1.3 Scoping of the EIA

Prior to the commencement of the EIA process, a scoping exercise was conducted to identify the key issues of concern at an early stage in the planning process. Scoping also aids site selection and identifies any possible alternatives. The results of scoping determined the scope, depth and terms of reference to be addressed within the Environmental Impact Statement. In accordance with Section 4 of the *Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2002)*, the consultation process consisted of consultation with competent bodies, statutory bodies, interested parties and the public.

The following lists the various parties consulted to-date.

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Competent Authorities
Mayo County Council
Environmental Protection Agency
Department of Communications, Marine and Natural Resources

Prescribed Bodies / Statutory Consultees
North Western Regional Fisheries Board
National Parks and Wildlife (formerly Dúchas)
OPW
National Museum of Ireland
An Taisce

Interested Parties
Private Fisheries Owners
Bangor Angling Club
Geological Survey of Ireland
Local residents

Consultation with the Public and the Local Communities
In order to brief the local communities fully of the development and to consult with the public at an early stage Bord na Móna and Shell organised a public exhibition at Geesala in November 2003.

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Consultation Sessions
The exhibitions were held in Teach Iorrais, Geesala, Co. Mayo on Friday, 28th November and Saturday 29th of November 2003. Letters of invitation had been sent out in advance to local residents and other interested parties. Staff members of Bord na Móna, Shell, RSK, various technical experts and TES Consulting Engineers were present to outline the proposals, take on board comments and suggestions and to answer questions from the public.

In total, some 232 members of the public signed the register and 84 filled out feedback forms. In general, the project was received favourably. Comments raised in the feedback forms have been addressed in the two volumes of this EIS, namely the Terminal Volume and the Peat Deposition Site Volume.

1.4 An overview of the structure of an EIS

The minimum information that must be contained in an EIS is specified in Part X of the Planning and Development Act, 2000 and Schedule 6 of the Planning and Development Regulations, 2001. The structure and content of this EIS has been based on the legislative requirements as set out in Part X of the Planning and Development Act, 2000 and Part 10 of the Planning and Development Regulations, 2001 and the following documents, as published by the Environmental Protection Agency:

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- Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) (2002).
- Guidelines on the information to be contained in Environmental Impact Statements. (2002).

To allow for ease of presentation and consistency when considering the various elements of the environment, a systematic structure has been adopted for the main body of the statement. This structure is known as a "Grouped Format". The structure is used for each particular environmental aspect as given below.

Receiving Environment
In describing the receiving environment, an assessment is made of the context into which the proposed activity will fit. This takes account of any other proposed and existing developments.

Characteristics of the Proposed Development
Consideration of the "Characteristics of the Development" allows for a projection of the "Level of the Impact" on any particular aspect of the environment.

Potential Impact of the Proposed Development
This section allows for a description of the specific, direct and indirect impacts, which the proposed activity may have. This is done with reference to Receiving Environment and Characteristics of the Development, while also referring to the magnitude, duration, consequences and significance of the development during both construction and operational phases.

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Do Nothing Scenario
In order to provide a qualitative and equitable assessment of the proposed activity, it is imperative to consider the impacts should the development not take place.

Mitigation Measures
This includes a description of any remedial, or mitigation measures that are either practicable or reasonable having regard to the potential impacts.

Predicted Impact of the Proposed Development
This section allows for a qualitative description of the resultant specific, direct and indirect impacts, which the proposed activity may have, if all mitigation measures are applied. This is done with reference to both *Potential Impact of the Proposed Development* and *Mitigation Measures*, producing a definitive and concise statement of impact for the development.

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Monitoring

This involves a description of monitoring required during the development and post development phase, if required. It also addresses the effects, which require monitoring, along with the methods and the appropriate agencies that are responsible for such monitoring.

Reinstatement and Residual Impacts

While not applicable to every aspect of the environment considered within this EIS, certain measures need to be proposed to ensure that in the event of the proposal being discontinued, there will be minimal impact to the environment.

1.5 Technical difficulties and availability of data

No significant technical difficulties or lack of data were experienced in preparing the Environmental Impact Statement for the proposed Peat Deposition Site.

1.6 Study Team and Contributors to the EIA

This Peat Deposition Site Volume of the EIS has been prepared by a team of consultants co-ordinated by TES Consulting Engineers. The relevant inputs of the various members of the Study Team are as follows:

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Team Member	Inputs
TES Consulting Engineers	Project Direction, Project Management, Production, Evaluation and Reporting. Geology and Hydrogeology. Surface Water and Pump Tests. Engineering Design.
Bord na Móna plc.	Technical advice on Construction and Operations, Topographic Survey, Ecological Assessment, Rehabilitation Plan
Tom Phillips and Associates Town Planning Consultants	Human Beings - Planning, Tourism and Socio-Economics.
TOBIN Consulting Engineers Shell E&P Ireland Ltd	Traffic and Roads Geotechnical review
RSK ENSR Environmental Ltd, Environmental Consultants	Material Assets, Climate, Air Quality, Cumulative Impacts, Sustainable Development
Brady Shipman Martin, Landscape Architects	Landscape & Visual Impacts
ADS Ltd., Archaeological Consultants	Archaeology

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Team Member	Inputs
Alan Saunders and Associates Acoustic Consultants	Predictive Noise Modelling
AGEC Applied Ground Engineering Consultants TES Consulting Engineers	S.I. (Trial Pitting, COT, Stability report/calculations (Local and Global Stability)

In addition to the main Study Team outlined above the following firms also made contributions to the Study, namely:

- Irish Drilling Ltd — Geotechnical Site Investigations (Borehole Drilling/ Trial Pitting/Soil Analysis)
- ALcontrol Geochem Ireland Ltd. — Groundwater /Surface water analysis.

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2 DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 Site context

The site lies in the north-western part of County Mayo. The landscape contains a mixture of dramatic coastal scenery ranging from extensive rocky cliffs (Achill and Erris) to low coastal dunes and sandy bays (Belmullet and Broadhaven). Extensive blanket bog and dramatic upland terrains (Nephin Beg/Owenduff area) and numerous lakes of varying sizes (Loch Conn and Carrowmore Lake) are found inland in this area.

The site is situated approximately 1km northwest of the village Bangor-Erris and comprises cutover peatland in the Oweninny bog complex. This consists of eight separate areas of cutover peatland, numbered 1 – 8, each of which was assessed for suitability for the development. Area 5 was selected as the peat reception area. Area 6 was selected for the actual deposition of peat and a section of Area 7 will be utilised as a "controlled overflow area" in the event of exceedence of the design rainfall. The peat reception area to be utilised for off-loading of the peat is the closest area to the public road.

The existing topographical contours for the site are as shown on Drawing No. 1169/01206. as shown, Area 6 is a low-lying saucer shaped depression of cut over peatland, which is surrounded by perimeter banks of fringe peatland habitats. The site slopes gently at c.1.8 degrees from east to west falling from 20.5 metres above Ordnance Datum (mOD) to 14 (mOD). Area 6 is subdivided by a series of "high fields" left in situ to facilitate stockpiling of peat. These high fields are typically 14m wide and 130m apart and will be utilised to transport peat for deposition in Area 6.

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2.2 Proposed Development

Development of this site will require the construction of a hardstanding peat reception area of 5,112m^2, approximately; the provision of a temporary administration building with a gross floor area of 108m^2, approximately, inclusive of offices, canteen and toilets. The development of the peat deposition site will also consist of the provision of a new entrance and access road to the peat deposition site from the R313; the construction of internal roads; the construction of a surface water swale along the southern and western boundaries of the site; the provision of 5 no. surface water settlement ponds (2 no. ponds of 800 m^2 each; 3 no. ponds of 400m^2 each approximately). Deposition of peat will take place within an area of 63 hectares approximately. The peat deposition site will also entail the provision of a controlled overflow area of 12 hectares approximately; an oil interceptor; a settlement tank of 28 cubic metres approximately; the provision of a temporary weighbridge and a temporary wheelwash. The development of the peat deposition site will also consist of 5 no. car parking spaces located adjacent to the administration building and 20 no. parking spaces for haulage vehicles at the peat reception area.

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The development entails the deposition of peat from Bellanaboy on Bord na Móna peatlands at Srahmore, Bangor-Erris, County Mayo in order to facilitate the construction of the Bellanaboy Bridge Gas Terminal at Bellanaboy Bridge, County Mayo. Approximately 450,000m³ of peat must be excavated from the terminal footprint to allow for the terminal to be constructed at the required level.

In summary, the proposed removal of the peat from the terminal footprint and subsequent deposition at the Srahmore will involve the following:

- The trees/scrub at the Bellanaboy Bridge Terminal Site will be removed from the terminal footprint by Shell and will be retained on site (Refer to Terminal Volume of this EIS).
- The peat (up to 450,000m^3 cubic metres) excavated from the terminal footprint will be drained, windrowed and transported from the Bellanaboy Bridge site to the cutover peatland at Srahmore.
- The peat will be transferred from the road haulage vehicles to low ground-bearing pressure tractors/trailers (Haku trailers) at a hardstanding Peat Reception Area. These trailers will haul the peat, via internal haulage roads to the Peat Deposition Area.
- The deposited peat will be spread and graded to provide for falls towards drainage ditches.
- Following completion of peat deposition these areas will then be allowed to revegetate and stabilise.

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2.2.1 Bellanaboy Bridge Gas Terminal Site

Pre-treatment of the peat on the Bellanaboy Bridge Gas Terminal site will be carried out in order to shed free water and reduce the peat moisture content, prior to road transport. This is necessary to reduce the moisture content to the required level for the spreading process. Any moisture content reduction would also be a significant benefit by reducing the volume and impact of road transportation.

The peat pre-treatment at the Bellanaboy Bridge Gas Terminal Site will be a two-stage process entailing the implementation of a site drainage programme at the earliest possible stage followed by the implementation of a 'windrowing' regime for the peat material (see Section 3 Terminal Volume).

2.2.2 Road Transport Operation

The road transportation will involve the haulage of the peat in trucks carrying approximately 11 tonnes of peat per load. The proposed haulage route is along local road L1204, as outlined in Section 16 herein.

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2.2.3 Peat Deposition Site

All preparatory construction, spreading operations and rehabilitation works at Srahmore will be carried out and directly managed by Bord na Móna. This includes the construction of a site access road from a location on the R313 at a point approximately 1.3 km west of Bangor.

During the road haulage phase of the project, the trucks (which will be managed by Shell) will deliver and unload the peat at a Peat Reception Area, which will be managed by Bord na Móna, located in the peatlands immediately south of the R313.

The actual peat deposition area comprises approximately 63ha. This area was utilised for industrial peat extraction up until summer 2003. This has resulted in a topographic landform that comprises banks of peat, known as high fields (14m wide), with intermittent lower elevation, cutover production fields, known as low fields. The high fields are approximately 2m higher elevation than the low fields. The high field banks are separated by up to 10 low fields. The low field production areas are grouped and referred to as "bays". Therefore Area 6 is effectively divided into seven bays where it is proposed to deposit the peat.

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2.3 Site Layout and Design

The location of the proposed site is as outlined on Drawing No. 1169\01\201. The site activity boundary is shown in red on Drawing No. 1169\01\202. The development will include the following:

- an access road from the R313;
- a Peat Reception Area;
- a Peat Deposition Area; and,
- surface water settlement ponds.

Details of the peat reception area are shown on Drawing No. 1169\01\212. This area will include:

- administration/site building;
- on-site parking;
- hard standing for transfer of peat from road haulage to on-site vehicles;
- weighbridge (temporary);
- wheel wash (temporary);
- security kiosk (temporary); and
- chemical toilets (temporary).

2.4 Peat Transfer/Spreading Method

Several methods of peat transfer and spreading were considered as outlined in Section 4.2 herein, including:

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1. Direct transfer of peat onto the cutover peatland by road haulage vehicles.
2. Transfer from road haulage vehicles to low ground bearing pressure trailers for dispersal on the cutover peatland.
3. Transfer form road haulage vehicles to rail wagons for rail transport and dispersal on the cutover peatland.

As outlined in Section 4.2 herein, the second option listed above, i.e. the transfer from road haulage vehicles to low ground bearing pressure trailers for dispersal on the peatland is considered the optimum peat transportation method.

This involves the transport of the peat overburden by road trucks to the peat reception area, which will be constructed in Area 5 of the peatland (see Drawing No. 1169\01\203). This reception/transfer facility will be accessed from the junction of R313 and L1204 public road via a new access road.

At the peat reception area the road trucks will unload the peat onto a concrete hardstand area. The peat will then be loaded using two front-end industrial loaders into low ground bearing pressure trailers (Haku trailers) (See Figure 2.1). These trailers will transport the peat to the high fields in Area 6 of the peatland via internal roads, which will be constructed on the existing peat. The proposed internal roads and traffic routing are shown on Drawing No. 1169\01\209

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It is envisaged that a fleet of approximately 20 Haku trailers will be required to transport the 4,000 m^3 of peat, which is expected to arrive daily over the six months of operation of the facility, which may be spread over two seasons depending on weather conditions.

The Haku trailers will travel along internal roadways which will be constructed on the high fields in Area 6 and empty the peat by tipping to the side as shown in Figures 2.2 and 2.3 respectively.

Excavators will remove the peat from the high fields and stockpile it on the 2nd low field as shown in Figure 2.4

The peat will then be bulldozed towards the centre of the area between the two high fields creating a cambered surface with the highest point in the centre sloping back towards drains close to the high fields as shown in Figure 2.5. The height of deposited peat will generally be of the order of 1.4 to 1.8m above the existing ground levels at the highest point in the centre, with a fall of approx. 1:200 towards the high fields. The edge of the peat deposition area will be offset from the bottom toe of each of the high fields, thereby allowing for the construction of drainage ditches as shown on Drawing No. 1169\01\218.

Longitudinal and cross sections of the proposed peat deposition area following completion of peat deposition, showing existing ground levels, base of peat, and finished ground levels

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are shown on Drawing No. 1169/01/214 and Drawing No. 1169/01/215. Final restoration contours are also shown on Drawing No. 1169/01/216.

As shown on Drawing No. 1169\01\208 each of the separate peat deposition areas in Area 6 will be referred to as a Bay and numbered 1 to 7.

Peat deposition on the low fields in Area 6 will take place with a number of bays being filled, in parallel in a phased manner. As shown on Drawing No. 1169\01\208, four phases of filling are proposed, with Phase 1 filled first, then Phase 2, Phase 3, and finally Phase 4. The timing of the filling of each phase is also presented schematically on Drawing No. 1169\01\208. This sequence can be adjusted to take account of site conditions.

Each phase will be filled from the high fields running adjacent to the particular bay and in the direction indicated on Drawing No. 1169\01\208. This allows for ease of passage of the Haku trailers along the high fields and also provides for more efficient operation of the bulldozers in the bays.

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Figure 2.1. Haku trailer carrying milled peat

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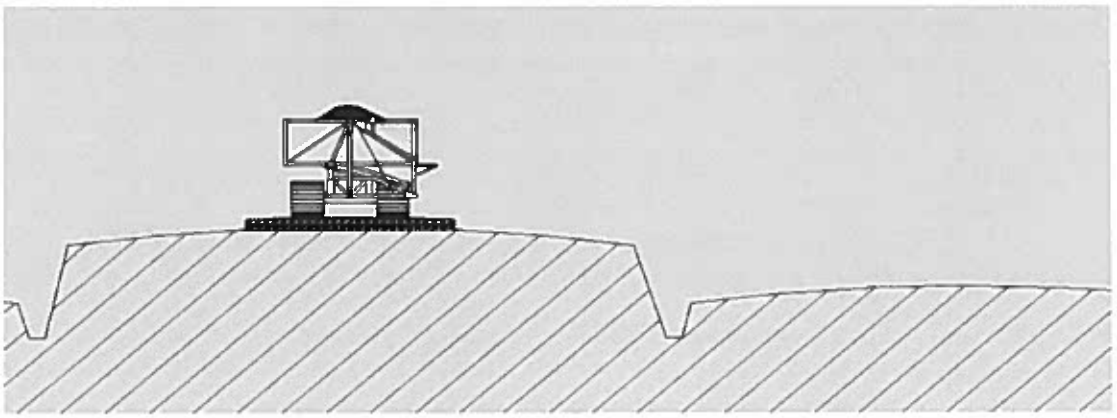

Figure 2.2. Material transported onto peatlands in Haku trailers, which travel on roads constructed on high fields.

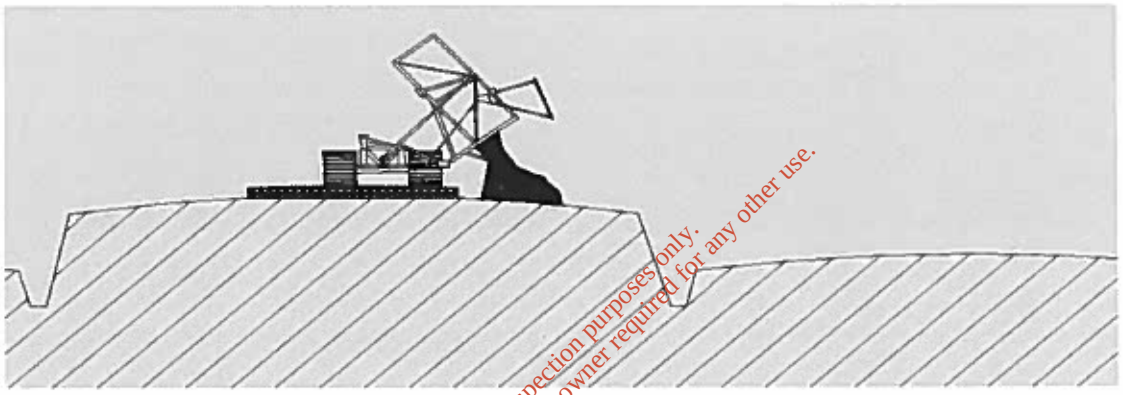

Figure 2.3. Material side tipped from Haku trailers onto sides of high fields.

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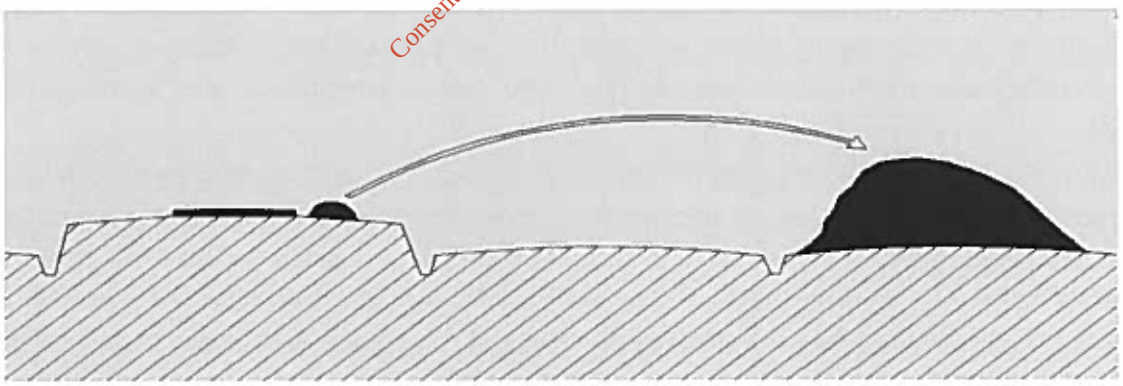

Figure 2.4. Material moved from high field to low field using excavators.

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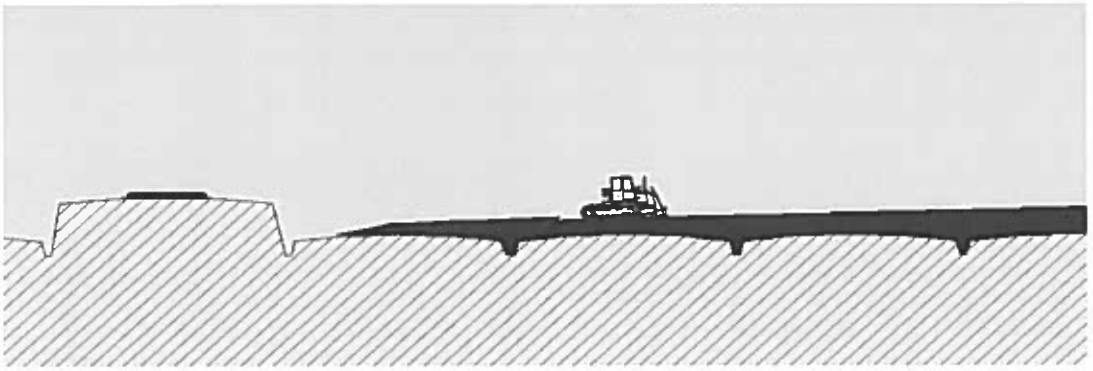

Figure 2.5. Material spread over low fields and compacted with dozers.

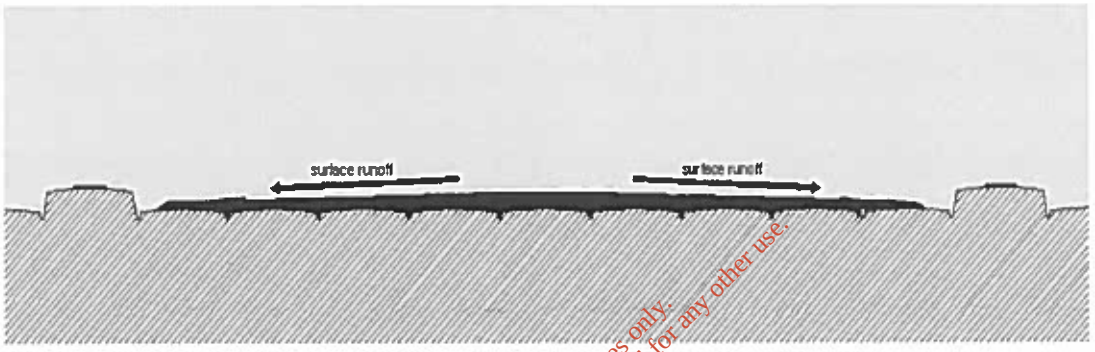

Figure 2.6. Material in final position

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2.4.1 Peat Handling Logistics On-Site

Bord na Móna will typically operate the site for twelve hours per day during the deposition operations. This may be extended in exceptional circumstances to take advantage of favourable working conditions. This will allow for the transfer of peat from the peat reception area to the peat deposition area. The following paragraphs describe the proposed peat handling operations on the site and should be read in conjunction with Drawing No. 1169\01\209 and Figure No's 2.7-2.10.

The peat will be loaded from the hard standing peat reception area into the Haku trailers using industrial front-end loaders. The peat reception area, as shown on Drawing No. 1169\01\212 is broadly shaped as a "hammer head" with the two side areas acting as temporary peat storage areas. For the purpose of description these two areas will be referred to as 'Area A' and 'Area B'.

Generally, all peat haulage vehicles will be directed towards one of the two areas for tipping purposes, while the other area is being worked by the front-end loaders, moving tipped peat into the Haku trailers for transport.

This buffer is necessary both to prevent the two streams of traffic crossing each other's operating area, and to provide enough storage for the productive working of the front-end

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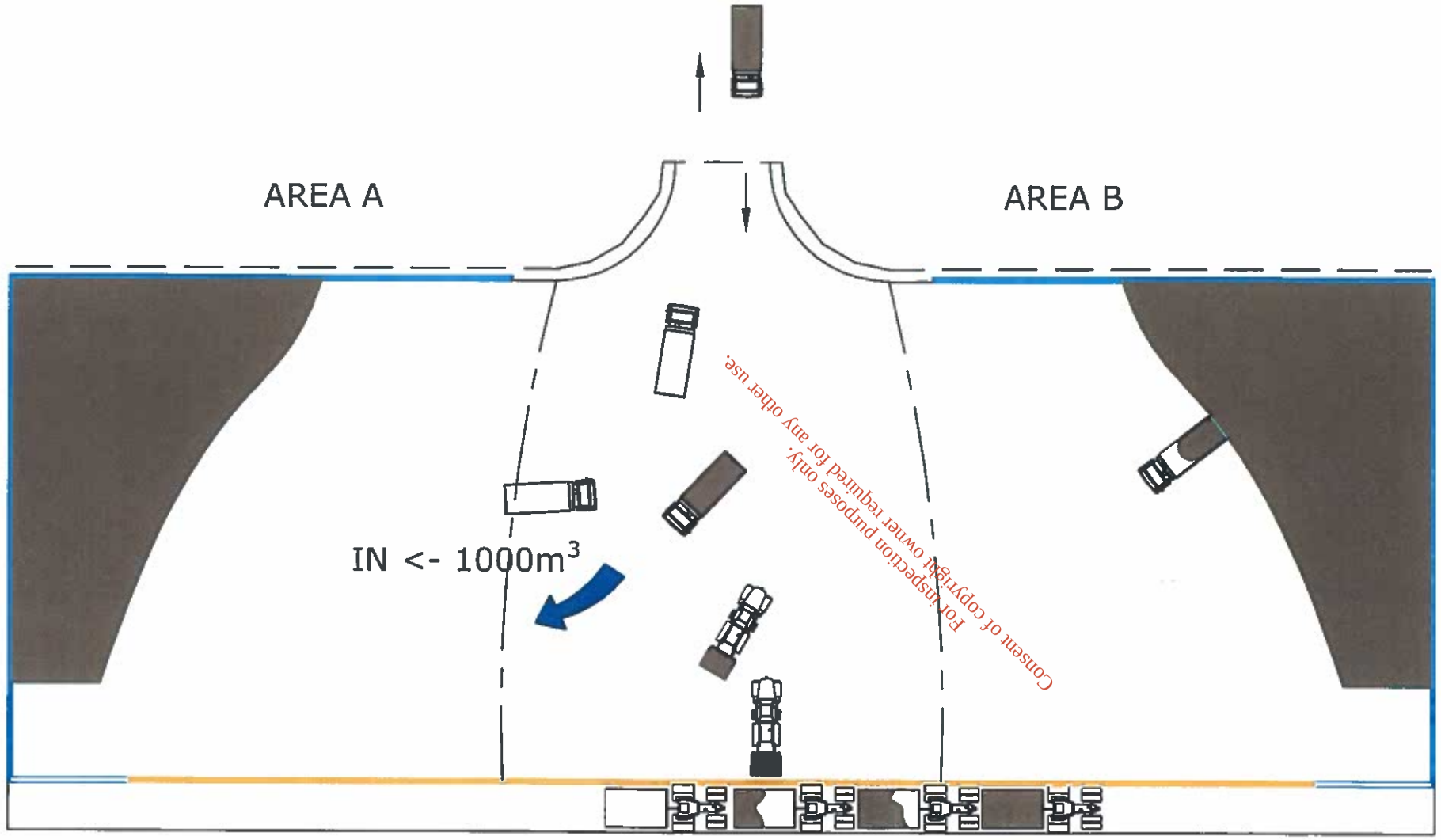

FIGURE 2.7

PERIOD 1 :- 07:00 - 10:00

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Applicant: Shell E&P Ireland Limited

Operator: BORD NA MÓNA

Project: CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

Drawing Title: PERIOD 1 :- 08:00 - 11:00
FOR SRAHMORE PEAT DEPOSITION

Scale: 1:500 @ A3

Drawn by	Checked by	Date
Colin Peacock	Damien Grehan	DECEMBER 2013

ENGINEER IN CHARGE: DAMIEN GREHAN

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Drawing No.: FIGURE 2.7

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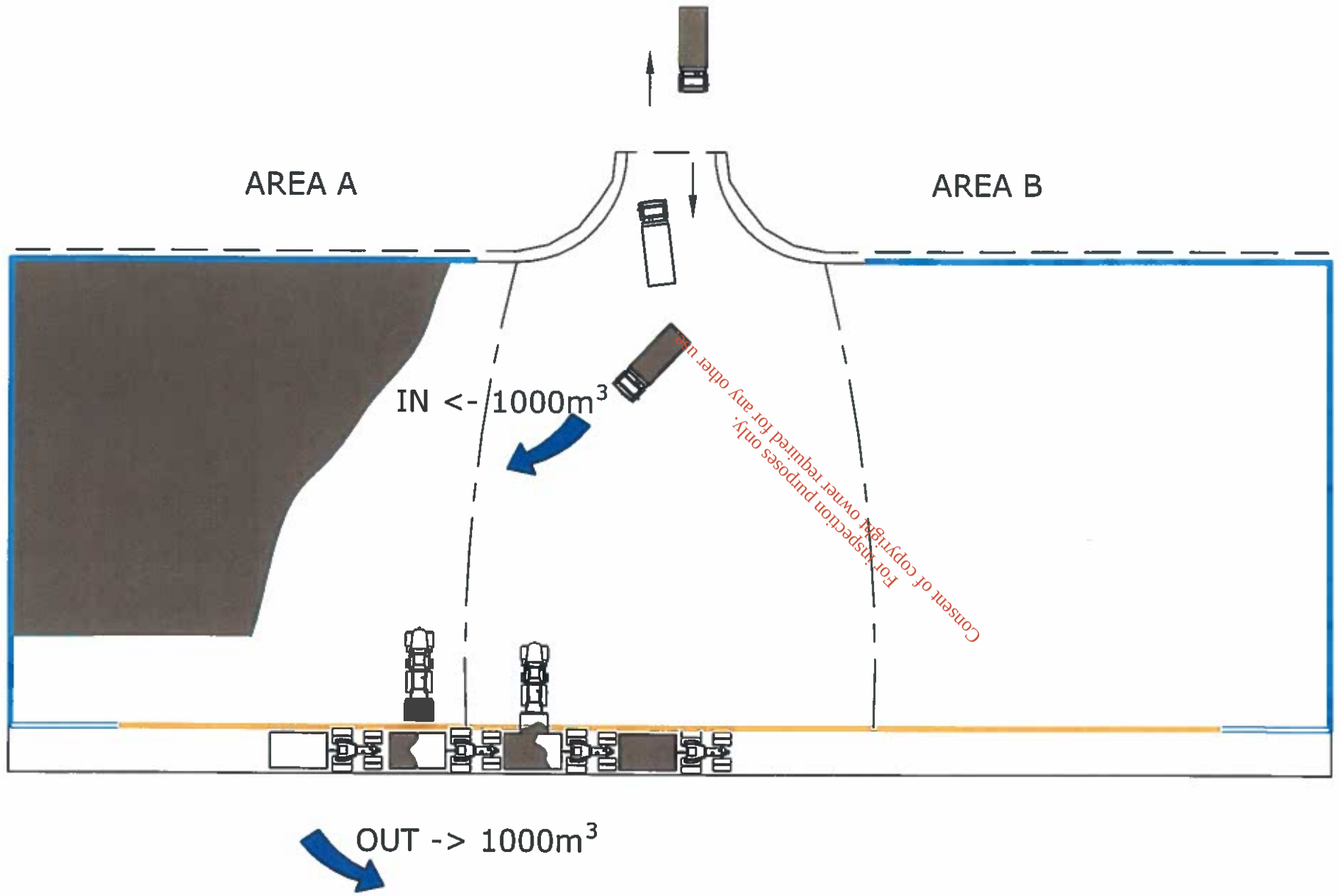

FIGURE 2.8

PERIOD 2 :- 10:00 - 13:00

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Applicant: Shell E&P Ireland Limited

Contractor: BORD NA MÓNA

Project: CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

Drawing Title: PERIOD 2 :- 11:00 - 14:00
FOR SRAHMORE PEAT DEPOSITION SITE

Scale: 1:500 @ A3

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Drawing No.: FIGURE 2.8

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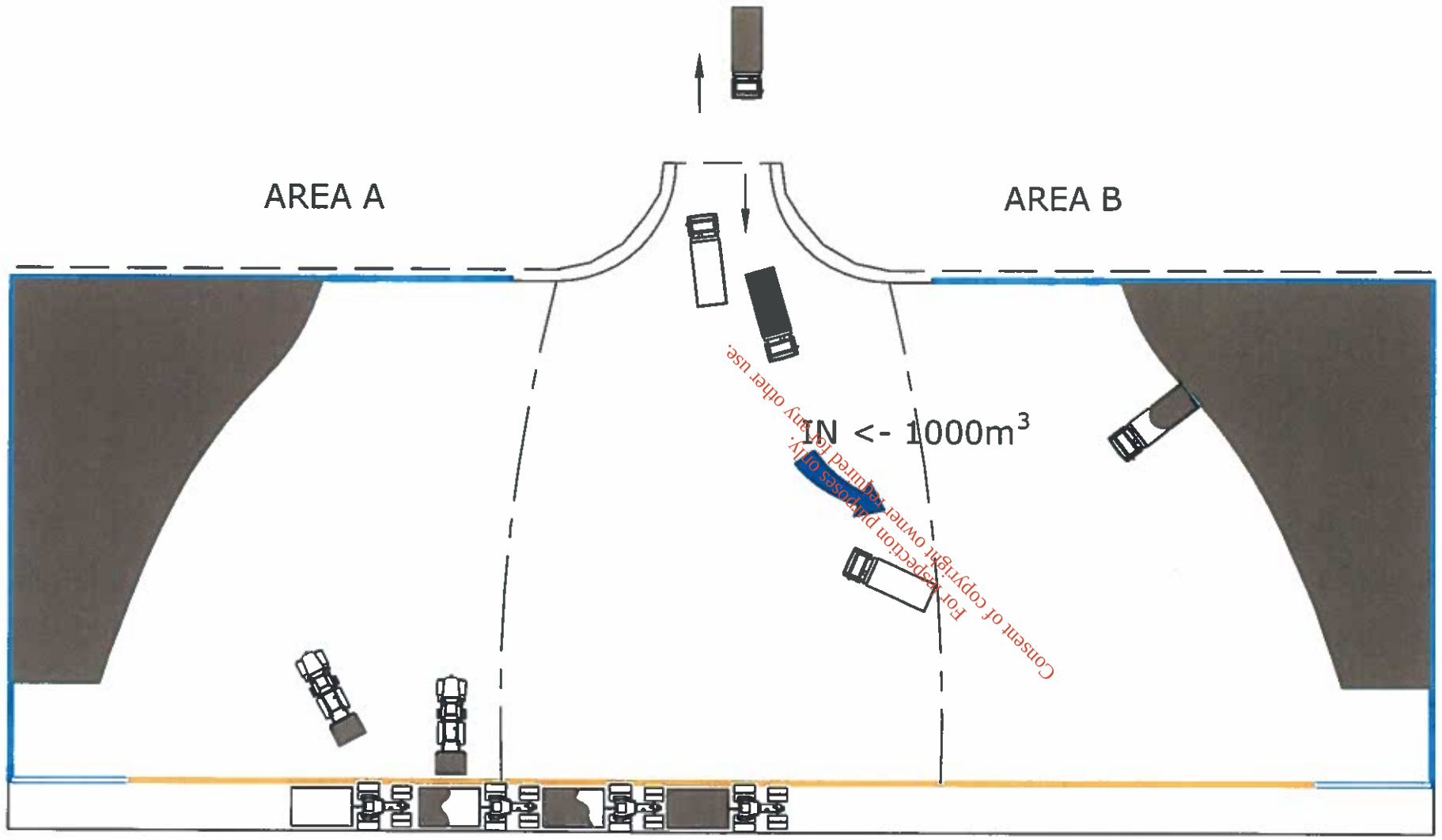

FIGURE 2.9 PERIOD 3 :- 13:00 - 16:00

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Operator: BORD NA MÓNA

Project: CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

Drawing Title: PERIOD 3 :- 14:00 - 17:00
FOR SRAHMORE PEAT DEPOSITION SITE

Scale: 1:300 @ A3

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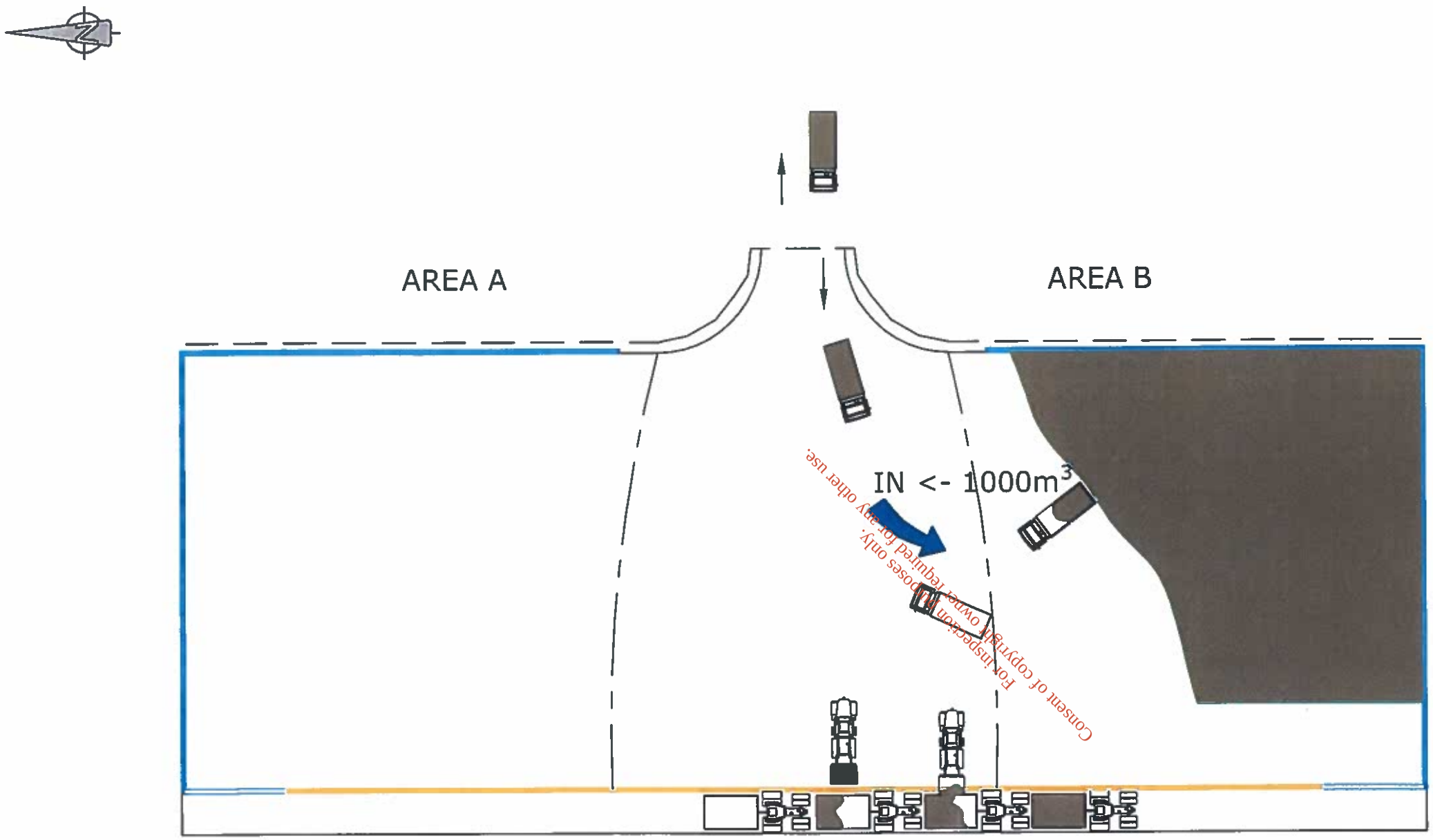

FIGURE 2.10 PERIOD 4 :- 16:00 - 19:00

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Applicant: Shell E&P Ireland Limited

BORD NA MÓNA

Project: CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

Drawing Title: PERIOD 4 :- 17:00 - 20:00
FOR SRAHMORE PEAT DEPOSITION SITE

Scale 1:500 @ A3

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Drawing No. FIGURE 2.10

Rev.

loaders, particularly at the start of the working day.

As shown in Figure 2.7, at any given time, four of the Haku trailers will typically be pulled up alongside the peat reception area on the extended concrete apron and will be loaded using the two front-end industrial loaders. The Haku trailers will carry an average of 5m³ of peat per load, while the front-end loaders have a capacity of 170m³ per hour.

The haul distance to the peat deposition area is dependent on the Phase into which deposition is taking place as outlined in Table 2.1 below. The Haku trailers will travel at an average speed of 15km/hr. A typical fill time per trailer is of the order of 2 minutes. The time to empty the trailers is taken to be 2 minutes, as they will empty while moving slowly along the high field.

The total cycle time to include for fill, travel to and back from the point of peat deposition and peat emptying is as given in Table 2.1. The total cycle time is given for a number of routes of varying distance depending on which bay is being filled.

As shown below, the minimum total cycle time per Haku trailer load is 11.52 minutes, while the maximum total cycle time per Haku trailer load is 17.47 minutes.

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Table 2.1: Peat Deposition Cycle Times for Haul Routes

Route	Distance (m)	Speed (km/hr)	Time (hr)	Filling Time (hr)	Deposition Time (hr)	Cycle Time (hr)	Cycle Time (min)
1	3378	15	0.225	0.033	0.033	0.291	17.47
2	3158	15	0.211	0.033	0.033	0.277	16.59
3	2948	15	0.197	0.033	0.033	0.263	15.75
4	2649	15	0.177	0.033	0.033	0.243	14.56
5	2130	15	0.142	0.033	0.033	0.208	12.48
6	1890	15	0.126	0.033	0.033	0.192	11.52

If 4,000m³ of material is imported to site each day by the road haulage vehicles, this is the volume that needs to be deposited each day by the Tractors/Haku Trailers.

⇨ 4,000m³ in 12 hrs => 4,000/12=333m³/hr.

Taking both the longest and shortest routes we can calculate the number of Haku trailers required.

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Route 1 (longest route)

Cycle time is 17.47 mins.

60/17.47= 3.43 cycles/hr.
3.53* 5 = 17.17m^3/hr./trailer
333/17.17 = 20 trailers

Route 6 (Shortest route)

Cycle time is 11.52 mins.

60/11.52 = 5.21cycles/hr.
4.6* 5 = 26.04 m^3/hr./trailer
333/26.04 = 13 trailers

Based on the above calculations between 13 and 20 No. Haku trailers will be required to haul the requisite 1,000m³ of material over any 3 hour period.

The above calculation is based on model conditions. Local onsite conditions may produce a variance in the number of Haku trailers. The handling capacity of the proposed industrial front-end loaders is 170m^3/hr. Therefore in order to handle 333m^3/hr. 2 No. loaders will be required.

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The peat handling operation for a typical 12-hour operational day divided into four No. 3 hour periods, as illustrated on Figures 2.7 – 2.10, is as follows:

07:00 – 10:00 (Period 1)

- All tractors and front-end loaders will be stored on Area A overnight with a stockpile of approximately 1,000m³ of peat held overnight on Area B.
- At 07:00 drivers and machine operators will have completed their daily visual check of plant and be ready to begin work.
- As shown on Figure 2.7, during Period 1 the 1,000m³ of peat stored overnight on Area B will be transferred from Area B to the peat deposition area.
- Simultaneously, during Period 1 the off-site trucks will haul 1,000m³ of peat into Area A.

10:00 – 13:00 (Period 2)

- As shown on Figure 2.8, during Period 2, 1,000m³ of peat will be transferred from the front end of Area A to the peat deposition area.
- Simultaneously, during Period 2 the off-site trucks will haul an additional 1,000m³ of peat into Area A.

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13:00 – 16:00 (Period 3)

- As shown on Figure 2.9, during Period 3, 1,000m³ of peat will be transferred from Area A to the peat deposition area.
- Simultaneously, during Period 3 the off-site trucks will haul 1,000m³ of peat into Area B.

16:00 – 19:00 (Period 4)

- As shown on Figure 2.10, during Period 4, 1,000m³ of peat will be transferred from Area B to the peat deposition area.
- During Period 4 the off-site trucks will haul an additional 1,000m³ of peat into Area B.
- At the end of this period, end of day, there will be 1,000 m³ of peat, which will remain overnight on Area B.

At the end of this period the tractors and front-end loaders will be parked in 'Area A' as referred to in Drawing No. 1169\01\212. At the end of each day of operation a fitter will check each item of plant and carry out any maintenance/repairs, which can be carried out on-site. As and when necessary plant will be brought off site for more extensive repairs/maintenance and replacement plant will be provided. At all times the full complement of plant and equipment will be available on the site.

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2.4.2 The Drainage System

In order to provide for the reception of the material in Area 5 and to spread the peat throughout Area 6, modification of the existing drainage system will be required.

At present there are two catchment areas involved (see Fig. 2.11).

Area 5 and part of Area 6 form part of Catchment 5, the surface water flow from which enters a series of settlement ponds (S5-5) before it enters the Munhin River.

The remainder of Area 6 is in Catchment 2, which at present goes through settlement pond treatment (S5-2) just north of the Bangor to Geesala road (L1206) after which the water enters the Owenmore River.

The final drainage scheme will be installed in order to eliminate any water build-up and remove excessive water from the site, particularly during periods of high rainfall. This drainage system will convey water to the Munhin River via two proposed new settlement ponds.

The settlement ponds will be constructed at the location shown on Drawing No. 1169\01\218 and as detailed on Drawing No. 1169\01\219.

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This new drainage system will ensure that surface water runoff from Areas 5 and 6 will be effectively treated before reaching the Munhin River and Owenmore River, to prevent excessive suspended sediment from entering the river.

A detailed description of the proposed drainage for the site is provided in Section 9 herein.

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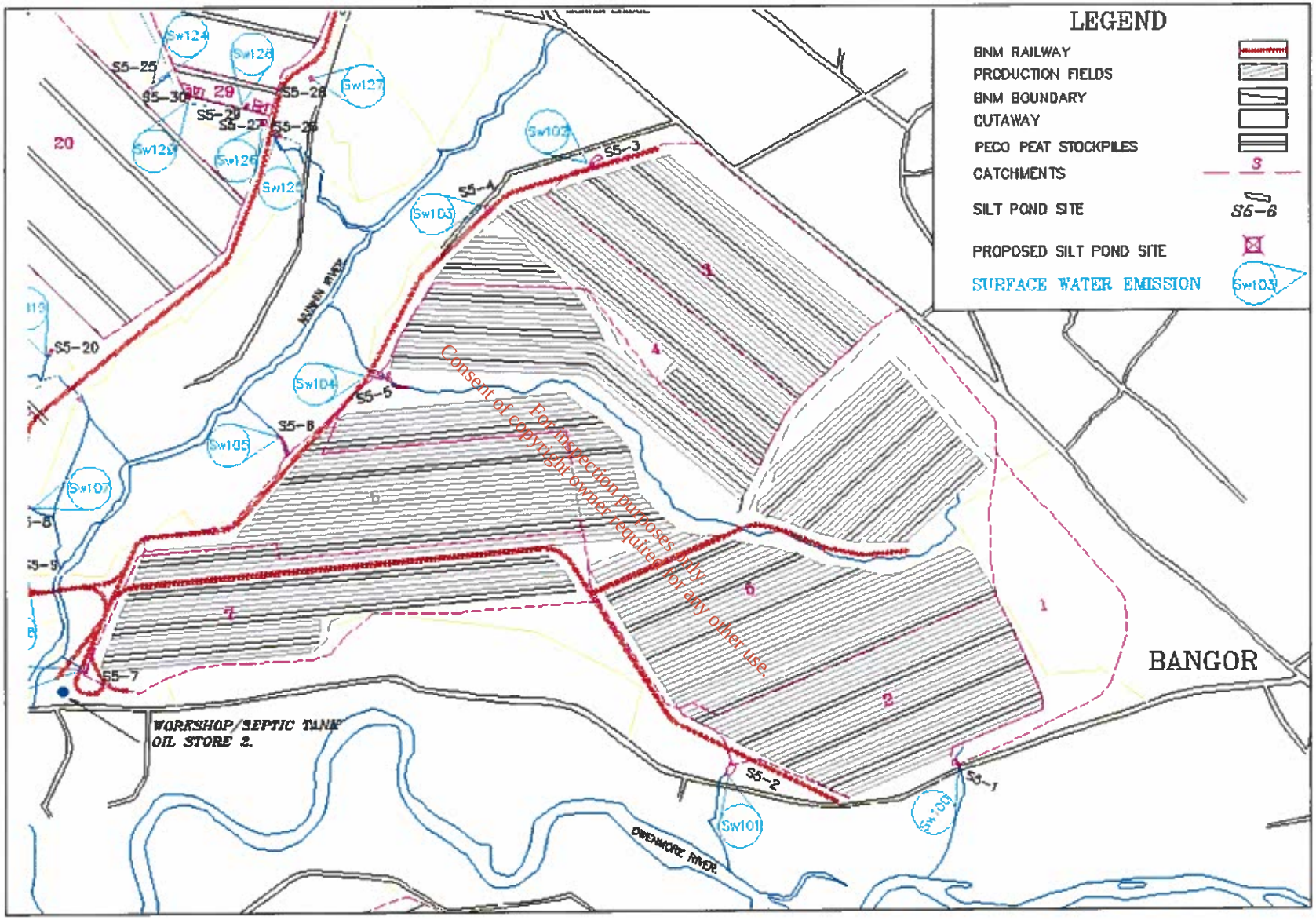

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Figure 2.11: Existing Drainage Layout

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2.5 Feasibility

As outlined above, in order to facilitate the handling of the peat, some pre-treatment will be necessary at the Bellanaboy site. This will involve re-opening the drain infrastructure, making it effective and extending the original drainage network to assist more complete drainage of the site. An initial 5,000m^3 of peat will then be removed from the gas terminal site in order to allow space for windrowing. This peat will however be extensively drained. It is then proposed to windrow the remaining peat prior to removal for deposition.

Given the pre-treatment, as described above, the removal, transportation, spreading and stabilisation of the peat on the Bord na Móna cutover peatland is feasible.

As outlined in Section 4.2, a number of methods of peat transfer were considered, including:

1. Direct transfer of peat onto the cutover peatland by road haulage vehicles.
2. Transfer from road haulage vehicles to low ground bearing pressure trailers for dispersal on the cutover peatland.
3. Transfer from road haulage vehicles to rail wagons for rail transport and dispersal on the cutover peatland.

Option 2 is considered the optimum peat transfer method as (a) it requires minimal disturbance within the site and (b) it will maximise the storage capacity of Area 6.

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2.6 Operational Plant Requirements

The following plant and equipment will be required in order to carry out the deposition of the 450,000m^3 of peat.

20 No. Haku trailers
20 No. Tractors
2 No. Front-end industrial loaders at peat reception area to load peat into Haku Trailers
11 No. Excavators for moving and shaping peat
7 No. Bulldozers for spreading and compacting peat

Spares will be available on-site to cover breakdowns as follows:
3 No. Haku trailers
3 No. Tractors
1 No. Front-end industrial loaders

Support plant will also be available on site as follows:

- 2 No. Fitters tractors
- 2 No. Tractors and service wagons
- 1 No. Tractor & Trailer (road repair)
- 1 No. Supervisor's motorbike

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- 1 No. Foreman's van
- 1 No. Foreman's tractor

2.7 Facilities Description

It is proposed to provide a site building at the site adjacent to the peat reception area as shown on Drawing No. 1169\01\213. The proposed site building will cater for up to 50 people and will include for the following:

- Reception
- 2 No. Offices
- Canteen
- Gents Wash Room
- Gents Locker Room
- Ladies Wash/Locker Room

The site building will be a prefabricated structure of portacabin nature and will be removed off-site following completion of the peat deposition at the site.

Details including plan, elevations and section of the proposed site building are shown on Drawing No. 1169\01\213

It is also proposed to provide 5 No. chemical toilets on-site as shown on Drawing No. 1169\01\212. These will be proprietary systems and will be emptied/maintained on a regular basis by an approved contractor.

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A proprietary wheelwash system will be installed at the egress from the peat reception area to eliminate the chance of material being deposited on the public roads.

The proposed weighbridge will provide for the logging of the quantity of peat brought onto the site.

It is intended not to use conventional static tank storage for fuel oil. The approach to be taken instead will entail mounting a double-skinned mobile tank on the chassis of a Haku trailer. This tank will be filled from a fuel supplier's tanker truck while standing on the bunded reception area. It will then be drawn by tractor to refuel the operating plant wherever convenient. The loading shovels will be refuelled at the reception area, on the drained hardstand area which will be oil-trapped. The remainder of the plant will be re-fuelled at continuously changing points within the peat deposition area.

As the capacity of this tank will be 5,000 litres and as the projected daily consumption is also 5,000 litres, it may be necessary to utilise two of these mobile tank units to ensure continuity of supply.

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A temporary bunded oil/lubricant storage facility will be provided on-site.

Some of the trucks employed to haul the peat from the Terminal Site at Bellanaboy Bridge to the deposition site reception area will also be refuelled at the reception area. This will be effected by using a fuel supplier's tanker-truck with the entire operation taking place on the drained and oil trapped hardstand area.

2.8 Programme

The time envisaged for actual peat deposition is approximately six months based on a 6 day week. This timeframe is however weather dependent and may be spread over two seasons.

The construction programme for the proposed facility is as outlined in Section 3, herein.

2.9 Decommissioning

The decommissioning strategy for the Srahmore site is as described here. The options for the decommissioning strategy are outlined below and will be reviewed after the 5-year stabilisation process. The options will be further discussed with various regulatory bodies and interested parties at that stage.

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Area 6

The following is the decommissioning plan for the elements of Area 6, which need to be decommissioned.

Element	Option	Decommissioning Date	Logic
Internal haul road network	Decommissioning would involve the removal of the roads and the reuse or disposal of the materials as outlined in 2.10.	This is envisaged to occur at the end of the stabilisation process, which is expected to be five years after the deposition is complete. These roads may not be decommissioned if they are required as part of the afteruse of the peat deposition area. This would have to be agreed with the EPA at the end of the stabilisation phase.	The internal road network will be required for access of plant during the stabilisation period.

The following is the decommissioning plan for the elements of Area 5, which need to be decommissioned.

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Area 5

Element	Option	Decommissioning Date	Logic
Entrance road from R313 and the link road to Area 6.	Decommissioning would involve the removal of the roads and the reuse or disposal of the materials as outlined in 2.10. The roadways would be covered with peat, which was stored in Area 5 during the construction period.	This is envisaged to occur at the end of the stabilisation process, which is expected to be five years after the deposition is complete.	The roads will be required for access of plant during the stabilisation period.
Peat reception area.	Decommissioning would involve the removal of the concrete structures and the reuse or disposal of the materials as outlined in 2.10. The area would be covered with peat, which was stored in Area 5 during the construction period.	This is envisaged to occur at the end of the stabilisation process, which is expected to be five years after the deposition is complete.	The peat reception area will be required for parking and fuelling of plant during the stabilisation period.
Temporary buildings, equipment and services.	This will involve removing these items off the site.	This is planned to occur at the end of the deposition process.	These items will not be required when the deposition process is complete.

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2.10 Decommissioning materials

The material which will be removed during decommissioning will go to one or other of the following in order of preference:

1. To be used as construction material at the proposed wind farm development at Bord na Móna's Oweninny site.
2. To be used as construction material at an alternative site
3. To be disposed of at an appropriate landfill site

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3 CONSTRUCTION

This section describes the construction works at the Srahmore site. The construction works at the terminal site is described in the Terminal Volume of this EIS.

The site at Srahmore, Bangor-Erris, Co. Mayo is to be developed for the purpose of accommodating the deposition of approximately 450,000m^3 of peat, which will be transported from the proposed Bellanaboy Bridge terminal site to the Srahmore site. The peat removal from Bellanaboy Bridge Terminal site is expected to take up to six months to complete. This timeframe is however weather dependent and may be spread over the seasons. This section has been compiled to provide details of the construction required to enable acceptance of peat at the site and internal works required for peat deposition.

3.1 Construction Strategy

The construction activities on the peat deposition site at Srahmore, Bangor-Erris, Co. Mayo comprise:

- Construction of entrance and access road to peat reception area
- Construction of site building/accommodation area
- Construction of peat reception area
- Construction of internal roads
- Construction of site drainage, including interceptor drains and settlement ponds

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There will also be various temporary activities carried out as part of the construction of the above such as the drainage of the accommodation/reception areas during construction to ensure the local watercourses are not adversely impacted.

3.2 Environmental Management Strategy

The Bord na Móna environmental management strategy for the Srahmore site is included in Section 19 herein.

3.3 Site set-up

The entrance to the site will be from the R313, via a new access road suitable for construction traffic. The entrance will be developed to be suitable for the turning of long trailer and multi axle vehicles, according to the National Road Authorities guidelines.

The access to the site will be directly opposite the junction between the R313 and the L1204 and will be controlled by Flagmen during construction and peat transport operations. Warning signs will be installed on the roadside to the east and west of the site entrance on the R313 and on the L1204.

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The access road to the peat reception area in Area 5 will use a geogrid reinforced road laid directly on top of the peat. The details of the site access road are shown on Drawing No. 1169\01\211.

A proprietary temporary wheelwash system will be installed at the egress from the peat reception area to eliminate the chance of material being deposited on the public roads.

3.3.1 Site operation

The purpose of developing this site is to put in place sufficient infrastructure to allow the successful deposition of approximately 450,000m^3 of peat at the site. Currently the site is a cutover peatland, with a number of "low fields" i.e. the worked areas separated by "high fields" which are approximately 14m wide strips. The site layout plan can be seen on Drawing No. 1169\01\205. It is proposed to import the peat from the Bellanaboy Bridge Terminal site to the peat reception area (Area 5) by means of road haulage vehicles, where the peat will be stockpiled and transferred to Haku trailers and subsequently transported to the peat deposition area (Area 6).

Roads will be constructed to facilitate the travel of the tractors and Haku trailers around the site. The roads will be constructed from imported material. The layout of the roads will be as outlined on Drawing No. 1169\01\209. The deposition area will be filled as detailed on the site phasing Drawing No. 1169\01\208.

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3.3.2 Materials

All construction materials will be imported into the site, which will be sourced from local quarries.

3.4 Construction Programme

The construction of the facilities at Srahmore will commence with a number of parallel activities. These activities are detailed below:

1. An access road will be constructed from the R313 to the peat reception area. This will start at the R313 and will progress to the peat reception area. A traffic management system will be in place at the site entrance for this activity. This will include signage and flagmen.
2. Peat will be excavated from the peat reception area and stored on site.
3. The settlement ponds in Areas 5 and 6 will be constructed. The peat, which is removed during this construction, will be spread over the adjacent peatlands.
4. The internal drainage system in Areas 5 and 6 will be constructed.

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When the peat reception area and adjoining hardstand area for site facilities are complete, the temporary buildings and facilities will be constructed and installed.

When the entrance road to the peat reception area is completed the following activities will commence in parallel:

1. The construction of the peat reception area will commence. This will include the peat transfer area and the adjacent facilities area including hardstanding for the site accommodation building, parking area etc.
2. The construction of the link road from the peat reception area to the peat deposition area (Area 6). This will include the construction of a bridge over the main drainage channel from the Srahmore site.

Temporary facilities-Area 5

Temporary facilities to be constructed in Area 5 will comprise chemical toilets, a portable wheelwash, portable weighbridge and a prefabricated accommodation building. Also a temporary grey water tank shall be on site for the collection of water from sinks, showers and wash hand basins. A number of skips will also be kept in the accommodation area for the collection of refuse, namely a skip for recyclables and a separate one for non-recyclables.

A temporary bunded oil/lubricant storage facility will also be provided at the site.

It is proposed that the chemical toilets, grey water tanks and waste skips shall be emptied as required by an appropriately permitted and licensed contractor. All of these facilities will be removed from the site when the peat deposition operation is complete.

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Construction in Area 6

When the link road to Area 6 is complete the construction of the internal road network within Area 6 will progress on a phased basis. The sequencing of the road construction will be such to allow deposition in Phase 1.

The peat deposition in Phase 1 will be in parallel with the construction of the internal roads surrounding Phases 2 and 3.

Drainage and Infrastructure

The major earthworks activities on the site shall consist of the works set out below;

Prior to the deposition of peat within Area 6 it is proposed to modify and augment the existing drainage network within Areas 5, 6 and 7. Details of the existing and proposed drainage infrastructure are provided in Section 9 herein. A brief summary of the proposed infrastructure is provided below.

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The actual peat deposition area comprises approximately 63ha. This area was utilised for industrial peat extraction up until September 2003. This has resulted in a topographic landform that comprises banks of peat, known as high fields (14m wide), with intermittent lower elevation, cutover production fields, known as low fields. The high fields are approximately 2m higher elevation than the low fields. The high field banks are separated by up to 10 low fields. The low field production areas are grouped and referred to as "bays". Therefore Area 6 is effectively divided into seven bays where it is proposed to deposit the peat.

Along the edge of the each peat deposition bay, running adjacent and in parallel to the high fields, surface water drains will be constructed to transport the surface water from the deposition area to a perimeter swale. The precipitation falling on the deposited peat will be dealt with by creating a fall from the centre of each peat deposition bay, i.e. the centre of each bay where the peat is deposited to the outside of the deposition area, i.e. the edge of the low fields. The precipitation falling on the peat deposition area will, by gravity, find its way into the adjacent swales and from there it will be gravity fed to the perimeter swale.

Within each bay, where peat will be deposited, the perimeter swale will be constructed, as shown on Drawing No. 1169\01\219. The purpose of constructing this perimeter swale is primarily to transmit any surface water runoff falling on the peat deposition area to the settlement ponds constructed in Area 6. The swale will also act as storage for surface water during periods of heavy rainfall.

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Existing settlement ponds S5-1 and S5-2 on the site shall take fixed volumes of water and the rest will be directly fed into the perimeter swale or diverted into the perimeter swale. At the end of the perimeter swale, at location 5 Drawing No. 1169\01\218, a 525mm pipe will be laid from the swale to an open drain leading to the settlement ponds. This arrangement restricts the volume flow rate to that which can be effectively treated by the two settlement ponds S1 and S2.

The settlement ponds at the peat deposition area will consist of two existing settlement ponds, namely S5-1 and S5-2, and two proposed settlement ponds to be constructed in the northwest corner of the peat deposition area, these are labelled S1 and S2 on Drawing No. 1169\01\218. The proposed settlement ponds will be constructed according to details shown on Drawing No. 1169\01\219, and will be of dimension 100m long x 8m wide x 1.5m deep.

The settlement ponds S1 and S2 will act in series so that any runoff will be effectively treated by both of the settlement ponds before it is allowed to reach the receiving waters.

A similar drainage design is proposed for the northern and southern portions of Area 5. Minimal works are proposed in Area 7 other than the construction of a channel connecting Area 6 to Area 7 for the controlled overflow.

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3.5 Fencing

Fencing and an entrance gate will be provided at the entrance along the R313 as detailed on Drawing No. 1169\01\211.

The fencing will consist of palisade fencing 2.4m high. A 2.4m high palisade type gate will also be provided at the site access.

3.6 Civil Works

The civil engineering works will comprise the following:

- Construction of entrance and access road to deposition area/reception area.
- Construction of accommodation area.
- Construction of peat reception area.
- Construction of site roads.
- Construction of site drainage, including interceptor drains and settlement ponds.

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3.6.1 Construction of entrance and access road to deposition area/reception area

An 8m wide access road will be constructed from the R313 to the peat reception area. The road will be constructed from gravel/rock imported to the site, and will be finished with blacktop. The road will be suitable for trafficking by heavy vehicles. A geometry will be provided for the entrance such that it is suitable to allow long vehicles access and exit the site freely. Typical cross sections through the access road are shown on Drawing No. 1169\01\210. The entrance arrangement is shown on Drawing No. 1169\01\211.

3.6.2 Construction of accommodation area

The accommodation area will consist of an office/canteen building, with accommodation for approximate 50-55 people who will be working on the site and a number of offices to accomadate site supervision staff. The accommodation building will also contain changing/shower/wash rooms for staff. The layout for the accommodation building is shown on Drawing No. 1169\01\213.

The accommodation area will also contain a toilet block, car parking and parking for 20 number haulage vehicles. The layout of the accommodation building area is shown on Drawing No. 1169\01\212.

3.6.3 Construction of peat reception area

The detailed layout of the peat reception area is shown on Drawing No. 1169\01\212. The reception area will consist of a 200mm thick fibre reinforced concrete slab. The slab will be of dimension 120 x 42m and will be bounded by a concrete wall of varying height, between

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1300-1500mm. The wall will return around the front to the slab for 30m at either end and over the other 60m at the front of the slab there will be a 300mm high slip form kerb.

The reception area will be fully bunded, and will be laid to falls such that any precipitation/surface water runoff is channelled toward a concrete open drain at the centre of the reception slab. This drain will outfall to a deep settlement tank adjacent to the peat reception area, to allow the larger particles to collect. This sump will be cleaned out on a regular basis via an access chamber. From here the runoff is piped to a grit trap and oil interceptor, and then outfalls to a surface water settlement pond.

3.6.4 Construction of site roads.

There will be approximately 7,000m of site roads constructed. These roads will facilitate the tractors and Haku trailers to traverse the site from the reception area to the peat deposition area.

The roads will be approximately 4m in width and will be constructed using approximately 300mm of gravel/crushed rock which will be sourced from local quarries. A detail of the haul road is shown on Drawing No. 1169\01\210.

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3.6.5 Construction of site drainage, including interceptor drains and settlement ponds

The site drainage will be constructed as shown on Drawing No. 1169\01\218. The drainage system is described in detail in Section 9 herein.

3.7 Buildings

The site buildings will consist of 1 no. prefabricated site accommodation building, as detailed in Drawing No. 1169\01\213, and is 108m^2 in floor area. The site accommodation building will contain:

- Reception
- 2 no. Offices
- Canteen
- Gents wash room
- Gents locker room
- Ladies wash/locker room

The site accommodation building will provide for administration of the operations and the welfare requirements for workers on site for the deposition period.

3.8 Equipment Installation

- A temporary weighbridge

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- A portable wheelwash

3.9 Traffic

The traffic associated with the construction of the proposed facility is detailed in Section 16 herein.

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4 ALTERNATIVES

4.1 Background

A planning application and accompanying EIS for the proposed Bellanaboy Bridge Gas Terminal was submitted to Mayo County Council in April 2001. Following appeal to An Bord Pleanala the development was refused planning permission due to concerns about potential peat stability. The original proposal had envisaged storing all peat excavated during construction activities on site within bunded areas. Following An Bord Pleanala's decision, the project was re-examined and alternatives as well as other options for peat management were considered.

4.2 Need for the Scheme

With gas consumption increasing annually and predicted to rise sharply in the future, demand for energy has outstripped Ireland's domestic production. The two small new gas fields on the South Coast, Seven Heads and Green Sands, which are expected to be on stream by late 2003, will not make up the short fall. Consequently, Ireland requires significant additional supplies of gas.

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From 2001 to 2003 Bord Gáis Éireann (BGE) undertook a major upgrade of the gas pipeline infrastructure, with the construction of a second pipeline connection between Scotland and Dublin, and a transmission pipeline from Dublin to Limerick via Galway. The new infrastructure allows more gas to be imported from the UK and continental Europe gas networks but it does not provide an alternative source of indigenous gas. A very significant proportion of Europe's gas comes from Algeria, Siberia and some of the former Soviet Republics in Central Asia. Ireland is at the very end of the gas supply line and is vulnerable to an interruption of supply anywhere along the line.

The development of Corrib will help to provide security of supply, as Corrib will be an independent source of gas. It will also stimulate expansion of the onshore transmission system to the north west of the country, which in turn will result in increased potential for growth in this region of Ireland, similar to that which occurred in the Cork region when the Kinsale Head gas field came on stream.

Ireland's recent high economic growth has driven the demand for power and energy. Gas is predicted to become a greater provider of energy in Ireland due to its reduced CO_2 emissions compared with other fossil fuels. This combined with the current liberalisation of the energy market will lead to increased gas consumption in Ireland. Infrastructure investments, of which the development of the Corrib field is a significant part, will cater for the predicted increased demand in gas, contributing to the long-term economic well being of Ireland.

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4.2.1 Energy Sources in Ireland

Ireland currently uses coal, oil, gas, peat, wind and hydro as sources of energy. As the demand for energy increases, it is expected that gas will have increasing importance in power generation because of the significantly greater efficiency of combined cycle gas turbine generators, the lowest CO_2 emissions per thermal unit of fossil fuels and the resulting relatively benign environmental impact of the emissions.

Substitution of other fossil fuels by natural gas in power generation has the potential to assist in achieving Ireland's targets for reduction of greenhouse gas emissions under the Kyoto protocol.

4.2.2 Need for the Terminal

The Corrib field is located in the Atlantic Ocean, some 65km off the west coast of Ireland. To supply consumers in Ireland the gas must be brought ashore from the offshore wells. The gas must be conditioned to meet BGE specifications before entering the national transmission system for subsequent use by domestic and industrial users. This conditioning can be carried out either offshore or onshore.

An onshore reception facility is required near the landfall regardless of whether the gas is processed offshore or onshore. However the size of the onshore terminal and activities to be undertaken in it will depend on where the gas is processed.

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4.3 Examination of Alternative Construction Methods

The ground works will be one of the principal elements of the construction project. It is estimated that up to 450,000m^3 of peat will be removed from the site in order to create a suitable platform for the terminal plant and equipment, at an elevation that will ensure that the existing forestry screens the site.

The main issues considered in order to determine the best solution for site preparation and the alternatives, including why they have been discounted or selected are discussed in this section. It also takes into account the grounds for refusal by An Bord Pleanála of permission for the previous scheme, which included the option to store the peat onsite.

4.3.1 Required Characteristics of Terminal Platform

The proposed terminal site is at a slight incline, of approximately one in forty, and is underlain by a layer of peat, of varying thickness, which in turn overlies mineral soil.

In considering the development of the site, Shell had the following options:

- build the terminal on the slight slope, or
- re-grade the site to create one or more flat terraces.

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A flat site is proposed for the following reasons:

- for ease of construction and maintenance access to areas of plant should be from level roads;
- hard standings to facilitate fire fighting around storage tanks should be at the same level as the tanks being served;
- ease of operations, maintenance and emergency access and egress, stairs and access routes should be simple;
- embankments (possibly with retaining walls) would have to be introduced in a split level site, thus increasing the area required; and
- equipment design, operation and maintenance would be more complicated if there were differences in relative elevations on a sloping or split level site.

In considering the foundations for terminal structures, and equipment, the options were:

- found the terminal on the peat and/or the mineral soils;
- treat the peat and/or the mineral soils in order to increase their strength; and
- found the terminal on bedrock.

It was concluded that minimal differential settlement would be essential because:

- for safety and operability, particularly for equipment operating under high pressure, piping and equipment require very tight tolerances on differential settlement;
- piperacks, piping and equipment design and installation would be very complex in a plant subject to differential settlement, as flexible connections would be required throughout; and
- excessive settlement would create operability difficulties for equipment such as turbines and compressors

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4.3.2 Foundation Options in Peat and Mineral Soil

In determining how a flat site, with minimal differential settlement could be achieved, consideration was given to the question: Can the peat and mineral soil be utilised to support foundations?

The geotechnical site investigation work concluded that the peat and the underlying mineral soils would have very low load bearing capacities and would give rise to excessive, variable and difficult to predict settlements, if subject to foundation loads. It was determined that it would not be feasible to achieve the necessary foundation criteria in the peat or the mineral soils, without improving their engineering properties.

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Of equal importance was the suitability of the peat as a platform from which to construct the terminal buildings and erect the terminal structures. It was concluded that the peat, without improving its engineering properties, would not provide a suitable surface, and would not be a stable platform from which to undertake construction works.

The engineering properties of the mineral soils vary. However, most of it has sufficient strength to provide suitable foundations for terminal structures and equipment, the mineral soil would also provide a stable construction platform, provided rainfall runoff was carefully controlled to avoid water collecting, as ponding would soften the mineral soil.

4.3.3 Peat Improvement Techniques

Various methods have been considered for improving the engineering properties of the peat and mineral soil, and the advantages and disadvantages associated with each.

Ground Improvement by either Vibro Stone Columns or Vibro Concrete Columns
This technique would require the placement of columns on a regular grid covering the complete area of the proposed works followed by a geogrid reinforced granular mattress. This would create a sound-working platform for the construction of the works.

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This method was discounted due to the need for in excess of 10,000 columns. The equipment to install the columns would also require stable working platforms, necessitating the import of additional fill because the peat would not provide a stable platform. The environmental impact would be significant in terms of traffic movements related to the import of concrete for the columns and the temporary and permanent fill materials. Furthermore this method would result in the terminal being built at a higher elevation creating a more significant visual impact.

Surcharging the Peat
This option was reviewed but not proposed due to uncertainties over predicting the stability of the peat during surcharging. If the peat and mineral soil were surcharged with sufficient load, for a sufficient duration, they would be consolidated and compacted. This would increase their strength and, by causing settlement to occur in advance, would result in reduced settlement when loaded by the terminal equipment and structures.

Surcharging of the peat and mineral soil would require a considerable thickness of fill to be laid on the peat. The thickness could then be reduced after design settlement had been achieved. This solution was discounted because the fill would have to be transported into the site generating significant vehicle movements. It would result in the terminal being built at a higher elevation creating a significant visual impact. The long-term settlement would be an issue over the life of the plant because, although the peat would have been compressed, its engineering characteristics would continue to be uncertain and hence lead to

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uncertainty in determining future differential settlement. The surcharge would have to be left in place for a significant length of time to maximise the strength gain and the consolidation of the peat. This would delay the overall schedule.

Treatment of the Peat

There are methods by which soft soils such as the mineral soil and peat can be treated. The addition of either lime or cement can greatly improve the strength properties. In recent years peat improvement techniques have proved successful for road and rail construction but have yet to be proven for foundation purposes, for buildings and equipment; they have been used primarily for, enabling works.

4.3.4 Foundations on Bedrock with Peat Retained

It was considered that the peat and/or mineral soils could not be improved sufficiently to provide an adequate founding medium for the terminal buildings and structures. Consideration was then given to the following techniques, which would allow the peat to remain in place, yet provide a stable construction platform, with foundations supported on piles on the bedrock.

Creation of Fully Piled Concrete Raft

A piled concrete raft would be constructed on top of the peat over the terminal footprint area, on which to support the equipment, structures and/or buildings. The raft would offer the advantage that it would act as a single foundation for all the works both temporary and permanent. However, it would require a significant volume of imported fill to create a level platform. Furthermore, the raft itself would be a major construction project. It would require a considerable number of piles and a considerable volume of reinforced concrete. The import of this fill and ready mixed concrete would generate significant environmental impacts related to vehicle movements. There would also be schedule implications, as the raft would have to be constructed before the main terminal works could commence. This option would also result in a much higher terminal elevation creating a significant visual impact.

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Addition of a Graded Fill Blanket

The principle of this alternative is to leave the peat in place and to introduce a complete blanket coverage of a graded rock fill over the entire area of the site. The rock fill blanket would provide a construction platform. The main structures and equipment would be supported on piles on the bedrock, through the rock blanket. Site roads and hard standings would be support on the rock fill blanket. This option would require an enormous volume of rock fill, which would be difficult to source locally and would have major traffic implications.

Settlement of the peat would generate maintenance issues during the life of the terminal because the un-piled areas would consolidate over time. This alternative would also result

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in a much higher terminal elevation creating a significant visual impact.

As all of the techniques for improving the strength characteristics of the peat and retaining the peat on site had considerable disadvantages, the assessment then considered firstly partial and then total removal of the peat.

4.3.5 Partial Peat Removal

In this option the peat and mineral soils would be removed from the parts of terminal footprint in which the main structures and equipment would be located. The main issues arising from this option can be summarised as follows.

A significant volume of imported fill would still be required to provide a construction blanket and pile head restraint. A significant volume of peat would have to be removed which would also require the initial construction of temporary haul roads. This option would result in the terminal being built at a higher elevation, causing greater visibility and therefore a more significant visual impact. The import of fill would also generate a significant amount of vehicle movements. Settlement of the remaining peat would generate maintenance issues during the life of the terminal because all the unpiled areas would consolidate over time. Measures to minimise the effects of settlement on underground drainage systems would also have to be implemented.

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4.3.6 Total Peat Removal

Total peat removal was considered. The plan would involve the excavation of the peat and underlying soil and rock to create a level platform. This would ensure a stable working platform for the construction of the terminal and eliminate the maintenance and operability problems associated with differential settlement. The terminal elevation could be chosen to ensure that the visual impact was minimised.

However, very large quantities of peat and some mineral soils would be generated for which a use or disposal site would be required.

It was concluded that if an environmentally appropriate reuse or disposal option could be identified for the excess peat and mineral soils, total peat removal would present the best practical option for the terminal, both for its construction and operation.

4.3.7 Peat and Mineral Soil Re-use

The reuse of the peat and mineral soil was considered. The excavated peat would not be suitable as an engineering fill material. It cannot be laid down and compacted to meet engineering criteria. The characteristics of the mineral soils are quite variable. Some of this material would be reusable as fill but not all of it.

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4.3.8 Alternative Uses of Peat

Investigations were undertaken to identify and assess alternative means of utilising the excavated peat. These are described below:

Fuel in Power Stations

The use of the excavated peat as a fuel in power stations has been investigated in discussions with Bord na Móna. It was determined that the peat would be too wet to be used directly as fuel and a complex and time consuming procedure of drying the large volumes would be required. In addition, there would be the issue of haulage from the site to the power stations (it is understood that the local peat burning power station at Bellacorick will cease operation by the end of 2004). These issues determined that it would not be feasible to use the peat as a fuel.

Gardens / Horticulture

The type of peat used for horticultural purposes is termed Younger Sphagnum Moss Peat. The peat present on the terminal site is Blanket Bog Peat, which has been humified too much and its structure broken down. It is therefore not suitable as a horticultural material.

There is the possibility that the peat could be used to improve soil texture in agricultural land. However, the very large quantities of peat to be excavated make this alternative impracticable due to the infinite variety of potential locations and the uncertainty over the timescales in which the peat could be removed.

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Fuel for Domestic Use

Market demand was deemed too small relative to the quantities of peat involved. Use as domestic fuel would also entail a lengthy process of drying, as well as the difficulty of distributing the peat as discussed above.

4.3.9 Peat Storage Proposal

Since any offsite reuse or disposal option would involve significant traffic movements and consequent impact, on-site peat storage was investigated.

A method was identified to store this peat on a site adjacent to the terminal in an engineered repository. This solution had the advantage of a short haul distance within the construction site, thus avoiding the use of public roads. It also offered the possibility of utilising the storage area for future planting or forestry. To avoid importing substantial quantities of fill, and thereby minimise the traffic impacts, the repository would have been founded on the in-situ peat.

A planning application was made to Mayo County Council incorporating the peat

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repository. While Mayo County Council granted permission, the repository did not receive approval from An Bord Pleanála, which had concerns over the drainage and the long-term stability of the stored peat.

Offsite Removal

Transportation of the peat offsite by various means was considered depending upon the location of the deposition site or end use. Export of the peat away from the area by barge was considered but discounted for the following reasons;

- the Sruwaddacon Estuary would have to be crossed. This would increase the time and costs for installing the pipeline;
- an obvious choice may be to use the outfall pipeline but this would not be in place before the peat would have to be removed;
- building a new pipeline in a short timeframe may not be possible;
- there is no adequate mooring point for a barge, therefore barges would have to be moored more than 2km offshore from Glengad and a pipeline laid out to the barge;
- the distance to pump would be almost the same as to Srahmore area, 9km pipeline length and 1-2km offshore;
- this would be a large volume for any barge system to collect and then deposit in another place.
- Acquistion of the way leaves would potentially impact project schedule.

Dumping of peat at sea would not be acceptable to Shell for environmental and reputation reasons.

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4.3.10 Current Proposal – Peat Removal

Following the An Bord Pleanála refusal, all options were reviewed, including the alternatives for retaining the peat in situ and treating it, which had been investigated prior to the original planning application.

The review determined that total peat removal was still the preferred method of developing the terminal site.

Given that the option to retain the peat in a repository on site was rejected by An Bord Pleanála, it was necessary to consider the potential for depositing the peat on a site that had been previously excavated.

A number of sites were considered and the methods whereby the peat would be removed and subsequently deposited were also assessed.

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4.3.11 Peat removal options and sites considered

An assessment was made of deposition locations, which would satisfy the Planning Authorities. On the basis of the assessment the favoured site is a Bord na Móna cutover peatland, at Srahmore, to the west of Bangor Erris.

This site, approximately 11km away from the proposed terminal site, is one from which peat has been harvested for a local power station. The peat from the terminal could be deposited at this site, which is saucer shaped with an extensive drainage infrastructure that was installed for industrial peat extraction.

Having identified a deposition location, consideration was given to the method of transporting the peat from the terminal site.

4.3.12 Assessment of Transport Methods

A number of possible peat transport methods were considered by Shell and its consultants, including experienced earthworks contractors. The methods are summarised below:

4.3.13 Alternative Peat Transport Options

The possibility of transporting the peat by rail was considered. Issues which were identified included:

Transport the Peat by Rail

- installing a temporary rail link would take a considerable amount of time given the many stream and small river crossings required. It would be a major construction project in itself;
- wayleave agreements with landholders would be required;
- there would be severance of farms;
- train drivers may require special licences as there would be several roads, including 2 regional roads to cross as well as many private driveways;
- loading and unloading facilities would be considerably more complicated for trains than for trucks or for a pipeline;
- there would be no residual benefit to the community of either a train system which would have to be removed after use;

Pump the Peat

Pumping the peat in a pipeline to Srahmore was considered.

Following are some characteristics and problems associated with pumping, in general:

- two types of pumping are possible, either as a paste with 0-1 times water added or as a more liquid waste with 5-6 times water added. As liquid waste, the volume would

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be 6-10 times as large as a paste (2-4 million cubic metres);
- it is possible to pump the peat;
- this quantity, distance and timeframe has never been done before;
- to progress the proposal some investigation and sampling of the peat would be required to determine rheology and settlement patterns;
- to ensure a reliable, working system, extensive testing and trials would be required. There are also potential environmental problems with the risk of run-off of the liquid waste into rivers.
- pumping paste would require a much higher pressure than pumping as a liquid and therefore would require a steel pipe;
- pumping paste may require intervention during operation to clean the system or provide additional pumping. This may pose a serious risk for a pipeline crossing watercourses.
- pumping liquid waste would require large amounts of water for mixing; and
- wayleave agreements may also be required for a temporary pipeline but it might be possible to lay the pipeline along the road with minimum disruption.

Pumping to Srahmore raised a number of issues:
- a temporary pipeline should be buried alongside road to avoid disruption to road users;
- Bord na Móna would not consider accepting liquid peat on their site.
- there is uncertainty about the characteristics of the peat in 5 or 10 years time, i.e. it is not clear whether or not the peat would revegetate and stabilise.

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During consideration of these factors it was concluded that there were constraints on the pumping option based upon:
- uncertainty about pumping a paste type substance over 10km distance (several intermediate pumps may be required, additional water injection, etc.);
- the handling difficulties to be dealt with at the deposition location if the peat is pumped in liquid waste form (containment, bunds, drainage, etc.);
- the pipeline difficulties to be resolved including temporary wayleaves;
- the extensive testing regime, which would be required to prove the feasibility of pumping and the time required to undertake this (characteristics of the peat, preliminary pump trials, more extensive scale trials, etc.); and
- environmental risks to watercourses caused by the disaggregated nature of pumped peat. .

It was therefore decided on environmental and logistical grounds that further study of this option would not be beneficial.

Peat Transport by Truck

The use of trucks travelling on the public roads to transport the peat would be simple, practical and a proven method. The roads are already there. There would be no new

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severance and new wayleaves would not be required. The transport operation would be expected to take up to six months. It would be necessary to upgrade the roads between the terminal site and Srahmore and to take other measures to minimise disruption to other road users. The upgraded road network would be a residual benefit to the local community.

Having considered alternative peat transport methods, it was decided that the peat would be transported by truck on the public road.

4.3.14 Modification to Total Peat Removal Option

Following the decision to remove the peat from the site and to transport it using the public road network, construction methods were reviewed in order to reduce, to the practical minimum, the quantity of peat which would have to be removed from the terminal footprint.

Thus a combination of different techniques is proposed to create stable construction platforms. In the process area of the terminal footprint the peat will be removed. The peat will be left in place in the access roads and the temporary construction facilities. Peat stabilisation will be used in these areas to increase the strength of the peat, in order to create a working platform. In the administration building area a piled concrete raft will be constructed on top of the peat, the piles transferring the load to mineral soil

4.4 Deposition of peat on the Bangor peatland

Following a meeting between Shell E&P Ireland Ltd (Shell) and Bord na Móna, a feasibility study was commissioned into the concept of transporting the excavated peat from the Bellanaboy Bridge Terminal and depositing it on Bord na Móna cutover peatland at Srahmore west of Bangor Erris.

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This site, approximately 11km away from the proposed terminal site, is one where peat has been harvested for a local power station.

4.4.1 Peat deposition on Bord na Móna's lands

In a preliminary study, Areas 1 to 8 of the Bangor Group of peatlands (Drawing No. 1169\01\203) were evaluated, using a number of criteria:

- Environmental issues. Any potential sediment laden run off from the peat following the deposition must be contained and channelled through appropriately designed sedimentation ponds before it is allowed to enter the Munhin or Owenmore rivers. Therefore;
  - The proximity of the chosen site to these rivers is critical, as it would be unacceptable to have run-off reaching them untreated.
  - The drainage layout of each area – the catchments and the path of the run-off – determines the potential for manipulation of drainage and insertion of sedimentation ponds.

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- The contours of the site are also critical as significant slopes can encourage peat erosion, especially in periods of heavy rainfall.

- The location of the site was considered from three aspects:
  - Its proximity to the terminal site determines the round trip time.
  - Accessibility from either the R313 (Bangor-Belmullet) or the L1206 (Bangor-Geesala) public roads: the distance from the road and the terrain between the road and the reception area determine the preparation required for the road haulage vehicles to gain access.
  - The greater distance that the site is from the R313-L1204 junction, the longer the round trip time and greater the disruption to local residents. Any option which requires road haulage vehicles to go through Bangor village is undesirable.

- The total area available is also a major consideration. A minimum of 63 hectares is required to spread the estimated 450,000m^3 while keeping the height of the deposited peat below that of the high fields and therefore safely contained.

- In order to spread the peat a series of roadways will need to be constructed across the chosen deposition site. The existing depth of peat in the deposition site will determine the design of these roadways.

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4.4.2 Site Selection

Areas 1, 6, 7 & 8 were evaluated in detail. Other areas within the Bangor site were eliminated immediately where the size, proximity to Bellanaboy and/or contours were obviously unacceptable.

In order to assist in the selection of the most suitable site a scoring matrix was drawn up. The criteria above were given weights to reflect their significance and each site was scored accordingly. A summary of the scoring can be seen in Table 4.1.

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Table 4.1. Site Selection Matrix

Criteria		Weighting	Peatland Area			
0= Most Unsuitable			1	6	7	8
10= Most Suitable		(0-10)	(0-10)	(0-10)	(0-10)	(0-10)
Control of run-off	Proximity to River	9	3	7	3	5
	Drainage Potential	6	5	8	8	4
	Bog Contours	10	4	9	6	3
Site Location	Proximity to Terminal Site	8	4	10	6	5
	Site Accessibility	7	5	7	6	6
	Traffic impact on Bangor	8	3	10	3	3
Area Available		5	8	8	8	7
Peat Depth		4	6	3	6	7
TOTAL SCORE			252	462	313	268

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Area 6 was identified as the most suitable site for spreading the peat overburden from Bellanaboy. Area 5 was identified as an area which would be suitable for locating a delivery /transfer facility with road access from the R313 if required.

Area 7, immediately to the west of Area 6, was identified as an area that could also receive peat overburden if additional capacity were required. However it was not deemed necessary to utilize Area 7 for receiving peat overburden. A section of Area 7 is to be used as a controlled overflow area should an extreme rain event occur.

4.5 Peat Spreading Method

4.5.1 Feasibility

In order to facilitate the handling of the peat, some pre-treatment will be necessary at the Bellanaboy Bridge site. This will involve re-opening the drain infrastructure, making it effective and possibly extending the original drainage network to assist more complete

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drainage of the site. It is then proposed to windrow the peat to facilitate shedding of free water and reduction of water content. This will make the peat more suitable for transfer by road haulage vehicles to the site in Bangor.

With the required pre-treatment, Bord na Móna is confident that the removal, transportation, spreading and stabilisation of the peat on a Bord na Móna cutover peatland is feasible.

4.5.2 Methods of Peat Transfer Considered

Two methods of peat transfer were considered:

1. Direct transfer of peat onto the peatland by road haulage vehicles.
2. Transfer from road haulage vehicles to low ground bearing pressure trailers or rail for dispersal on the peatland.

4.5.2.1 Direct Transfer

This option was initially considered and involves the direct transfer of peat onto the peatland using the road haulage vehicles that transported the material from Bellanaboy Bridge. These would travel on an internal road network (to include unloading areas), which would have to be constructed.

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This method has the advantage that there is no requirement for secondary transport equipment as the road trucks travel into the peat spreading area. However, this option would involve the excavation of approximately 200,000 m^3 of existing peat to enable the required roads be constructed and would also involve the construction of approximately 7 km of internal roads.

This option is deemed inappropriate in that it involves the removal of a significant amount of the existing peat. This would (a) alter the physical character of the site and (b) prove to be a less environmentally sustainable activity.

4.5.2.2 Transfer via reception area.

This option involves the transport of the peat overburden by road trucks to a reception/transfer facility, which will be constructed in Area 5. Area 5 was eliminated from consideration as a deposition site as undulating contours make it unsuitable for peat spreading. However, the site is adjacent to the Bellanaboy-Bangor road and would therefore be suitable for use as an off-loading facility. This facility will be accessed from the junction of R313 and L1204 public roads. At this location the road trucks will unload the peat onto a concrete hardstand. The peat would then be loaded into either low ground bearing pressure trailers (Haku trailers) or on to rail wagons. These would transport the peat to Area 6 via roadways/railways, which would be constructed on the existing peat

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4.5.3 Peat Transport Methods within the site.

Field tests were carried out by Bord na Móna to determine which transport options could be used to transport peat delivered to the proposed Peat Deposition site from the Peat Reception area at Bangor, Co Mayo. These field tests were carried out at Bord na Móna's facilities in Ballydermot during October 2003.

Three transportation methods were tested.

1. Rail transport using gravel wagons.

These are open top metal skips which are mounted on rail bogies. They have been used in the past by Bord na Móna to transport gravel onto peatlands for use as a foundation material for railway lines. These wagons are emptied by manually tilting the metal skips to one side.

2. Rail transport using ash saddleback wagons.

These are open top metal rail wagons, which are mounted on rail bogies. They are currently being used by Bord na Móna to transport milled peat and peat ash. These wagons have two doors at each side which, when opened, allow the material being carried within the wagon to exit using gravity.

3. Temporary road transport using milled peat Haku trailers (see Figure 2.1).

The tests involved excavating raw peat from the edge of a production peatland near the Ballydermot workshop and loading into each of the three transport methods being tested. From visual inspection the raw peat was similar to that viewed in inspection pits at the Bellanaboy site. Each transport method then carried the material to the Ballydermot Workshop site (an approximate distance of 1 kilometre). At this location each transport method attempted to empty their respective raw peat load onto the concrete yard.

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The results of the tests were as follows:

1. Rail transport using gravel wagons.

The material was successfully unloaded from the gravel wagons. However, the wagons were unstable during unloading and some of the peat material was deposited on the rails, which caused the wagons to derail easily. This tendency coupled with the fact that each wagon only held 1 m^3 of material means that this type of wagon would not be suitable.

2. Rail transport using ash saddleback wagons.

In this instance the material emptied from the wagons when the side doors were opened. However, all the material in the wagons did not empty out until the wagons were moved by the locomotive. When this occurred the peat was still in contact with the bottom of the wagons which impeded further wagon movement. The result of this was that the locomotive had great difficulty in moving the train, which only consisted of three wagons. As the transport plan would require that trains with 12 wagons be used, it was evident from the test

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that this method would not work.

3. Temporary road transport using milled peat Haku trailers.

When the trailer was tipped all the peat material emptied from the trailer onto the concrete yard. After unloading, the nearest peat material was approximately 0.5 metres from the tracks of the trailer and because of this the unloaded material did not impede the trailer in any way. It was concluded from this test that this was the most suitable method for the transport and deposition of peat onto Area 6.

Conclusions from Field Tests

1. Both of the rail options, which were field-tested, proved to be unsuitable for the application.

2. The transport option, which uses milled peat Haku trailers, is suitable for the Srahmore Peat Deposition operation.

It is envisaged that a fleet of approximately 20 Haku trailers will be required to transport the 4,000 m^3 of peat which is expected to arrive daily.

This is the optimum peat transfer and deposition method as (a) it requires minimal disturbance within the site and (b) it will maximise the storage capacity of Area 6. This is also borne out by Bord na Móna's experience in transporting raw peat.

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5 HUMAN BEINGS

5.1 Introduction

Tom Phillips + Associates have prepared this section of the EIS. The section discusses the key issues affecting human beings, and the potential impacts of the proposed peat repository on them. The issues discussed include population, language and culture, employment and economic climate, tourism and health and safety.

5.2 Study Methodology

An integral part of the assessment on human beings involved quantitative, qualitative and documentary research. The quantitative research involved the review of population trends at national, county and local level, by examining information contained in the Census of Population 1986–2002, and the Small Area Population Statistics, 1986-2002, obtained from the Central Statistics Office.

The Qualitative research was informed through discussions with local representatives from Bord na Móna.

Government, local and County publications were consulted. These include the *Border, Midlands and Western Region Development Strategy, 2000-2006* prepared for the regional authorities in 1999 and the *Mayo - Sustainable Tourism in the Coastal Zone* published by An Taisce and Mayo County Council.

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5.3 Receiving Environment

5.3.1 Population

While Ireland as a whole has recently experienced significant economic growth, this has not had as great an impact on the West of the country. Generally, County Mayo and the west of Ireland is characterised as a rural area with a weak urban base and poor infrastructure relative to the rest of the State. The area has suffered from continual economic decline stretching back to the early 1800's.

The 1991-1996 period was the first period of growth in County Mayo since the beginning of census records and halted a decline that has seen the population of the County fall to 111,524 in 1996 from almost 390,000 in 1841 and almost 200,000 in 1901. In more recent times, the population of County Mayo has increased by 0.7% between 1991 and 1996 and by 5.3% between 1996 and 2002. However, most of the rural areas, particularly in Mayo, are continuing to decline with the urban centres accounting for recent population growth.

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As shown in Table 5.1, the populations at National and county level decreased between 1986 and 1991, but subsequently increased between 1991 and 2002. Over the same period, the population of the Belmullet Rural District has continually decreased, with the decline becoming more marked in recent years. At the local level, the proposed site is located within the District Electoral Division of Goolamore. However, given that the Srahmore bog is immediately adjacent to the boundary of the Bangor DED, the analysis of population in relation to the local community includes both the Goolamore and Bangor DEDs (hereafter referred to as the 'Srahmore Area'). The Srahmore area experienced a population decrease between 1986 and 1991, followed by a slight population growth in the 1991-1996 period. However, the most recent Census has again shown a decrease in the local population, falling by 4.1% between 1996 and 2002.

In 2002, the local population of the Srahmore Area represented almost 8% of the population of the greater Belmullet rural district, and 0.5% of the population of County Mayo.

The village of Bangor Erris (population 266 no. persons in 2002 Census) is situated approximately 1.5km east of the proposed peat deposition area (Area 6 of the Srahmore bog complex).

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There are approximately 40 residences located immediately north of the Srahmore site, distributed linearly along the R313 and the county road heading north along the eastern shores of the Carrowmore lake. South of the proposed site, there are approximately 30 dwellings located along a county road, along with a number of agricultural buildings and several derelict houses. The majority of these dwellings are located to the south of the Owenmore River. There are no dwellings located immediately west of the site, between the bog complex and the Munhin River.

This population density would be typical for rural areas in the Erris region outside the main settlements. As a consequence of existing and likely proposed planning policies restricting rural housing, it is not expected that this number will increase significantly in the medium to long term.

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Table 5.1 Population Change 1986 – 2002 (CSO)

Year ▶	Population				% Population Change		
Area ▼	**1986**	**1991**	**1996**	**2002**	**1986-1991**	**1991-1996**	**1996-2002**
Ireland	3,540,643	3,525,719	3,626,087	3,917,203	-0.4	2.8	8.0
County Mayo	115,184	110,713	111,524	117,446	-3.9	0.7	5.3
Belmullet Rural District	9,160	8,467	8,339	7,927	-7.6	-1.5	-5.1
Goolamore & Bangor (i.e. the Srahmore Area)	665	653	658	631	-1.8	0.8	-4.1

(Source: Census of Population, 1986-2002)

5.3.2 Household Numbers & Size

Census of Population trends indicates that the average household size in Ireland experiences a gradual decline over time. Between 1986 and 2002, the national average household size fell from 3.53 to 2.94 persons per household. The Economic and Social Research Institute (ESRI) estimate that by the year 2011, the average household will be in the region of 1.98 persons.

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The average household size for the State in 2002 was 2.94 persons, with a slightly lower figure of 2.87 persons per household in County Mayo. As shown in Table 5.2, the average household size in the Srahmore area has steadily decreased from 3.75 to 3.16 between 1986 and 2002. This is in accordance with trends at national and county level.

Table 5.2 Household Numbers & Size

Households	1986		1991		1996		2002	
	No.	**Avg. Size (persons)**	**No.**	**Avg. Size (persons)**	**No.**	**Avg. Size (persons)**	**No.**	**Avg. Size (persons)**
Goolamore	57	3.91	51	3.73	55	3.53	54	3.09
Bangor	123	3.59	129	3.59	134	3.46	141	3.24
Srahmore Area Total	**180**	**3.75**	**180**	**3.66**	**189**	**3.50**	**195**	**3.16**

(Source: Small Area Population Statistics, 1986-2002)

The number of households in the Srahmore area remained steady at 180 no. between 1986

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and 1991, rising by 5% in 1996 and by a further 3.2% in 2002. (See Table 5.2.) The vast majority of these households are situated in the Bangor DED i.e. the rural area surrounding the village of Bangor Erris.

5.3.3 Age Profile

The age profile of the State, County Mayo and the Srahmore Area, according to the 2002 Census is given in Table 5.3. Two principle factors are examined in this analysis of age profile of the population of the receiving environment; the dependent population (persons aged 14 and under, and persons aged 65+) and the percentage of the population within the working age group i.e. the 15-64 age cohorts.

Table 5.3 Age Profile of the State, County Mayo & the Srahmore area, 2002 (%)

Area ▶ Age Groups ▼	State	County Mayo	Belmullet Rural District	Srahmore Area
Less than 15	21.1%	21.5%	22.1%	25.2%
15-24	16.4%	14.2%	14.2%	15.4%
25-44	30.1%	26.4%	23.4%	25.0%
45-64	21.3%	23.2%	23.5%	20.9%
65+	11.1%	14.7%	16.8%	13.5%
Total	100%	100%	100%	100%
Dependency Ratio	32.2%	36.2%	38.9%	38.7%

(Source: Census of Population, 2002)

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Dependent Age Cohorts (0-14 and 65+)

In the Srahmore area in 2002, 25.2% of the local population were in the 0-14 age cohort; a higher proportion than the State (21.1%), county (21.5%) and Belmullet Rural District (22.1%) . In the 65+ age categories, 13.5% of the Srahmore Area population are contained in this cohort in 2002; higher than the State (11.1%), but lower than both County Mayo (14.7%) and the Belmullet Rural District (16.8%).

As seen in Table 5.3, the Srahmore area has a dependency ratio of 38.7%. This rate is higher than the comparable rates for County Mayo (36.2%) and the State (32.2%), but marginally lower than the dependency ratio in the Belmullet Rural District (38.9%). This elevated dependency ratio at the local level is mainly attributable to the fact that the Srahmore area has a larger proportion of young people aged 0-14 years, than the county and the State.

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Working Age Cohorts (15-64)

As shown in Table 5.3, the total proportion of the State population in the working age categories (15-64) in 2002 was 67.8%. This figure is higher than the comparable proportion for County Mayo (63.8%), and notably higher than the proportions for the Belmullet Rural District (61.1%) and the Srahmore area (61.3%).

The population of 15-24 year olds in the Srahmore area (15.4%) is slightly lower than the comparable proportion in the State (16.4%). This statistic does not support the findings of the Border, Midlands and Western Region Development Strategy 2000-2006 which notes that this region as a whole 'suffers from a major "braindrain"', with school leavers leaving the area to study in third level institutions and not returning. This proportion of 15-24 year olds recorded in the Srahmore Area in the 2002 Census indicates that young school leavers are remaining in the local area, and perhaps taking up employment locally and / or commuting to work in the nearby urban centres e.g. Belmullet.

5.3.4 Social Class Structure

As shown in Table 5.4, proportionally, social classes 3 and 4 (non-manual and skilled manual workers) are the best represented in the Srahmore area, with almost 40% of the population aged 15 and over classified in these two social groups, in 2002. This trend is representative of the situation occurring at State and county level, where approximately 34% and 35% of the respective populations fall into social classes 3 and 4.

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Table 5.4 Percentage Distribution By Social Class, 2002

Categories ▶ / Area ▼	1 and 2	3 and 4	5 and 6	7	Total
State	31.6%	33.7%	16.5%	18.2%	100%
County Mayo	26.7%	35.4%	20.2%	17.7%	100%
Srahmore Area	18.0%	39.5%	23.5%	19.0%	100%

(Source: Census of Population, 2002 and Small Area Population Statistics, 2002)

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Social Class Categories
Social Class 1: Professional Workers Social Class 2: Managerial & Technical Social Class 3: Non-Manual Social Class 4: Skilled Manual Social Class 5: Semi-Skilled Social Class 6: Unskilled Social Class 7: Others gainfully employed

Professional workers are not well represented in the Srahmore area, with only 18% of the population categorised in social classes 1 and 2, as opposed to 32% at national level. The comparable proportion for county Mayo is 27%, also below the national average.

In the Srahmore Area, over 40% of the population aged 15 and over fall into the lowest three social classes, as opposed to a national level of 35%.

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5.3.5 Economic Performance

The most appropriate measure for gauging differences in the level of economic development across a Country or a Region is GVA (Gross Value Added). GVA is a measure of output per capita for an area, equivalent to GDP at market prices.

Table 5.5 below shows that per capita output for the West amounted to only 73% of the national average. County Mayo as well as Donegal, Leitrim and Roscommon are particularly weak in this regard.

Table 5.5 Indicative Estimates for GVA per Capita

County/Region	Total GVA per Capita £	Index State = 100	Index EU = 100
Mayo	6,800	67.3	61.9
Galway	8,100	80.2	73.7
Donegal	6,100	60.4	55.5
Sligo	7,700	76.2	70.1
Leitrim	5,200	51.5	47.3
Roscommon	5,600	54.4	50.1
Clare	9,600	95	87.4
Total 'West'	7,348	72.7	66.9
Ireland	10,106	100	100

(Source: Central Statistics Office, 2003)

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The data on GVA per capita outlined in Table 5.5 are supported by the Composite Deprivation Score, (1996) for Ireland as a whole. This measure also shows that most of County Mayo is classified as "Most Disadvantaged".

Relative Deprivation

The Haase Index of Relative Affluence and Deprivation provides a single measurement of the overall Deprivation of the area. Based on the 1996 Census, the index takes into consideration the social class composition, the level of education, the level of unemployment and long-term unemployment, the proportion of lone parents, the extent of small farming and the age dependency rate. The index ranks each DED on a scale of 1 to 10. A rank factor score of 1 indicates that an area is amongst the most affluent 10% of areas, whilst a rank factor score of 10 indicates that an area is amongst the most disadvantaged 10%.

In 1991 and 1996, the deprivation score for both Goolamore and Bangor was 10, while in the Belmullet Rural District, all 14 DEDs had a score of 10 in 1996. This leaves the entire Rural District in the top 10% most deprived areas in the country, well above the national mean of 4.6. In 1991, 2 of the 14 DEDs, Baroosky and Belmullet, had a deprivation score of 9. This indicates a slight increase in the level of deprivation in the area since 1991.

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5.3.6 Employment

Poor employment growth is a feature of lagging economic development and there is a correlation between this measure and the state of the region's infrastructure, low labour force participation rates and higher rates of outward migration.

The level and growth in employment in the Western Counties (i.e. those west of the Shannon) is shown in Table 5.6 and gives a context within which to view the employment performance of County Mayo. Between 1991 and 1996, while the region experienced employment growth of 11.8%, the level of growth in Counties Mayo, Roscommon and Leitrim, in particular, was considerably below the national average of 13.8%. In the 1996 to 2002 period, employment growth across the country has dramatically increased, with the national average growth being 25.6%. The corresponding figures for the West region and County Mayo are 22.8% and 22.4% respectively. This rate of employment growth in Mayo, while slightly below the regional average, is higher than the rates of growth in Counties Donegal, Sligo, Leitrim and Roscommon.

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Table 5.6 Employment Growth in the West – Persons aged 15 and over at Work

County/Region	1991	1996	2002	% Change 1991-1996	% Change 1996-2002
Mayo	33,664	36,583	44,764	8.7	22.4
Galway	58,816	67,497	85,210	14.8	26.2
Donegal	35,134	39,811	48,379	13.3	21.5
Sligo	17,992	20,204	23,927	12.3	18.4
Leitrim	8,012	8,518	9,990	6.3	17.3
Roscommon	17,493	18,559	21,270	6.1	14.6
Clare	30,735	34,572	43,679	12.5	26.3
Total 'West'	201,846	225,744	277,219	11.8	22.8
Ireland	1,149,080	1,307,236	1,641,587	13.8	25.6
Leinster	620,666	715,137	916,027	15.2	28.1

(Source: Central Statistics Office, 2003)

The Border, Midland and Western Region Development Strategy 2000-2006 (BMW Report) prepared for the regional authorities in 1999, states that the overall Region suffers from a "braindrain". In this case, participation in third level education is relatively high and young people generally leave the region to study and do not return. Nationally, in 1999, only 13% of all new graduates finding employment in Ireland did so in the Border Midland and Western region.

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In addition, the BMW Report notes that the Region's economy is still more reliant on agriculture than is the national economy, and that this agriculture is relatively weak. The Region's industry is more traditional in nature than that of Ireland as a whole, particularly outside the larger urban centres.

The BMW Report notes that there is a good availability of human resources in the Region, but that this availability is being reduced by declining unemployment. The Region has not yet experienced labour shortages as pronounced as those in the Eastern and Southern Regions, nevertheless, it does have difficulties in relation to highly skilled personnel in many instances.

The Region as a whole scores relatively lowly in terms of research, technology and innovation in comparison to other areas of the country. The number of high R & D performing companies is limited and is heavily concentrated in a few specific locations.

The employment trends in the local area are slightly more difficult to gauge. However, an examination has been carried out of the recent Live Register figures for the Belmullet area, which is representative of the population in the vicinity of the Srahmore Area. These figures show a decrease in the number of persons claiming unemployment benefit over the eight-year period 1996 to 2003 (See Table 5.7).

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While this trend would seem to reflect the current economic situation of the country as a whole, as referenced in the BMW report, the decrease in unemployment will affect the availability of labour in the local area.

Table 5.7 Average Number of Persons on Live Register in Belmullet

Year	1996	1997	1998	1999	2000	2001	2002	2003 (to Sept)
Average No. Of Persons	1244	1234	1103	1036	935	822	778	708

(Source: Central Statistics Office, 2003)

Bord na Móna Employment in the Bangor Area

Bord na Móna has been providing employment in peat-related activities in the Bangor area of Mayo for the past forty years. This has consisted of semi-skilled, skilled and supervisory jobs, both part-time (or seasonal) as well as full time. From an administrative viewpoint, the Bangor unit is grouped with that in Oweninny, which is located some 15 kilometres eastwards towards Crossmolina and Ballina. Whereas the combined Works has a current complement of 92 full-time employees plus 108 seasonals, the Bangor unit accounts for 21 and 29 of each respectively (i.e. a total of 50). This level of employment is typical of the last ten years or so. Approximately 80% of the workforce live within 15 kilometres of the Works.

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This employment in peat development, harvesting and transport has been a direct result of, and is consequently totally dependent on, the existence of the ESB's peat-burning electricity generating station at Bellacorrick. As this power station is scheduled to close at the end of 2004, Bord na Móna will no longer be in a position to continue providing peat-related employment at its Oweninny Works beyond the end of next year.

Employment Status

The labour force in the area adjacent to the proposed peat deposition area can be gauged from the employment status of persons aged 15 and over in the Srahmore area Table 5.8 presents these figures for the 1986, 1991, 1996 and 2002 Census.

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Table 5.8 Employment Status of Persons aged 15 Years and Over, Srahmore Area (Goolamore & Bangor DEDs)

Employment Status	1986		1991		1996		2002	
	No. of Persons	%	No. of Persons	%	No. of Persons	%	No. of Persons	%
At Work	149	32.5%	153	36%	135	30.3%	173	36.6%
1st Job Seeker	3	0.7%	6	1.4%	0	-	5	1.1%
Unemployed	60	13.1%	50	11.7%	55	12.3%	50	10.6%
Student	45	9.8%	31	7.3%	55	12.3%	68	14.4%
Home Duties	126	27.5%	127	29.9%	125	28%	77	16.3%
Retired	59	12.9%	42	9.8%	54	12.1%	61	12.9%
Unable to Work	16	3.5%	16	3.7%	22	5%	31	6.6%
Other	0	-	1	0.2%	0	-	7	1.5%
Total	**458**	**100%**	**426**	**100%**	**446**	**100%**	**472**	**100%**

(Source: Small Area Population Statistics, 1986-2002)

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As can be seen from the Table 5.8, in each Census year the two most common categories were people 'at work' and people engaged in home duties. The level of employment in the area increased from 32.5% to 36% between 1986 and 1991, but then dropped to 30.3% in 1996, before rising again to its highest level of 36.6% in 2002. Unemployment dropped from 13.1% in 1986 to 10.6% in 2002.

In the most recent Census, first time job seekers in the Srahmore area represent only 1% of the population aged 15 years and over, while 14.4% are students. The proportion of the local population engaged in home duties has dropped significantly from 27.5% in 1986 to 16.3% in 2002.

In the wider Belmullet Rural District, the employment status of persons aged 15 years and over in 2002 is quite similar to that of the Srahmore area. The most frequent categories are people 'at work' (34%) and people engaged in home duties (20%). Unemployment levels in 2002 were 9.8%, slightly lower than the 10.6% unemployment at the local level. The proportion of students in the Belmullet Area is 12%, with first time job seekers measuring 2% of the population aged 15 years and over.

Agriculture, Forestry and Fishing

Low intensity sheep and livestock faming typify agricultural activity in the area immediately surrounding the proposed development. There is also a limited amount of

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silage production, dairy faming and organic farming.

Forestry in the area is primarily controlled by Coillte however there are pockets of private plantations. The majority of the plantations are coniferous.

There are five main fishing ports on the coastline close to the proposed development at Portulin, Ballyglass, Rinnroe, French Port and tidally at Belmullet. These ports are used as bases for fishing trawlers and smaller fishing boats. There is also a crab factory at Portulin as well as an oyster farm in Sruwaddacon Bay. There is also a natural oyster fishery in Blacksod Bay.

5.3.7 Education

The Barony of Erris comprises the Belmullet Rural District, and the DEDs of Ballycroy North and South. There are 19 primary and three post-primary schools in the Erris area. Many of the primary schools are very small, with several having an enrolment of less than 30 pupils. The nearest primary school to the Srahmore bog is located in Bangor Erris. Two of the post-primary schools are located in Belmullet and the third is in Rossport. Post-primary students in the southern part of Erris go to secondary schools in Achill. The nearest form of third level education is the Galway Mayo Institute of Technology (GMIT), located in Castlebar.

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According to the Census, persons aged 15 years and over whose full-time education has ceased are classified by the highest level of education completed. A strong link exists between educational attainment and earnings capacity. Thus the level of educational disadvantage in an area may be an indication of or a controlling factor to social and economic deprivation.

Table 5.9 shows that in 2002, 39% of the Srahmore area population (aged 15 and over) left education at or before the age of 15 years. This proportion was greater than the county (22.6%) and the State (17.6%). In the Srahmore area, 38% of the population have no formal education or primary education only, as compared to 25% in County Mayo and only 18% in the State. A proportion of 9% of the Srahmore population have third level education, in comparison to 16% in County Mayo and 21% in the State.

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Table 5.9 Educational Attainment, 2002

Area	Population					
	Primary Education Only	**Lower Secondary Education**	**Upper Secondary Education**	**3rd Level Education**	**Age Education Ceased (< or =15 years)**	**Age Education Ceased (> 15 years)**
State	17.9%	18.3%	23.4%	20.9%	17.6%	54.6%
County Mayo	24.6%	18.7%	23.8%	15.9%	22.6%	53.3%
Srahmore Area	38.3%	25.6%	18.1%	9.1%	39.1%	45.3%

(Source: Census of Population, 2002 and Small Area Population Statistics, 2002)

5.3.8 Tourism

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County Mayo

County Mayo is a largely rural area with rich scenic resources and a distinctive culture. The economy is heavily dependent on the declining sectors of agricultural and fishing. Large proportions of County Mayo are designated as proposed National Heritage Areas (NHAs) and Special Areas of Conservation (SACs). In addition, the area is also rich in cultural resources through language, history, literature, archaeology and vernacular building traditions. Visitors are attracted to the region for its tranquillity, unspoilt landscape and traditional community structure. Tourism has become an engine for growth in the County in recent times.

County Mayo is also well known for its museums and visitor attractions and has an abundance of festivals throughout the year, mostly during the summer months. Summer schools to learn or improve Irish language skills and schools to study English are hosted throughout the County. In this regard, a major element of the tourism industry in the Gaeltacht areas relates to Irish language schools for school children, students and others.
In recent years, tourism has become an important part of the local economy of west and northwest Mayo, but there is still potential to develop this resource further. However, the rapid growth of tourism (6 million tourists visited Ireland in 1999, projected to 8 million in 2005) and its impact on vulnerable environments has brought about concern. In order to address these concerns, County Mayo aims to promote sustainable tourism to:

- support the social and economic prosperity of the resident communities; and
- protect their cultural and natural environments.

A new co-ordinating tourism marketing company, Margaíocht Turasóireacht Iar Thuaisceart

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Mhaigh Eo, is currently being formed in northwest Mayo to implement the above policies.

Tourist Survey of County Mayo

Mayo County Council published a tourism brochure entitled "Mayo – Sustainable Tourism in the Coastal Zone, published by An Taisce and Mayo County Council, 2000". Within this publication, a visitor survey was carried out during July, August and September of 1999 to determine the profile of current visitors to Mayo. During the survey, some five hundred and eighty three interviews were carried out across the following locations in Mayo: Achill; Mulranny; Erris; Westport and the Ceide Fields Visitor Centre.

It was found that the most popular type of accommodation in the region is Bed and Breakfast, followed by rented self-catering, hotels and caravan and camping.

New accommodation is being developed at the moment with a hotel proposed for Mulranny and another due to be constructed near Carne. However, in other areas like Erris, the range of accommodation and other facilities are less developed. There is a general shortage of accommodation in Mayo, which is partly due to the suitability of the land for building as it is mountainous, boggy, sandy or liable to flood.

Of the people surveyed, walking was the most popular leisure activity, followed closely by water-based activities, general sight seeing and relaxing. Fishing was also popular with those visitors staying in Westport and Erris.

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A high proportion of visitors who come to Mayo have family connections in the nearby area, with 25% of the total sample from the An Taisce/Mayo County Council survey having family connections with Mayo.

Of the people surveyed, the largest single percentage of overseas visitors came from the UK, with Germany the second highest. The majority of these people were on their main holiday with 58% staying a week or longer.

Fifty-four per cent of visitors were informed about Mayo from friends and relatives; 16% from guidebooks; and only 8% from a tourism office or Bórd Fáilte.

The most popular reasons for visiting Mayo were quoted as being for the scenery including its wild and unspoiled nature, the beaches and the quiet, uncrowded and non commercial character of the area.

Negative aspects of the holiday were quoted as being too much development (especially in Achill), a general lack of facilities (particularly no indoor leisure facilities to cater for wet weather conditions) and a need for improved roads and signage.

The Barony of Erris

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The site of the proposed peat repository is located in the Barony of Erris, with Broadhaven Bay to the north and the Atlantic to the west. Parts of Erris are classified as Gaeltacht, where Irish survives as a community language. The Barony of Erris stretches from the village of Belderg and the Céide Fields in the North East to the villages of Ballycroy and Castlehill in the South, and includes Blacksod Bay, The Mullet Peninsula and Broad Haven Bay.

The Céide Fields, situated on the R314 coastal road from Ballina, 8km west of Ballycastle, is the site of a 5,000-year-old Neolithic farm site discovered beneath the blanket bog. These fields are the oldest known field systems in the world. The Céide Fields visitor centre explains the stone-age landscape of the North Mayo coast.

Another feature of the landscape is the North Mayo Sculpture Trail (Tir Saile), which begins in Ballina, and follows the coastal route through Killala, Ballycastle, Belderg, Belmullet and down to Blacksod. This unique trail of 15 site-specific sculptures encompasses miles of rugged coastline. Seven of these sculptures are to be found in the Barony of Erris.

Carrowmore Lake is the largest lake in Erris, covering an area of approximately 2000 acres. It is home to a variety of birdlife, especially during winter months when Teal, Mallard, Chelduck, Widgeon and Brent goose are among the species to be spotted.

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Tourism in the Area Local to the Proposed Peat Deposition Area

The area immediately adjacent to the proposed peat deposition site has a limited amount of tourist attractions. The R313 is a route used by tourists travelling from Bangor to the Mullet Peninsula. Tourist traffic in this area mainly focuses on hill walking, fishing, horse riding and the North Mayo Sculpture Trail. The main centres for tourism nearest the site are Bangor Erris, Glenamoy, Pollatomish, Rossport, Belderg, Belmullet, Glencad and Inbher.

Fly-fishing and spinning are the main attractions of the Bellanaboy local area. Salmon and sea trout may be caught here between early February and late September. There are three small rivers in the vicinity: Muingnabo, Bellanaboy and Glencullin. The Muingnabo is 14.5km long and flows into the Glenamoy Estuary 3km west of Glenamoy village. The Bellanaboy river flows into Carrowmore Lake from the north and has the best fishing opportunity at its last bridge closest to the lake. The Glencullin River flows west into the Carrowmore Lake.

One of the sculptures on the North Mayo Sculpture Trail is located on the Glenamoy/Belmullet Road at Bellanaboy Bridge. More precisely, it is on the road to Bangor just before the bridge on the west side. The sculpture was carved by Niall O'Neill from a mixture of sandstone and granite. It is called "Stratified Sheep" and aims to reflect

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the land structure and express the rural culture which formed it over millennia.

The local tourism group, Iorras Domhnann Rural Tourism Co-Op. Ltd., has developed a series of walks 'Siuloidi Iorrais' in the Barony of Erris. There are a variety of recommended walks to suit all age groups and abilities, ranging in distance from 3 to 21km, and graded from easy to moderate. All are circular walks with the exception of the Belderg to Glenamoy walk, which is linear. Each of the walks are way-marked using yellow arrows on naturally occurring features such as boulders etc. The self-guided walks closest to Bellanaboy Bridge include routes in Carrowteige and Rossport, as well as the Glencullen Loop.

Tourist Accommodation

Shell E&P Ireland Limited have funded the development of a local tourist accommodation database. The database was developed by Atlantek Computers in Rossport for Iorrais Domhnan, a local tourism Co-op. The database shows that there are a total of 567 tourist accommodation beds within 40 Km of the proposed Gas Terminal site at Bellanaboy Bridge (to which this proposed peat repository is an ancillary development). Of these tourist accommodation beds, 181 are within 10km, 304 are within 20 Km and 427 are within 30 Km of the Bellanaboy Bridge site.

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Recreation and Sport

Recreation and sporting activities are varied and well served in the wider area surrounding the proposed peat repository site. There are GAA Clubs in Bangor Erris, Glenamoy, Rossport, Belmullet and Drum. Bangor Erris also has a soccer club. Other past time and sports which are actively pursued in the area include:

- Swimming,
- Watersports,
- Golf,
- Cycling,
- Hill Walking,
- Fishing,
- Snooker,
- Darts,
- Tug-o-war,
- Bingo
- Drama and musical groups

5.3.9 Language and Culture

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The proposed site and surrounding area is located in a Gaeltacht area. The term "Gaeltacht" describes those areas where the Irish language is the community language. Údarás Na Gaeltachta is the Regional Development Agency in Ireland with responsibility for the economic, social and cultural development of the Gaeltacht regions, ensuring the continuation of the Irish language as the spoken language of the community in these regions.

The Irish language is one of the oldest written languages in Europe and has a strong and rich literary tradition. The oral tradition has played a major role in the survival of Irish as a living language.

The Gaeltacht areas were established to encourage an unbroken link with a past that saw Irish as the main language in Ireland. They are seen as a vital lynch-pin for the transmission of Irish as a community language to the next generation.

5.4 Description Of The Proposed Development

5.4.1 Introduction

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The proposed development relates to the development of a peat repository on lands owned by Bord na Móna at Srahmore, Bangor, Co. Mayo. This peat repository is an ancillary development to the proposed Gas Terminal at Bellanaboy Bridge. It is proposed to transfer approximately 450,000 cubic metres of peat from the Bellanaboy Bridge site to the worked out bog at Srahmore, Bangor, approximately 9km south of the proposed Gas Terminal. The Srahmore bog complex is located to the west of the village of Bangor Erris, immediately south of the R313 route.

The proposed development will involve two phases: - construction and operation. The construction stage will necessitate the building of an access road to Area 6 of the Srahmore bog complex, and the construction of a concrete hardstand in Area 5 to accommodate vehicle movements and ancillary services. The operation phase will involve the delivery of peat to the site in heavy goods vehicles, and the transfer of peat to the deposition area of the bog.

5.4.2 Environmental Emissions

The environmental emissions from the proposed development which have the potential to negatively impact on humans include air, noise, water and traffic. The nature and extent of the environmental emissions during construction and operation are discussed in detail in the relevant chapters of this EIS.

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5.5 Impacts Of The Proposed Development

5.5.1 During Construction Impacts

The construction of this proposed peat repository facility at the Srahmore bog complex has an expected timeframe of 6 months. Prior to this construction phase, road improvement works will be necessary on the county road linking Bellanaboy Bridge to the R313, to accommodate the ease of movement of the heavy goods vehicles transferring the peat between the sites. While the peat is being transferred, a traffic management plan will be implemented in the area, including a temporary signalling arrangement at the junction of the county road linking Bellanaboy Bridge to the R313 route.

Population, Language and Culture

The effects on population of the proposed development will be negligible, as Bord na Móna intend to utilise its existing staff to man the proposed deposition facility at the Srahmore peatland. It is estimated that the manning requirement for the peat deposition activity would be approximately 50-55 people.

The proposed facility will not create any adverse impact on language or culture in the area, as an influx of workers is not required to serve the proposed development. Employees will be locally sourced, and are likely to be primarily Bord na Móna workers. It is not expected that employees will commute from any distance greater than a 15km radius of the site.

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Architectural Heritage

With reference to the Mayo County Development Plan, there are no protected structures that will be affected by the deposition of peat on the site. The site area has experienced a significant level of disturbance through being worked as an industrial peatland over the past forty years. There will be no further effect on the architectural heritage of the area as a result of the proposed development.

Employment and Economic Impacts

Should the peat deposition activity proceed in Srahmore as proposed there would be a manning requirement for 50-55 people and Bord na Móna would intend, in the first instance, utilising its existing workforce, depending on availability. Bord na Móna's Oweninny works is scheduled for closure at the end of 2004 and the development would provide an alternative employment source beyond this time.

Agriculture Forestry and Fishing

It is not expected that there would be any negative impact on agriculture, forestry or fishing

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during peat deposition so long as the mitigation measures outlined elsewhere in this Volume are implemented.

Tourism

A number of tourism centres have been identified in the county. However, most major attractions are sufficiently remote from the Srahmore Bog for their associated visitors to be unaffected by the peat deposition activity. During the deposition period, visitors to the local area who have to pass by the Srahmore site will notice site activity. There will be minor traffic delays at the temporary signalling arrangement proposed at the junction of the county road linking Bellanaboy Bridge to the Srahmore site. There will be increased traffic movements on the county road haul route and the R313 during the deposition period with the movement of heavy goods vehicles to and from the site. These increased traffic levels should not impact significantly on local tourism.

During the deposition phase there will be some disturbance in terms of noise, visual impact, and increased levels of heavy goods vehicles traffic upon the local population.

It is not envisaged that the local fishing industry and angling attractions will be disturbed by the peat deposition exercise at the Srahmore site, provided that the necessary mitigation measures outlined in this Volume are effectively implemented.

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The operation of this facility will not affect any known recreational routes. The site will, however, be visible from local roads and tracks used in the area. However this activity will be restricted to a relatively short timeframe and the rehabilitated site will ultimately blend with the surrounding landscape.

Recreation and Sport

The site is currently not used for any form of recreational activity. In this regard, it is not expected that there will be any significant negative impact on local recreation or sporting facilities, as a result of the proposed peat transfer and deposition activities.

Health and Safety

Peat transfer and deposition activities at the Srahmore site will be subject to Bord na Móna health and safety procedures, carried out according to best practice guidelines.

Environmental Emissions

The impact of the environmental emissions from the proposed peat deposition site is discussed in each of the relevant chapters of the peat Deposition Site Volume. Each individual section discusses the likely impacts during the construction phase of emissions on

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humans, flora and fauna and the environment, where relevant.

5.5.2 *Long Term Impact of the Proposed Development*

Population, Language and Culture

The long term effects of the proposed peat transfer and deposition activities on population, language and culture are negligible.

Employment and Economic Impacts

The Bellacorrick power station is due to be shut down at the end of 2004. The transfer and deposition of peat to the Srahmore site will, in the short term, create an estimated 50-55 jobs which in the first instance will be available to Bord na Móna employees. However, there will be no significant long-term impact on employment due to the peat deposition activity.

Agriculture Forestry and Fishing

It is not expected that there would be any negative impact on agriculture, forestry or fishing during construction so long as the mitigation measures outlined elsewhere in this Volume are implemented.

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Tourism

In the long term this development will not negatively impact on the visual amenity in the Srahmore area, as the cutover peatland will revegetate naturally. This will have an overall positive impact on visual amenity and therefore on tourism. Other than minor traffic delays due to construction traffic, which may occur during the tourist season, there will be no negative impact. There are no significant tourist attractions that will be visually impacted upon directly.

With the appropriate mitigation measures employed as detailed in the other sections of the Peat Deposition Site Volume of this EIS, there will be no impact on fisheries or the natural resources of the area as a result of emissions. In this regard, the important local tourist resources of fishing, hill walking and horse riding will not be negatively impacted.

It is therefore anticipated that the long term impacts on tourism and recreation as a result of the development will be slight in terms of their magnitude.

Recreation and Sport

Given the nature of the proposed development, it is not expected that there will be any significant negative impact on local recreation or sporting activities or facilities as a result of the peat transfer and deposition activities.

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5.5.3 *Environmental Emissions*

The impact of the environmental emissions from the proposed peat deposition facility are discussed in each of the relevant sections of this Volume. Each individual section discusses the likely impacts during the operation phase of emissions on humans, flora and fauna and the environment, where relevant.

5.6 Mitigation Measures

There are no mitigation measures required in relation to the transfer and deposition of peat at the subject site, except for the implementation of a traffic management plan, as part of the traffic impact mitigation measures.

5.6.1 *Health and Safety*

Bord na Móna safety procedures will be implemented during the transfer and deposition of peat.

5.7 Monitoring

There will be no need for monitoring over and above that identified elsewhere in this Volume.

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5.7.1 *Environmental Monitoring*

It is proposed to set up an environmental monitoring group (EMG) to discuss and monitor the results of the environmental monitoring committed to as part of this Volume. The EMG will include representatives of the local community so that their interests and concerns can be properly accounted for.

5.8 Do Nothing Scenario

If the development did not proceed, the site would be rehabilitated according to the rehabilitation plan (see Appendix 2) for the Oweninny Works.

5.9 Reinstatement and Residual Impacts

No reinstatement having regard to human beings is required as a result of this development.

5.10 External Associated Impacts

This planning application to develop a peat deposition facility on lands owned by Bord na Móna at Srahmore, Bangor, Co. Mayo is part of the overall plan to exploit the Corrib Natural field discovered by Enterprise (now Shell) and its partners.

The impact of the construction and operation of the proposed Gas Terminal at Bellanaboy Bridge is discussed in detail in the Terminal Volume.

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6 TERRESTRIAL ECOLOGY

6.1 Introduction

The aim of the *Terrestrial Ecology* study is to outline the ecological features of the receiving environment and any potential impacts of the proposed activity on habitats and species within the development site and adjacent areas. Areas of scientific and/or conservation interest, as well as the presence of protected plant and animal species within the vicinity of the development site are investigated. On the basis of these studies, a number of mitigation measures are outlined to (a) minimise potential negative impacts, (b) enhance the ecological condition of the development site once activity ceases and (c) to encourage the development site to blend with the surrounding landscape.

6.2 Methodology

Dr. C. A. Farrell of Bord na Móna undertook the ecological assessment of the lands owned by Bord na Móna in the Bangor area. The information presented here is based on (a) the author's experience of this particular site (and the greater Bord na Móna production areas) as a peatland research scientist from 1996 to date and (b) on a more detailed inspection conducted in relation to this development. The author was also involved in the site selection process and project design phases.

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The site of the development was visited on a number of occasions between August and November 2003 as part of a detailed selection process and to provide comprehensive data on habitats and fauna. The fieldwork consisted of a walkover survey of the site. The main habitats were identified and the species composition listed. Some drainage channels were not accessible but these areas were visibly low in diversity, comprising mono-specific stands of vegetation. Fauna noted at the site (actual sightings and observed tracks) were also recorded.

The habitats are classified according to Fossitt (2000). The habitats are described below and habitat codes (after Fossitt 2000) are presented in parentheses. A habitat map is also presented (Figure 6.1). This was compiled using field survey and recent colour aerial photography. Nomenclature for vascular plants follows Webb *et al.* (1996). Nomenclature for bryophytes, hepatics and lichens follow Smith (1978), Smith (1990) and Purvis *et al.* (1982) respectively.

National Parks and Wildlife and the North West Regional Fisheries Boards (NWRFB) were consulted for relevant ecological information relating to the site and surrounding areas. Concerns of the NPW were also noted in relation to monitoring of the site following deposition of the peat and potential re-instatement options.

The development site is evaluated for its ecological significance based on the outcome of

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desk and field studies and consultation with statutory bodies to date. The temporary and permanent impacts of the development are evaluated using the *Guidelines for Ecological Evaluation and Impact Assessment* (Regini 2000).

6.3 Receiving Environment

6.3.1 Site Description

6.3.1.1 General site description

The development site forms part of a larger unit of Bord na Móna bog located in northwest Mayo on the Erris peninsula. The whole area is situated to the south of the high Slieve Fyagh Bog area and the adjacent Carrowmore Lake Complex, comprising a relatively low-lying area through which inland waters drain to reach the depositing area in Tullaghan Bay. The Bord na Móna production areas are therefore split into a number of units by the road network and also the network of tributaries of the Munhin and Owenmore Rivers. Carrowmore Lake and the Owenmore River are significant salmonid fisheries with the Munhin serving as an important link between the two. There is a significant tourism element to the lands immediate to the watercourses.

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The bogs are therefore centred on the Owenmore and Munhin River catchments (both of which terminally deposit in Tullaghan Bay), and the town of Bangor-Erris, located north of the Bord na Móna holdings. Bangor is located on the main Ballina-Belmullet route, with routes to Geesala, Mulranny and Belmullet encompassing the totality of the Bord na Móna Bangor holdings. The development site is located at the junction of the Bangor-Belmullet and Bangor-Geesala routes (Drawing No. 1169\01\201). Immediately north of the development site is the junction of the Bangor-Belmullet and Bangor-Glenamoy routes.

Lands adjacent to the Bord na Móna bogs comprise a combination of fringes of Atlantic blanket bog and discrete parcels of bog improved for agricultural use. There is some forestry in the vicinity but this is limited to small isolated stands that cover no more than one hectare.

The main land-use within the area has been (a) industrial peat production over a footprint of up to 1,000ha with (b) low intensity agricultural activity along the floodplains of the Munhin and Owenmore Rivers and on the lower slopes of Slieve Fyagh.

6.3.1.2 Industrial peat extraction in the Bangor area

The Bord na Móna bogs in the Bangor area were utilised for industrial peat extraction since the early 1960s for sod-peat and from the mid 1970s (for milled peat) up until the final peat production season in September 2003. Milled peat extraction was continuous in the area for

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a period of 28 years and the cessation of peat extraction coincides with the imminent closure of the ESB station (scheduled for December 2004) located at Bellacorick.

The landscape that preceded industrial development was a typical Atlantic blanket bog complex, with peat depths of on average 4m recorded. To develop the site for peat extraction, drains were inserted at 15m intervals within mapped out production units. The drains remained in situ for up to three years until the area was sufficiently dry for Bord na Móna machinery to traverse the site. Once this level of drying was attained, the surface vegetation was removed and the peat was *milled* to harvest a thin layer of peat crumbs, which was then stored on site at Bangor until transported to the ESB station at Bellacorick via road.

The typical method of extraction in milled peat workings is the Peco method. This method is used in extensive production areas on bogs where the underlying topography is relatively uniform and the peat fields extend for hundreds of metres. Peat is harvested and stored in Peco piles, which run the length of the production fields. The Peco method requires long peat fields (>100m) for efficient peat extraction and the construction of railways along the length of the field to transport the peat. This method gives rise to the industrial peatland landscape that is obvious at the development site – a mosaic of low-lying fields interspersed with high fields between.

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Up to forty years of peat production has resulted in significant lowering of the peat level within the peat production footprint area. The current depths in former production areas range from 0.5m to 4m. Bord na Móna policy is generally to harvest as much peat as possible, however, the Bangor bogs have been taken out of production even though there is a significant peat resource remaining. This is due to the aforementioned closure of the ESB station at Bellacorick.

Therefore, the landscape and component Atlantic blanket bog complex within the Bord na Móna holdings has been drastically altered since the 1960s. This is a consequence of (a) drainage, (b) lowering of the peat level and (c) the impact of heavy machinery on the peat.

6.3.1.3 Characteristics of the proposed development site

The development site comprises all of Area 6 and part of Area 5. These areas are former peat production units that were developed for peat production using the methods outlined previously. The activity boundary also extends into peat production Area 7. This part of Area 7 will be used as a controlled overflow facility to channel the drainage system in periods of high rainfall. It will essentially be utilised as a floodplain facility.

Within the development site, the remaining peat in production fields is (a) compressed due to the traversing of heavy machinery and (b) drained by the production drainage system that remains intact.

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The peat substrate is acidic and nutrient poor. The underlying substrate is carboniferous shales overlain by a mixture of gravels and sandy glacial tills, contributing to the general acidity of the waters in the area (Farrell 2001). In some areas the underlying glacial till has been revealed and this is due to the undulating nature of the underlying glacial landscape. The glacial tills comprise gravel and sand that is heavily compacted and generally slow to colonise (Farrell 2001).

The development site is typical of this industrial landscape. The peat off-loading area (Area 5) is undulating, reflecting the undulating and variable glacial topography, with areas of the underlying glacial till emerging. The deposition site (Area 6) is essentially saucer-shaped and compartmentalised north to south by the remaining high fields. The high fields are up to 2m higher than adjacent low-lying peat bays and separated by up to 10 low-lying production fields (up to 150m wide between high fields). The overflow facility (Area 7) is Basin shaped with a gradual westward fall.

Each of the former production areas are devoid of vegetation apart from isolated patches of soft rush and bog cotton (*described in more detail later*) in drainage channels and patches of ling (*Calluna vulgaris*) establishing along the edges of high fields. The area is surrounded by (a) a fringe of Atlantic blanket bog[1], (b) Bord na Móna railway lines and (c) deepened drainage channels that were installed for the efficient drainage of the area for peat production. These drainage channels drain into the Owenmore and Munhin Rivers (described in more detail later: *see Section 7*).

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6.3.1.4 Designated areas and rare species records

There are no records of rare plants for the development area and no rare or restricted distribution plants were recorded during survey of the site. There are some records for areas within 10km of the development site and these are detailed here. Rare plant records comprise the marsh saxifrage (*Saxifraga hirculus*) and scarce plant records comprise the ivy-leaved bellflower (*Wahlenbergia hederacea*). The former species is recorded from springs and flushes within blanket bog complexes located several kilometres to the east of the development site. The latter is frequent along the Owenduff River, which is also separated from any effects of development within the development site.

The development site is however, central to a network of cSACs and pNHAs[2]. In total 10 designated areas occur within 10km or at the 10km boundary of the proposed site (Table 6.1). These areas are representative examples of a number of habitats listed in Annex I of the Habitats Directive (92/43/EEC) notably Atlantic Blanket Bog. The designated areas are

1 Either degraded or relatively intact Atlantic blanket bog, but generally considered as remnants of the previous Atlantic blanket bog that pre-existed industrial development of the Bangor Bogs by BnM (*see later*).

2 cSACs and pNHAs are *candidate* Special Areas of Conservation and *proposed* Natural Heritage Areas respectively.

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largely physically and hydrologically isolated from the development site apart from Tullaghan Bay and Blacksod Bay These areas form part of the greater hydrological unit of the southern Erris peninsula, with water from the site flowing into the Munhin River, and ultimately Tullaghan Bay.

Table 6.1. Designated ecological conservation areas located within 10km of the development site

	Name	Site Code	Designation	Approximate distance from development site
1	Aughness Bog	001473	cSAC	4 km
2	Broadhaven Bay complex	000472	pNHA	9.5 km
3	Carrowmore lake complex	000476	cSAC	1 km
4	Glenamoy Bog complex	000500	cSAC	10 km
5	Mullet/Blacksod Bay complex	000470	cSAC	9 km
6	Owenduff/Nephin complex	000534	cSAC	1 km
7	Pollatomish Bog	001548	pNHA	9.5 km
8	Slieve Fyagh Bog	000542	cSAC	6 km
9	Tristia Bog	001566	pNHA	3.5 km
10	Tullaghan Bay and Tullaghanashammer Bog	001567	pNHA	3.5 km

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The designated areas are host to species listed in Annex II of the Habitats Directive, including otter (*Lutra lutra*), salmon (*Salmo salar*) and the aforementioned marsh saxifrage and ivy-leaved bellflower. Bird species listed in Annex II of the Habitats Directive that utilise these designated areas include Greenland white-fronted geese (*Anser albifrons*), golden plover (*Pluvialis apricaria*) and whooper swan (*Cygnus cygnus*). These three species are found over-wintering while the golden plover is breeding on Aughness, Owenduff and Tristia bogs. Annex IV species present in this 10km radius include resident and breeding merlin (*Falco columbarius*) on Aughness and Owenduff bogs, with red grouse (*Lagopus lagopus*) on Tullaghanashammer bog (personal communication with local NPW staff: D. Strong).

The Bord na Móna holdings are therefore, central to a network of significant conservation value areas, predominantly bog and estuarine areas that have been designated cSACs and pNHAs. In line with this the *Rehabilitation Plan* for the former peat production area is designed to allow the post-industrial site blend in with the surrounding landscape. This is described in further detail later.

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6.4 Habitats

6.4.1.1 Introduction

The habitats recorded from within the development site are outlined below (except for watercourses). The habitats included are those within the actual development site (Areas 5 and 6), the overflow facility (part of Area 7) and those habitats described that are located within the Bord na Móna ownership boundary and marginal to the development. The extent of these habitats can be viewed from the habitats map (Figure 6.1).

Table 6.2. Summary of habitat types recorded at and adjacent to the development site (after Fossitt 2000).

Habitat name and code	Habitat type
PB4 Cutover Bog	Bare peat
PF2 Poor fen and flush	Pioneer vegetation on cutover bog (fluctuating water-table)
HH1 Dry siliceous heath	Pioneer vegetation on high fields
ED1 Exposed sand, gravel or till	Emerging glacial features
WS1 Scrub	Vegetation at edges of railway lines and drainage ditches
GS4 Wet grassland	Railway line and travel path vegetation
WD4 Conifer plantation	Planted commercial forestry
PB3 Lowland blanket bog	Fringe bog vegetation
FW4 Drainage ditches	Deepened drains

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6.4.1.2 Habitat descriptions

Cutover Bog, PB4

The entire post-production area footprint is included within the cutover bog habitat class, and this is the most extensive habitat recorded within the development site. This habitat comprises milled peat production bog devoid of vegetation and broken into peat fields that are 15m wide and of variable length (Fig. 6.1). The peat is generally compressed due to machinery traversing the fields, acidic and prone to large-scale fluctuations in the water-table due to the persistence of production field drains and deepened drainage channels into which the field drains flow. Peat was produced from these areas up until September 2003 and no plants have established as yet on the peat fields. There has, however, been some colonisation of field drains that are less disturbed than the peat fields. This patchy vegetation is described under the heading poor fen and flush (see next).

Poor fen and flush, PF2

This is the habitat class that is found within cutover bog habitats that marks the pioneer colonisation phase of bare peat. Soft rush (*Juncus effusus*) establishes in drainage channels

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with relative ease, being favoured by temporally fluctuating water-tables and the bare peat surface (Fig. 6.2). Other species common to the pioneer poor fen vegetation stands are bog cotton, bulbous rush (*Juncus bulbosus*) and sheep's sorrel (*Rumex acetosella*). In one drain a number of species typical of poor fen were recorded, and this indicates that particular 2m stretch of drain had been least disturbed within the site allowing a more diverse stand of poor fen to establish. The additional species recorded here were marsh pennywort (*Hydrocotyle vulgaris*), *Glyceria fluitans* and *Agrostis* spp.

There are two patches of cutaway bog[3] found within the development site. These areas are small (less than 20m x 20m each) and found in the southwest corner of Area 6 and eastern corner of Area 7. The peat is shallow with emergent underlying gravel being revealed. The vegetation here is assigned to poor fen also. There are also a number of relatively small emerging gravel areas that are included under the habitat class ED1 (*see later*).

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Fig 6.2. This illustrates the cutover bog habitat class, PB3. The fields are devoid of vegetation, except for fragmentary stands of poor fen in field drains (A) and dry heath (B) along the edges of high fields.

3 Cutaway bog refers to bog from which all economically viable peat has been exhausted. In the Oweninny Works this generally refers to when the underlying glacial till is encountered.

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Dry siliceous heath, HH1

This habitat class is found on the edges of high fields and comprises sparse growth of ling and purple moor grass (*Molinia caerulea*). These high fields present a habitat distinct from the greater part of the production areas (Fig. 6.1). While the peat remains acidic it is elevated from the surrounding area and therefore drier and suitable for the establishment of dry heath vegetation. This vegetation type is fragmented, being restricted to the edges of high fields and marginal areas that are drier. This habitat is frequent throughout north-west Mayo, but the type described here is only a pioneer, rudimentary form.

Exposed sand, gravel or till, ED1

Areas where peat has been harvested to a very shallow layer tend to remain bare and the remaining peat may wash off the surface in heavy rain periods. This leads to the emergence of the underlying glacial hills. These areas are compacted and nutrient poor and vegetation is slow to establish. There was also a certain amount of travel by machinery further hindering plant establishment. When these areas become vegetated, they are generally dominated by poor fen species such as soft rush and bulbous rush (Farrell 2001).

Scrub, WS1

Scrub vegetation occurs along the main drainage channels and the edges of railway lines. The main feature of the scrub along drainage channels is dense bramble (*Rubus fruticosus*) that is up to 2m high. There are also dense patches of soft rush growing through the bramble with occasional willow (*Salix* spp) saplings and isolated stands of bracken (*Pteridium aquilinum*). The scrub is largely impenetrable and occasional species recorded include sorrel (*Rumex acetosa*), purple moor grass, *Angelica sylvestris*, and rose-bay willow herb, (*Epilobium angustifolium*). In some areas it grades into fragmentary dry heath with tall ling and purple moor grass (up to 1.5m). Other patches of scrub along railway lines and degraded lowland bog are fragmentary, comprising individuals of gorse (*Ulex europaeus*), willow (*Salix atrocinerea*) and *Rhododendron ponticum*. There is generally an understorey of purple moor grass, soft rush, with occasional patches of bracken and/or bramble.

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Wet grassland, GS4

Wet grassland habitat occurs along railway lines, between sleepers and along the edges of the tracks. The vegetation is relatively diverse comprising soft rush, low-growing ling, Yorkshire fog (*Holcus lanatus*), purple moor grass, ribwort plantain (*Plantago lanceolata*), daisy (*Bellis perennis*), self-heal (*Prunella vulgaris*), bramble, sheep's sorrel and red clover (*Trifolium pratense*). Other ruderal species may occur in this habitat but they were not recorded at the time of survey (October 2003).

Conifer plantation, WD4

Conifer plantations cover less than one hectare to the southern end of the site with the trees planted over 20 years ago. The two stands comprise densely planted lodgepole pine (*Pinus contorta*), fringed by *Rhododendron ponticum*. The stands have low biodiversity as there is little or no light penetration and the trees are densely planted.

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Lowland blanket bog, PB3

Lowland blanket bog remnants fringe most of the development site. The condition of the bog can be distinguished as either (a) relatively intact or (b) degraded lowland bog remnants. The two conditions are distinct on the basis of vegetative composition, which is varied due to land-use history and the current drainage scheme within the Bord na Móna peat production footprint. For ease of reference they are included here together. On the habitats map (Figure 6.1), they are indicated by the term bog remnant complex.

Relatively intact Atlantic blanket bog:

Pleurozio purpureae-Ericetum tetralicis (Br.-Bl. et Tx., White & Doyle 1982)

The lowland blanket bog to the north of the development site remained undeveloped probably due to the notable increase in slope just north of the production area footprint. These conditions are unsuitable for development under the original Peco method of peat extraction. The vegetation here is most typical of Atlantic blanket bog, albeit a remnant of the former extensive complex that pre-existed the industrial development of the peatland.

The vegetation here is representative of a typical Atlantic blanket bog Pleurozio-Ericetum condition (White & Doyle 1982). The vegetation is largely cyperaceous, with low-growing shrubs and a significant bryophyte and algal component (the vegetation rarely grows above 30cm). There are no pools present, and this is due to the significant southward slope. There is one peat bank obvious that has revegetated with bog cotton and purple moor grass and a drain cuts through the area that has largely in-filled but may be impacting on the integrity of the vegetation.

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Species recorded include:

- Sedges – black bog rush (*Schoenus nigricans*), white-beaked sedge (*Rhynchospora alba*), deer sedge (*Trichophorum caespitosum*), common bog cotton (*Eriophorum angustifolium*), hare's tail bog cotton (*E. vaginatum*) and occasional patches of carnation sedge (*Carex panicea*).
- Grasses: purple moor grass (*Molinia caerulea*). The plants are generally scattered through the vegetation as individuals, never forming continuous swards or attaining the tussock growth form.
- Shrubs: cross-leaved heath (*Erica tetralix*), bell heather (*Erica cinerea*) and ling (*Calluna vulgaris*). The shrubs are low growing and depauperate. Cross-leaved heath and ling are more common with bell heather plants on small hummocks where the peat is drier.
- Bryophytes: *Sphagnum capillifolium, S. cuspidatum, S. magellanicum, S. papillosum, S. tenellum, S. imbricatum, S. recurvum, Campylopus atrovirens, C. Paradoxus, Hypnum jutlandicum, Leucobryum glaucum, Racomitrium lanuginosum.* These bryophytes are typical of Atlantic blanket bog and are generally growing through a thick layer of mucilaginous algae (*Zygogonium ericetorum*).
- Liverworts: *Diplophyllum albicans, Mylia anomala, Pleurozia purpurea.*
- Lichens: *Cladonia portentosa, C. uncialis.*

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- Herbs: milkwort (*Polygala serpyllifolia*), tormentil (*Potentilla erecta*), round-leaved sundew (*Drosera rotundifolia*), and bog asphodel (*Narthecium ossifragum*).

For a fuller description of Atlantic blanket bog see Farrell (2001), Fossitt (2000) and Doyle (1990).

Degraded Atlantic blanket bog

This habitat represents Atlantic blanket bog that has been heavily impacted upon by drainage and/or former hand-cut peat banks. A number of former peat banks can be seen from the aerial photograph, along the Bangor-Geesala route and also to the western fringe of the development site. These banks have colonised with blanket bog species and have as such naturalised. With time, these areas may further attain some of the typical Atlantic blanket bog characters.

In the most degraded remnant bog areas, the vegetation is dominated by bog cotton and purple moor grass, with patches of tall-growing ling (0.75m). In general the vegetation is taller growing than the typical Atlantic blanket bog condition (up to 1m), with the purple moor grass forming continuous patches although never attaining the tussock growth form. There is an absence of a ground layer except for high cover of *Molinia* leaf litter and patches of *Campylopus introflexus*. Other species present are occasional cross-leaved heath and bell heather with intermittent fragmentary stands of *Rhododendron ponticum*.

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Other areas included within the degraded bog complex range between the relatively intact and heavily degraded conditions described in the last paragraph. Such areas tend to display a number of typical Atlantic blanket bog features, but with a reduced bryophyte-algal layer due to drainage effects.

The vegetation is classified as degraded Atlantic blanket bog tending towards development of a dry heath and/or dense *Molinia*-grassland. Other bog remnants described from the Bellacorick Bord na Móna holdings are similarly described (Farrell 2001). Bog remnants are usually bordered by a narrow fringe (up to 2m wide) of dry heath that indicates the margin of drying-out caused by the hydrological isolation of the bog remnant, an effect of the adjacent Bord na Móna drainage operations.

Drainage ditches, FW4

The actual drainage channels are quite variable in vegetation and generally species poor, ranging from isolated stands of pondweed (*Potamogeton polygonifolius*), *Glyceria fluitans*, bottle sedge (*Carex rostrata*), and bog cotton depending on rate of flow and width of the drainage channel. There are occasional patches of *Sphagnum cuspidatum* in shallow drains, generally to the north of the development site.

6.4.1.3 Surrounding area

The land surrounding the Bord na Móna development site largely comprises fringe bog

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vegetation. This fringe bog is generally included under the lowland blanket bog habitat PB3, as relatively intact and/or degraded lowland blanket bog. This is justified as the typical bog species may be present but there may be some impact of drainage on the bog, generally dependent on the width of the fringe of bog remaining and/or whether there has ever been domestic turf cutting activity on the bog. Two sides of the development site are bordered by roads, beyond which the land-use is largely low-intensity agriculture bordering the Owenmore River and to the north of the Bangor-Belmullet route. To the north and east the land-use has been industrial peat production and these areas are largely devoid of vegetation, displaying similar vegetative characteristics described here for the development site under the PB4, Cutover peatland class.

6.4.1.4 Habitats Map

It is not possible to show the extent and range of each habitat as described above, as some habitats are represented as fragmentary stands within larger habitat complexes. For ease of diagrammatic presentation, the habitats have been designated as habitat complexes. They are as follows (the colour-coded system outlined here corresponds to that on Figure 6.1)

- Magenta: Cutover bog complex (may include fragmentary and pioneer stands of dry heath, poor fen or exposed sub-soil)
- Orange: Relatively intact Atlantic blanket bog (ABB) remnant
- Blue: Degraded Atlantic blanket bog (ABB) remnant (a derivative of the previous, usually impacted upon by drainage for agriculture or peat extraction and may include fragmentary stands of scrub, wet heath and poor fen)
- Green: Drainage channel habitat complex (a mosaic of fragmentary stands of wet grassland, dry heath, scrub and aquatic vegetation)
- Black: Railway line habitat complex (a mosaic of scrub and wet grassland)
- Yellow: Coniferous forestry complex

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6.4.2 Fauna

Mammals

There were no direct sightings of mammals during visits to the development site, and no evidence of mammal activity was recorded. The site had been used for industrial peat production up until September 2003 and this activity coupled with the lack of food and/or shelter makes the area largely inhospitable to mammals apart from occasional traversing from one side of the area to the other. Peat production areas are largely avoided by mammals because of the high exposure element. Mammals likely to be traversing the development site are foxes (*Vulpes vulpes*) and hares (*Lepus timidus hibernicus*). Otters (*Lutra lutra*) may also traverse the site although the field channels are relatively lacking in food. There was no evidence of otter spraints or holts within the site however, otters forage along the main river channel and adjacent streams and there is recorded activity along the Munhin River (local NPW staff recordings). Other species that may be active in the area and probably more in vegetated margins and drier scrub banks are pygmy shrew (*Sorex*

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minutus), wood mouse (*Apodemus sylvaticus*) and brown rat (*Rattus norvegicus*). There are no records of bats for the area and the habitat is coincident with lack of roosting sites and unsuitable habitat (local NPW staff recordings).

Birds

There is little or no bird activity within the development site. The following birds were sighted along the vegetated margins of the development site: meadow pipit (*Anthus pratensis*), wren (*Troglodytes troglodytes*), snipe (*Gallinago gallinago*), skylark (*Alauda arvensis*) and stonechat (*Saxicola torquata*). There may be use of the development site as resting sites for birds but the absence of food, perching posts and shelter again means little or no activity on the site, except for along vegetated margins and bog fringes. Mallard (*Anas platrhynchos*) are likely to use the drainage channels for feeding and social behaviour.

Other bird species recorded from adjacent designated areas within 5km of the development site include: cuckoo (*Cuculus canorus*), hen harrier (*Circus cyaneus*), cormorant (*Phalacrocorax carbo*), grey heron (*Ardea cinerea*), curlew (*Numenius arquata*), kestrel (*Falco tinnunculus*), swallow (*Hirundo rustica*), blackbird (*Turdus merula*), robin (*Erithacus rubecula*), hooded crow (*Corvus corone*) and raven (*Corvus corax*).

Other vertebrates

There are no other records of vertebrates from the site, however, other vertebrates likely to utilise the area are frogs (*Rana temporaria*) in marginal drainage channels. Frogs are common across cutover bog that has revegetated and in bogs where pools provide breeding and feeding areas. It is unlikely that there is extensive use of the area by frogs as the field drains dry-out in spring and summer leading to lack of feeding and subsequent juvenile mortality. Frog activity is likely to be restricted to deeper drains and channels, attracting the attention of predators, such as otters.

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Invertebrates

No invertebrates were recorded at the site but it is likely that marginal vegetated areas are home to common butterflies, such as small heath (*Coenonympha pamphilus*); dragonflies such as common hawker (*Aeshna juncea*) and common darter (*Sympetrum striolatum*) and damselflies, such as blue-tailed damselfly and large red damselfly (*Pyrrhosoma nymphula*). A range of small beetles, spiders and ants would also be found along the vegetated margins of the cutover bog and bog remnant fringes.

6.4.3 Evaluation of ecological significance of the proposed development site

An attempt is made here to provide an evaluation of the habitats within the development site, and those habitats described that are located within the Bord na Móna ownership boundary and marginal to the development. The evaluation follows the Regini (2000) guidelines for ecological evaluation. This evaluation considers the presence/absence of noteworthy species and a judgement of the viability of the habitat present. The levels of

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ecological value are listed in Table 6.3.

Table 6.3. Levels of Ecological Value

Ecological Value	
A	International value
B	National value
C	Regional Value
D	High local value
E	Moderate local value
F	Low local value
G	Negligible

The development site is considered to have **low local value F**. This category includes '*undesignated sites, or features considered appreciably to enrich the local habitat resource within the context of a Parish or neighbourhood (e.g. a species-rich hedgerow)*' (Regini 2000). This assignment is justified for the following reasons:

- There are no records or sightings of rare plants or animals within the development site.
- The development site does not include any areas designated, or that will be potentially designated, for their ecological value.
- The greater part of the site comprises a post-industrial peat production landscape that is devoid of vegetation.
- The potential for cutover bog to contribute to biodiversity is addressed in the *National Biodiversity Plan* and therefore the *potential* ecological value of the cutover habitat is noted.
- Nonetheless, the development site forms part of an extensive cutover (up to 1,000ha) area that stretches to the south, west and north of the development site. Therefore, utilisation of this area for an alternative use would not reduce the potential contribution of a rehabilitated cutover bog to the local area as a whole (*see later*).
- The fringe habitats around the peat-production area are fragmentary and considered to be of low ecological value.
- The fringe habitats do provide a wildlife corridor for movement and persistence of local genetic pools of species.
- The only habitat of ecological significance listed within the land fringing the development site is lowland blanket bog, PB3. The fragmentary nature of the habitat draws into question the viability of these remnant bog areas. However, these fragmentary areas will be largely excluded from the development activity.
- In the context of the extensive tracts of bog that have been designated as cSACs and/or pNHAs within view of the site, the fringe bog remnants are seen as of significantly low ecological value.
- The bog fringes are therefore viewed as of local ecological value in terms of their provision of remnant areas for persistence of local species and shelter for travel

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between bare cutover areas.

- The most significant ecological aspect is that the area is located within the catchment of the Munhin River that flows into the Owenmore River and ultimately the Tullaghan Bay pNHA. The evaluation of these areas and impacts on salmon and other salmonid species is considered in Section 7 of this Volume.

6.5 Characteristics of the Proposed Development

A detailed description of the development can be found in Section 2 of this Volume, with a brief outline here to highlight the salient features relevant to the ecological aspects of the development.

This proposal is to transfer *ca.* 450,000m^3 of peat from the Bellanaboy Bridge terminal site at Bellanaboy to a suitable location within the Bord na Móna holdings at Bangor. The peat overburden at the Bellanaboy site consists of a series of former reclaimed grassland fields surrounded by coniferous tree shelterbelts (see Bellanaboy Bridge Terminal Volume for a more comprehensive description). The former grassland sward has been replaced by a soft rush (*Juncus effusus*) sward due to the increased wetness of the site caused by drainage breakdown, loss of nutrients and an increase in acidity.

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The actual peat itself is predominantly a soft brown peat with humification levels increasing as peat depth increases (lower peat layers have high Von Post values, indicating they are highly humified with less structure binding properties). The excavation of the peat will inevitably involve mixing of peat layers – from vegetated top layers and highly humified bottom layers, with minimal contamination from underlying till.

The development requires a suitable area of cutover bog for (a) off-loading the peat on Bord na Móna property, (b) subsequent transfer of the peat to the deposition area and (c) a suitable area for deposition of the peat. Support mechanisms include a competent transport and drainage infrastructure and safeguards to mitigate against peat run-off into adjacent watercourses. A process to select the most appropriate site for introduction of the peat to the Bord na Móna holdings has been outlined, and this has also taken the ecological features and rehabilitation potential of the cutover bog area into consideration.

The site selected for off-loading of the peat is at the closest distance from the Bellanaboy Terminal site to the Bord na Móna holdings. Development of this site will require the construction of a large concrete hard-standing area and bridges to cross a deepened drain from Area 5 to Area 6 with the peat. Other associated developments in Area 5 will be the excavation of sedimentation ponds and the provision of parking and/or other service facilities for incoming vehicular transport. A significant area will have to be cleared of peat. This will be dozed over adjacent cutover bog.

The site selected for actual deposition of the peat (Area 6) is saucer shaped and suitable for

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peat deposition for the reasons outlined previously (compartmentalised site, facility to drain the area through a series of silt sedimentation ponds before entering the Munhin River and proximity to the Bellanabot Bridge Terminal Site). Development in Area 6 will involve the creation of suitable foundation for temporary roads on the high fields. Peat will be transported by tractor and trailer on these roads from Area 5, and off-loaded into the low-lying production fields. Introduction of the peat into Area 6 will be in a manner to stabilise the peat (i.e. cambered surface over the spread peat and competent drainage system to eliminate flood events) and this will involve peat handling by excavators and dozing by tracked machines. All of these machine types were utilised for peat production in both Areas 5 and 6 and are adapted for such conditions. Development in Area 6 will also involve the excavation of sedimentation ponds and the provision of a controlled over flow mechanism for high precipitation events.

The provision of the controlled overflow mechanism will result in the overflow of water from Area 6 into an adjacent former production area known as Area 7. This will be utilised as a 'floodplain' facility. There is no actual development proposed for this area and the use of this area as a floodplain facility is consistent with the activities outlined under the IPC licence *Rehabilitation Plan* for that area (IPC Licence Reg. No. 505) The field drains in Area 7 will be blocked in line with the *Rehabilitation Plan* and the overflow will be a complementary use of Area 7 and not an alternative use.

Following completion of the peat transfer and deposition operations and subsequent monitoring period, the area within the activity boundary will be decommissioned and rehabilitated in agreement with the consultees, the planning authority and the EPA.

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6.6 Potential Impact of the Proposed Development

The levels of magnitude of impact are assessed according to the Regini (2000) guidelines.

6.6.1 Temporary impacts during construction of infrastructure and deposition of material

There will be a number of temporary impacts on the site during the construction of the required transport and drainage infrastructure and the actual deposition of the peat material onto the cutover bog. Temporary impacts are considered as follows: long-term (15-25 years), medium (5-15 years) and short-term (up to 5 years) (Regini 2000).

6.6.1.1 Designated conservation areas

Designated conservation areas within 10km of the development are listed in Table 6.1. There will be no temporary impacts on any designated conservation areas, as all are located at some distance from the development and as such are physically isolated.

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There will be no impact from development of the site on any of the species listed as rare or scarce in Section *6.3.1.4*. There will be no effect on terrestrial species listed under Annex II and IV of the Habitats Directive in Section *6.3.1.4*. Medium and long-term temporary impacts on these species are likely to be positive for animal species listed. Post peat deposition there will be a replacement peatland habitat provided by the revegetated peat in Area 6 and the rehabilitated Area 5 that could allow for animals to extend their foraging and breeding ranges into the development site. This would be coupled with the complementary rehabilitation of the larger Bangor holdings area.

6.6.1.2 Habitats

There will be **very low magnitude** temporary impact on the habitats that fringe the development area. Loss of fringe habitat will be confined to the construction of bridges across the main drainage channel between Area 5 and 6. The bridges will be maintained in the short-term, but in the medium to long-term they could be removed and replacement habitats would develop in its place.

The main habitat class present on the site is the cutover bog class, PB4. This habitat type has low local ecological value, particularly when considered within the context of the extensive surrounding cutover bog landscape in Bangor. There will be a high magnitude impact on the peat deposition area on all temporary scales (0-25 years). In the short term, the temporary impact will be neutral, in that it will be bare peat covering bare peat. In the medium term, the peat deposition site will have revegetated and the impact will be positive. This will continue into the long-term temporary impact scale, as successional development will allow the area to develop a range of micro-habitats and contribute to biodiversity and habitat value at the local level.

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Area 5 will be subject to a **high magnitude impact** in the short-term temporary scale through the construction of the off-loading facility. A completely artificial habitat will be created in place of the cutover bog habitat but the impact will be isolated largely to the cutover bog habitat. In the medium to long-term temporary scale, Area 5 will be decommissioned and rehabilitated in line with the rehabilitation mechanism agreed with the consultees, planning authority and EPA.

The level of impact in Area 7 will be of **very low magnitude**, with the area only being utilised in high rainfall events. The impacts will be confined to raising the water level and providing for settlement of suspended solids. There will be no adverse impacts on Area 7 and the overall effect should be neutral.

6.6.1.3 Fauna

There will be **very low magnitude impact** on the fauna present in the fringe areas of the development area. The short-term impacts will be confined to the onset of the construction

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activities in Areas 5 and 6 and the final closure and decommissioning of the peat deposition and off-loading areas respectively. The extent of this activity will be approximately 6 months, which may be interrupted by breaks in weather, etc. The impacts are therefore in the short-term temporary scale. The effects will be disturbance through noise and operation of machinery. However, there has been a continual disturbance in the site for the last forty years from the same types of machinery that will be used for the translocation and deposition of peat on the site. It is therefore unlikely to have a significant effect on faunal activity relative to the previous use of the site for peat production.

There will be **very low magnitude** temporary impact on faunal activity following cessation of the activity. Any impact will be confined to excavation of settlement ponds, which should be completed within the medium temporary scale. Following from the cessation of all activities, there will be a positive impact in the long-term temporary scale for fauna as the peat in Area 6 revegetates and Area 5 is rehabilitated to provide additional shelter, food and breeding grounds. Area 7 will be rehabilitated according to the *Rehabilitation Plan* at an early stage in the development and will provide replacement wetland habitat for plants and animals.

6.6.2 Permanent impacts of deposition

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6.6.2.1 Designated conservation areas

There will be no permanent impacts on any designated areas within 10km of the development site. The development will result in a replacement peatland habitat that may with time form part of the greater SAC-NHA network either as a wildlife sanctuary or through use of the site by Annex II and Annex IV species mentioned in *Section 6.3.1.4*.

6.6.2.2 Habitats

The development site will blend with the surrounding landscape. The permanent impact will be the creation of replacement habitats that will contribute to local biodiversity and complement the ecological significance of the adjacent rehabilitated cutover areas and blend with the fringe habitats that currently border the development site. The permanent impact is therefore included within the very low magnitude category and is considered to have a positive permanent impact on the development site.

6.6.2.3 Fauna

There will be no negative permanent impact on faunal activity in the area (very low magnitude impact). The establishment of poor fen or wet grassland will improve the food and shelter aspects within the development site that were previously lacking. This may lead to an increase in invertebrate, bird and mammal activity on site, with the potential for

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species of ecological significance to expand their range into the area.

6.7 Do Nothing Scenario

6.7.1 Development of a Rehabilitation Plan for the Oweninny Boglands

Bord na Móna submitted a rehabilitation plan as part of the IPC Licence application for the cutover boglands of the Oweninny Works to the EPA in January 2002. This rehabilitation plan was essentially a generic plan that outlined the criteria defining successful rehabilitation at the Oweninny Works (to include both the Bellacorick and Bangor peat extraction sites) and described a number of test programmes that incorporated the principles and methods of rehabilitation. The EPA approved the rehabilitation plan in June 2002 (IPC Licence. No. 505). The condition that refers to cutover bog rehabilitation within the IPC Licence is Condition 10 (Appendix 1).

A comprehensive consultation process was conducted in relation to the development of the *Rehabilitation Plan* for the Oweninny Works to provide details of the rehabilitation criteria and methods that will be employed upon cessation of peat production. This also dealt with the integration of a large wind farm on the Bellacorick holdings. The consultees included Dúchas, the North West Regional Fisheries Board, Coillte, IPCC, An Taisce, Mayo County Council and other identified parties. The *Rehabilitation Plan* is included in Appendix 2.

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The aim of rehabilitation of the Oweninny Works is to ensure the stabilisation of the peat production area, while encouraging the area to blend with the surrounding Atlantic blanket bog landscape. The approach requires initial active rehabilitation work (blocking drains, etc.), followed by monitoring of effectiveness of this work. However, it is anticipated that natural processes of revegetation and vegetation succession will lead to the area becoming self-sustaining and stabilised, comprising a mosaic predominantly of semi-natural peatland habitats that will contribute to the existing natural biodiversity of the area.

The main criteria[4] defining successful rehabilitation of the Bellacorick and Bangor sites are:

- Stabilisation of the peat production areas[5].
- Mitigation of silt run-off.
- Re-establishment of peat-forming communities where possible.

It has been illustrated that a number of peat-forming communities have established spontaneously on the cutaway bog within the Oweninny Works and this has given rise to the inclusion of the third criterion shown above. This is also in line with the *National Biodiversity Plan,* which highlights that cutaway and cutover bog areas present

4 These are the basic criteria as identified in the consultation process.

5 Stabilisation of these areas infers revegetation. Once stabilised there will be no potential peat run-off from the site, which will cover the second criterion for successful rehabilitation.

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"*considerable opportunity for the development of...these areas to enhance biological diversity*" (Dept. of Arts, Heritage, Gaeltacht and the Islands 2002).

Any development or alternative after-use of the Oweninny boglands must take these rehabilitation criteria into consideration and must either work in tandem with the rehabilitation principles and/or have no effect on the rehabilitation process at all[6].

6.7.2 Rehabilitation of the proposed development site under the IPC Licence

If the development outlined here does not proceed, rehabilitation of Areas 5 and 6 is due to be initiated and completed by December 2004. This will still be the case for Area 7, regardless, as its part in the development requires that rehabilitation should be completed in order to function as a controlled overflow in high rainfall events.

Rehabilitation involves blocking of the field drains at appropriate intervals (determined by site-specific slopes) to reduce water-table fluctuations and restore hydrological conditions that favour the establishment of peatland plants. Main outfalls will be maintained to provide for the net movement of water out of the system, although the rate of run-off will decrease as revegetation increases the retention time on the revegetating cutover bog.

The site would therefore revert to an embryonic peatland. This new peatland would be quite species poor and remain as such until vegetative succession leads to a more diverse and stable habitat (*N.B. stable refers to an equilibrium in vegetation terms, the peat remains stable and in situ as it has never been disturbed*). The initial vegetation will be dominated by bog cotton in wet areas, with ling and purple moor grass establishing in drier areas. It is predicted that peatland mosses will establish in open water in blocked field drains and depressions on the bog surface. These mosses would further improve the water retention capacity of the new peatland area and the vegetation would continue to evolve over time. As field drains are blocked and vegetation establishes, any water leaving the system will be filtered through vegetation and there will be minimal peat run-off from the site.

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It is not possible to determine if the cutover landscape will revert to one akin to the Atlantic blanket bog landscape that is present in the region. It is noted that Atlantic blanket bog developed over thousands of years through continual climatic and cultural changes. The new peatland landscape following rehabilitation will be a semi-natural peatland, and monitoring will continue for a period to evaluate rehabilitation success and vegetative succession.

Rehabilitation of the greater Oweninny Boglands is underway and will be largely completed at the Bangor site by December 2004, with some work extending into early 2005.

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6 The use of part of the Bangor holdings to off-load and store peat would remove that part from the *Rehabilitation Plan*. The EPA has been notified of the potential change in after-use for part of the Oweninny Works and the full list of consultees has also been notified.

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6.8 Mitigation Measures

Consideration has been given to avoidance and reduction of impacts on the ecological environment at all stages of the project. However, as with any development, some level of impact is inevitable. These impacts and their magnitude on the temporary and permanent scales have been assessed (see previous). The proposed measures to mitigate against potential negative impacts are outlined below.

6.8.1 Mitigation by avoidance

The location of the development site has been selected as the most suitable site for off-loading and deposition of peat to present no impact on the rehabilitation of the remainder of the Bangor holdings and minimal ecological damage, thus providing for an environmentally sustainable means of integrating the Bellanaboy peat into a cutover landscape. The proposed site has been utilised for peat production for more than 40 years and is essentially an industrial peat extraction habitat, devoid of vegetation and of low ecological value. It is also physically isolated from any designated areas within the local area (*on a terrestrial level: see Section 7 for aquatic impacts*).

There will be minimal impact on the fringe habitats surrounding the development site, except for the construction of access routes (bridges) across the western drainage channel and an entry point to Area 5 from the main Bangor-Belmullet route. Apart from this all activity will be largely restricted to the post-peat production footprint.

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The mitigation measures proposed to control siltation of the Munhin and Owenmore Rivers are outlined in Sections 7, 8 and 9 and there should be no significant impact on these rivers. Peat run-off and surface water run-off will be trapped on site by sedimentation ponds that will be maintained and excavated on a regular basis to assure the efficient operation of the system (*see Sections 7, 8 and 9 for more detail*). The utilisation of Area 7 as a controlled overflow facility will further mitigate against the impacts of run-off in high rainfall events.

6.8.2 Mitigation by consideration of climatic variability

During the course of peat transfer to the Bord na Móna holdings all activity will be dependent on appropriate weather conditions. The period for transfer of the peat to the site and the spreading of peat in Area 6 will be timed to coincide with the most suitable climatic conditions. This allows for longer daylight periods, favourable drying conditions and optimal conditions for machinery.

During this period, when inclement weather conditions occur (high rainfall events) all activity will cease until favourable conditions return. High rainfall events lead to high water content in the peat and overall slowing down of progress with machinery. The objective of the peat deposition is to store it in a relatively dry condition to allow for (a) efficient utilisation of the deposition area and (b) minimal re-absorption of water by the peat at the

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deposition site.

It is generally accepted that the peat will be handled in a more efficient way in dry spells than in wet periods.

The provision of the overflow facility in area 7 will also assist in offsetting any potential peat run-off from the peat deposition site in high rainfall periods. This complements the after-use as outlined in the *Rehabilitation Plan*.

6.8.3 Mitigation by remedy

The peat off-loading area will be decommissioned and the area will be rehabilitated as agreed with the planning authority and the consultees. The option favoured by Bord na Móna will be to follow the criteria and methods outlined in the IPC Licence *Rehabilitation Plan*. This will involve (a) decommissioning of the site followed by (b) drain blocking and sculpting of the peat to create suitable conditions for the stabilisation of the peat through natural processes.

With respect to Area 6, it is proposed that once all the peat has been introduced on site and shaped into the appropriate deposition form (as outlined previously) that there will be no further high level activity within the site. Activity will be restricted to (a) maintaining the integrity of drainage channels, (b) excavating material from silt ponds periodically and (c) regular site visits (on foot) to ensure there is no subsidence of peat. The road infrastructure will remain in Area 6 to allow access for machinery to maintain drainage channels and/or in the event of ameliorative work being required. The hard standing in Area 5 and associated maintenance facility will remain in situ until such time as there is no further requirement for excavation of sedimentation ponds or other associated after-care work.

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It is anticipated, due to the high soft rush (*Juncus effusus)* seed content of the Bellanaboy peat, that there will be a flush of rush seedlings established within the first growing season with rapid spread and establishment of vegetation on the site in the following 4 to 5 years. This is based on: (a) a knowledge of the ecology of the soft rush (Farrell 2001); (b) the successional development of vegetation on bare peat from cutaway bog at Bellacorick, and dozed peat from silt ponds; and (c) Bord na Móna knowledge and expertise that ranges from agricultural activity to encouraging the establishment of wetland communities on a range of peatland types in Ireland.

Soft rush will dominate the vegetation establishing on the introduced peat. This plant has a wide ecological tolerance and is found in a number of plant communities. The plants are known to be the first to establish on peat soils bared by disturbance, but are generally confined to those sites remaining above the water-table for part of the year. This is a necessary requirement since seedling establishment is precluded on waterlogged substrates.

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Once the soft rush establishes it is anticipated that the plant roots will bind the introduced peat layer to the underlying cutover peat layer, altering the peat structure to create a homogeneous peat mass and thereby stabilising the peat. The establishment of other species between the tussocks of soft rush will further bind the peat together and eventually lead to a complete cover and stabilisation of the introduced peat.

This confers a number of advantages:

- The vegetation establishing will comprise native species that have a natural ability to establish and spread rapidly on peatland habitats that are drained or disturbed.
- The rapid establishment of vegetation ensures that the peat is stabilised in a relatively short timeframe without using fertilisers or non-native seed.
- The vegetation is akin to a successional vegetative stage of bog development.
- *Juncus*-dominated vegetation is common in north-west Mayo on agricultural fields that have been reclaimed from boglands and as such will blend with the surrounding landscape.

6.9 Predicted Impact of the Proposed Development

The impact of the development will be a product of (a) the nature of the incoming peat, (b) the mitigation measures employed, (c) the habitat that will result from the peat deposition method employed, (d) the vegetative processes that lead to stabilisation of the peat, (e) the rehabilitation methods employed in Area 5 and (f) the re-instatement methods employed in Area 6 (there will be no further rehabilitation work required in Area 7).

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Based on the field and desk studies presented here in relation to terrestrial ecology, it is predicted that the impact of the development on the development site will be of **minor ecological significance**. This evaluation is based on consideration of:

- The low ecological value of the development site and the fringe habitats
- The overall low magnitude of temporary and permanent impacts of the development
- The proposed mitigation measures outlined to off-set potential negative ecological impacts
- The predicted impact of the development considered relative to the outcome of the rehabilitation methods outlined in the IPC Licence *Rehabilitation Plan*

There will be a temporary high magnitude impact on the development footprint through construction of the off-loading facility in Area 5 and covering Area 6 with peat. Due to the **low local (ecological) value** of the site and the predicted replacement habitat resulting from the after-care of the site, the overall impact is considered **minor impact magnitude**. The level of impact in Area 7 will be of **negligible impact magnitude** as there will be no change in the after-use from that outlined in the *Rehabilitation Plan*.

No negative impact will arise from the development, provided that the peat is handled and deposited as outlined in previous sections.

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6.10 Monitoring

There will be regular monitoring of the site, particularly within the first 12 months of the peat introduction at the Bangor site. This will involve ensuring the peat remains in situ (to be followed by further dozing/excavating operations if necessary) and that the drainage system remains intact.

A series of sedimentation ponds will be excavated. These will be cleaned at regular intervals in order to ensure their effective operation at all times

An annual assessment of vegetation cover and vegetative successional development across the development site will be conducted. This will document and track changes in vegetation cover, species composition and trends in vegetative condition. This study will include all areas included within the development (Areas 5, 6 and 7).

Site visits will be made at the end of each growing season following introduction of the peat. The survey will cover the following aspects:

- Vegetation spread and establishment (quantitative and qualitative analysis)
- Vegetation succession
- An assessment of peat stability

The fringe habitats may also be included in this study to ensure there are no negative impacts or to assess how their integrity may be improved through alteration of drainage patterns within the development site.

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Therefore for the first 5 years the following will be a minimum requirement:

(i) Regular monitoring of the site for a 12-month period following introduction of the material.

(ii) Annual assessment of vegetative characteristics.

(iii) A programme of de-sludging sedimentation ponds on an 'as required basis'.

6.11 Reinstatement and Residual Impacts

6.11.1 Re-instatement

Area 5 will be decommissioned and rehabilitated in accordance with the criteria and methods outlined in the *Rehabilitation Plan* for the Oweninny Works. This will occur when there is no further need for machinery or maintenance facilities to be stored on site, and when there is no further requirement for after-care of the site (excavation of sedimentation ponds, drainage channel maintenance, etc.). Area 7 will be monitored along with Areas 5 and 6, to ensure that there is no further requirement for rehabilitation work.

Once the peat is stabilised in Area 6 a number of re-instatement options may be considered:

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- *Natural processes*

This option will involve leaving the former development area to natural processes: leaving the drainage system and peat to naturalise and also to allow the sedimentation ponds to naturalise. Once the peat is stabilised there will be no potential peat run-off and therefore no further requirement for sedimentation ponds. The area would comprise a *Juncus*-dominated landscape.

- *Rewetting*

There may be potential to alter the drainage within the site to encourage rewetting of the peat deposition facility. Rewetting will only be considered when the area is completely stabilised (100% vegetation cover) and there is no potential for peat movement within the site. Rewetting encourages the establishment of peat-forming plants (Farrell 2001) however, the appropriate rewetting and associated issues would be dependent on site conditions identified following stabilisation. A certain amount of re-sculpting of the area may also be required to (a) alter drainage patterns and (b) to allow the area to naturalise and to mimic typical bog conditions.

The most suitable re-instatement option for Area 6 will be selected following consultation with all interested parties.

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6.11.2 Residual Impacts

There are no negative residual impacts foreseen at this stage.

There will be an overall positive local ecological impact with the increase in local biodiversity through the replacement habitats establishing in Area 5, 6 and 7. The site will be dominated by soft rush and a number of species will colonise between tussocks. Depending on moisture content, it will comprise a mix of wetland and poor fen species. Area 7 will most likely comprise a more wetland habitat. These replacement habitats will enhance the local biodiversity by providing substitute habitats for species already established in the local area. With time, the area could be incorporated into the existent network of cSACs and pNHAs to complement the existing conservation value of the Erris peninsula and expand the habitat available for wildlife. This is in line with the *National Biodiversity Plan* and the *Rehabilitation Plan* for the Oweninny Works.

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7 AQUATIC ECOLOGY

7.1 Introduction

The aim of the *Aquatic Ecology* study is to (a) outline the current condition of the receiving environment (in this instance the aquatic ecology of the area associated with the development site), and (b) to assess likely (temporary and permanent, direct and indirect) impacts of the development. The aquatic habitats include the Munhin River, Owenmore River and Tullaghan Bay, which combined form the lower stretch of the Owenmore Catchment. The Owenmore Catchment covers an area of 340km^2 and stretches from the tributaries entering the Oweninny River at Knockmoyle (cSAC), the Altnabrocky River that flows north through the Bellacorick Bog complex (cSAC) and those entering Lough Carrowmore (cSAC).

The development site is situated within the Bord na Móna Bangor holdings and the terrestrial habitats largely comprise cutover bog (*see section 6*). The information utilised to make the assessment of the development on the aquatic ecology includes baseline water quality samples, existing baseline biological monitoring data from the EPA and literature relating to the Owenmore catchment. On the basis of these studies, potential impacts of the development on the immediate freshwater habitats (on site streams and the Munhin River) and those related to the site (in particular sites designated for their conservation value such as Tullaghan Bay), and appropriate mitigation or remedial measures are outlined.

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Sections 6 and 9 of this Volume also present data that are relevant to consideration of the aquatic ecology. Section 6 presents information on the terrestrial ecology, including descriptions of drainage ditches and non-fish vertebrates such as otters and frogs. In addition, Section 6 outlines the areas designated for conservation value within a 10km radius of the site (Table 6.1) and the guidelines used for ecological evaluation and impact assessment (Regini 2000). Section 9 outlines water quality aspects based on the result of water analysis of samples taken in October 2003 along the Munhin River. These three sections are therefore inter-related and should be read in context together. This part of the Peat Deposition Site Volume was compiled by Dr. C. A. Farrell (Bord na Móna) and TES Consulting Engineers.

7.2 Study methodology

7.2.1 Water Quality

7.2.1.1 Chemical analysis

Six water samples were taken from the main drainage channel on site and from the Munhin River in October 2003. These samples were analysed for the full range of parameters

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required under the EPA *Waste Licence* application guidelines (the results of this analysis are discussed in Section 9).

7.2.1.2 Biological analysis

The EPA maintains a database of river water quality that is compiled from a series of samples taken from rivers throughout the country. The quality assessment is based on the 'Q Value' rating system. The Q rating ranges from 5 to 1 with 5 being water of the highest quality. This index uses the presence and/or absence of species sensitive to pollution, assigning a score, which can be used to cross-reference with a pollution index that rates the pollution of a site. The evaluation of water quality is based on the relative abundance of groups of indicator species. The key features of the classification system are outlined in Table 7.1.

Table 7.1. The biological river quality classification system (McGarrigle *et al.*, 2002)

Q Value	Community diversity	Water quality
Q5	High	Good
Q4	Reduced	Fair
Q3	Much reduced	Doubtful
Q2	Low	Poor
Q1	Very low	Bad

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Samples for biological analysis are collected using a method called *kick sampling*. Kick sampling is carried out by kicking for a duration of 2 minutes in a stream or riverbed on a suitable gravely substrate in a riffle area[7]. A net is held down stream of the area being disturbed and all macroinvertebrates collected are identified and numbers recorded.

The main drainage channel on site and the Munhin River were surveyed in October 2003 for suitable kick sampling locations. There were no suitable locations for kick samples on site and the water levels of the Munhin River were considered too high to safely take samples. The EPA however carries out an extensive programme of kick sampling throughout the country on a regular basis and results from this ongoing monitoring are referred to for the purpose of impact assessment.

7 A riffle area is characterised by shallow, turbulent, fast-moving water over rocks or stone. Increased oxygen levels in a riffle area lead to a higher concentration of pollution sensitive invertebrate species.

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7.2.1.3 *Literature Review and scoping*

Relevant reports such as the Draft *Owenmore River System Report, Fisheries Catchment Plan* (NWRFB 2003) and the *Interim Report on the Biological Survey of River Quality - Results of the 2002 Investigations* (EPA 2002) were reviewed and all relevant information assessed in relation to the development. The North Western Regional Fisheries Board was consulted on potential impacts of the development and appropriate mitigation measures, as well as private fishery owners with interests down river of the development site. A public consultation day was also held and all interested parties invited.

7.3 Receiving Environment

A description of the general layout of the site, together with the main habitats found, and the historical land management use can be found in Section 6. Also detailed are the areas designated for conservation value that lie within a 10km radius of the development site. A description of the watercourses is presented below, and more detail is given on the ecological significance of the coastal cSACs and pNHAs into which the watercourses flow, particularly Tullaghan Bay and the Mullet/Blacksod Bay complex.

7.3.1 Designated conservation areas and rare and/or protected species

7.3.1.1 *Rare and/or protected species*

The Annex II species, the Atlantic salmon (*Salmo salar*) is present in the Munhin River. Lamprey species were also recorded from tributaries entering Lough Carrowmore (the tributaries were surveyed as part of the information provided for the Bellanaboy Bridge Terminal Volume). While the development site is downstream of Carrowmore Lake, it is worth noting the presence of lamprey in the area. Both salmon and lamprey species are recognised as highly sensitive receptors within the receiving environment and both are listed in Annex II of the EU Habitats Directive.

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7.3.1.2 *Designated conservation areas*

The north west Mayo coastline, and in particular the Erris peninsula and its associated coastal habitats is recognised as being of significant ecological value. This is based on the incidence of a number of habitats listed as priority habitats under the EU Habitats Directive such as machair and extensive sand dune systems, and the utilisation of these areas by noteworthy species. In particular, these coastal areas are rich in bird species. The coastal areas have therefore warranted a number of designations and these are outlined below. Another aquatic system of conservation value is the freshwater Carrowmore Lake, which is a significant salmon fishery. A brief description of these designated areas is provided here to put the development site in context with the surrounding area (Table 7.1).

Table 7.1. Designated ecological conservation areas located within 10km of the development site (Aquatic sites)

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Name	Site Code	Designation	Approximate distance from development site
Broadhaven Bay complex	000472	pNHA	9.5 km
Carrowmore lake complex	000476	cSAC	1 km
Mullet/BlacksodBay complex	000470	cSAC	9 km
Tullaghan Bay and Tullaghanashammer Bog	001567	pNHA	3.5 km

Carrowmore Lake is of international ecological value and significant national value. This is due to the occurrence of two Annex II species and the significant stocks of salmon and sea trout smolts, grilse and spring salmon. A fish counter was installed at the outlet of Carrowmore Lake for the purpose of recording salmon numbers entering and leaving Carrowmore Lake. The counter was installed by the NWRFB and over 12 months data has been collated to date. The preliminary results confirm previous assessments that Carrowmore is of great significance for the productivity of the greater Owenmore River catchment and environs.

The Munhin River is the outlet for Carrowmore Lake and is therefore of significance for fish travelling from the Atlantic to spawning beds. The Munhin flows into the Owenmore River, which in turn enters Tullaghan Bay.

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In relation to the development the coastal areas of note are broadly described under Tullaghan Bay, Blacksod Bay and Broadhaven Bay. The former two areas are directly related to the freshwater drainage channels from the development site: the Owenmore River flows into Tullaghan Bay, which is part of the greater Blacksod Bay. Broadhaven Bay is hydrologically isolated from the development site, nonetheless it is included here for completeness of the description.

The designations within these areas include cSAC, pNHA, SPA, IBA and *Ramsar* sites. The first two designations have been described and are listed under Table 7.1 (*see Section 6*). SPAs (Special Protection Areas) are areas designated for their ecological significance based on the presence of bird species and, as such are statutory designations under the EU Birds Directive. IBAs are Important Bird Areas, outlined by *BirdWatch Ireland* to indicate areas that are significant for their bird species complement. They are not statutory designations, but in general, most IBA areas are included in SPAs. *Ramsar* refers to an international convention in relation to wetland sites, which was ratified by Ireland in 1985. The *Ramsar Convention* has its roots in the protection of wetland wildfowl and for many sites it is species-associated. While the convention has no statutory basis it is generally operated through EU or national legislation. For example, the Blacksod Bay and Broadhaven Bay *Ramsar* site is protected by the EU Directives under the Wildlife and Amendment Acts (1976 and 2000) and their associated statutory instruments.

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The Owenmore River flows into Tullaghan Bay. Parts of Tullaghan Bay are designated as (a) a proposed Natural Heritage Area (pNHA), (b) a Special Protection Area (SPA), (c) an Important Bird Area and (d) a *Ramsar* site (see Appendix 3 for *BirdWatch Ireland* and *Ramsar* descriptions of these sites). These designations are justified due to the presence of a number of bird species that utilise the habitats within Tullaghan Bay and the adjacent Blacksod Bay and Broadhaven Bay.

Tullaghan Bay is not noted as being a site of particular importance for bird species owing to the silty, muddy substrate that is not favoured by waders. As a result there are significantly less numbers of species present in the bay relative to those recorded for the greater Blacksod Bay coastal habitats and Broadhaven Bay (personal communication with NPW staff: D. Strong and T. Murray). Peat operations within the Owenmore catchment and erosion from upland blanket bog areas may have had an adverse effect on feeding sites for waders. Tullaghan Bay is almost completely fringed by lowland Atlantic blanket bog and there is probably ongoing erosion of the banks. Parts of the inner sites of the bay such as around Aughness do not get the same levels of 'tidal-flushing' and subsequently peat sediment accumulates. This creates unfavourable conditions for feeding sites for waders (NPW communication: D. Strong and T. Murray).

Other parts of the bay however, do receive tidal flushing. Trawanaskil can be quite good for species like some of the Calidris species (sandpipers) and the muddy substrate is favoured by species such as curlew (*Numenius arquata*). [8] *I-Webs* Counts indicate that there is a good diversity of species in Tullaghan Bay (NPW communication: D. Strong and T. Murray).

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The development site is therefore located central to a number of areas designated for their ecological significance, as outlined in Section 6. While it has been outlined that there will be a low magnitude impact on terrestrial ecology, the freshwater system draining the development deposits in coastal areas that have a significant habitat and associated species resource. The aquatic ecology of the site and these designated areas are closely related and potential impacts of the development must be considered with respect to potential indirect effects on the surrounding system (*described later*).

7.3.2 Habitats

7.3.2.1 Depositing/lowland Rivers FW2

Both the main drain from the development site and the Munhin River fall into this habitat category (Fossitt 2000).

Main drain and two minor drains from the Srahmore site

8 *I-Webs*: International Wetland Bird Survey

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The main drain within the development site at Srahmore is approximately 950m in length and drains the greater portion of the development site, and the adjacent former Bord na Móna production areas. Bord na Móna field drains and main outfalls drain Areas 5, 6 and 7, each of which either partly or completely drain into the main drain. Two other minor drains are present: one drains an area of relatively intact bog and enters the Owenmore at Bord na Móna silt pond S5-1. Another drains the southern corner of the site and enters the Owenmore River at Bord na Móna silt pond S5-2. These drains are Bord na Móna drains and were never significant for salmonid productivity.

The main drain exhibits drain features and has been deepened by Bord na Móna operations. NWRFB records outline that it is a first order stream[9] with a gradient varying from 0% to 0.6%. The drain-like character and low gradient indicates that the main drain is not significant for salmonid production in the catchment.

The vegetative features of field drains and drainage channels are described in Section 6, with a brief description of the main drainage channel presented here. The eastern end of the main drainage channel is devoid of vegetation. Further down stream, the bank vegetation is dense, comprising impenetrable stands of bramble (*Rubus fruticosus*) with soft rush (*Juncus effusus*). Other species present include purple moor grass (*Molinia caerulea*), *Agrostis* spp and Bracken (*Pteridium aquilinum*) (*see Section 6*). The banks are steep *ca.* 1-2m high with the stream width approximately 0.75m. Water run-off through this stream is generally low.

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The main drain from the Srahmore site flows through a Bord na Móna settlement lagoon (S5-5) before passing underneath the existing railway through low intensity agricultural fields and into the Munhin River.

Munhin River

The Munhin River is the outlet from Carrowmore Lake and stretches from Carrowmore Lake (approx. 1km north of the development site) to the Owenmore River. On leaving Carrowmore Lake, water flows along the Munhin and under the County Road R313. The water continues in a southerly direction west of the development site, joining the Owenmore River approximately 2 km south of the site.

The Munhin River is a fourth order river. It is primarily a slow-flowing lowland river, with the gradient varying from 0.1% to 0.5%. Extrapolation from data from the NWRFB GIS system indicates that the section of the Munhin draining the development site does not make a significant contribution to overall salmonid production in the catchment. This is due to the absence of appropriate spawning and nursery habitat for salmonids. The Munhin River is nonetheless utilised for angling, as there are significant numbers of salmon and sea trout utilising the river as a migratory route to and from Carrowmore Lake.

[9] The classification system follows that utilised by the NWRFB.

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The Munhin River drains the adjacent low intensity agricultural fields, which are characterised by relatively low banks (*ca.* 0.5m) in comparison to the main drainage channel from the Srahmore site (see above). The stream side vegetation is dominated by bramble (*Rubus fruticosus*) and soft rush (*Juncus effusus*). Other species include *Agrostis* spp, creeping buttercup (*Ranunculus repens*) and red clover (*Trifolium pratense*). Other species may be present but were not in evidence at the time of survey.

The Munhin River to Owenmore to Tullaghan Bay

For completeness, a brief outline of the watercourse until its terminal point in Tullaghan Bay is provided.

The Munhin enters the lower catchment of the Owenmore River. From this point, the Owenmore stretches for a further 900m before it enters Tullaghan Bay. This is at the highest point to which the ordinary tide flows (marked as salmon weir on O.S. 6 inch maps). There is no discernible gradient along this 900m stretch of the Owenmore River on the NWRFB GIS system. This part of the Owenmore is utilised for angling but once again the lack of spawning habitat and nursery areas indicate that this stretch does not contribute to the overall salmonid productivity. The same applies to Tullaghan Bay. The NWRFB issues 25 special local draft net licences for salmonid fishing Tullaghan Bay, but the bay itself does not contribute to salmonid productivity.

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Biological water quality

The EPA conducts an ongoing monitoring programme of water quality in the Owenmore catchment. Sampling is conducted in summer months for a number of reasons; (a) the macro-invertebrate fauna of rivers are theoretically under the greatest ecological pressure from pollution, because of reduced flows and higher temperatures (McGarrigle *et al.* 2002); and (b) some macro-invertebrate larvae may not be recorded in freshwater systems during winter months[10]. The biotic indices that they have recorded in the Owenmore Catchment are presented in the table below.

Table 7.2. Q-values for the Owenmore Catchment (*Source: EPA 2002*)

Site Name	1981	1986	1990	1994	1997	1999	2002	Current Status
Altnabrocky			5	4-5	4-5	4-5	4-5	Unpolluted
Bellanaboy			4-5	4	4	4-5	4	Unpolluted
Glencullin			4-5	5	5	4-5	-	Unpolluted
Muing			4	3-4	3-4	3-4	3-4	Slightly Polluted
Munhin	4	4-5	4-5	4	4	4	3-4	Slightly Polluted
Owenmore (*at Srahnakilly*)	-	4-5	5	4-5	4	4-5	4	Unpolluted

10 Macro-invertebrate life cycles often involve an over-wintering strategy

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Site Name	1981	1986	1990	1994	1997	1999	2002	Current Status
Owenmore (*1.1km below Bellacorick Bridge*)	-	-	4	4-5	4	4	4-5	Unpolluted
Owenmore (*bridge at Bangor–main flow*)		4-5	4	4	4-5	4-5	4-5	Unpolluted
Owenmore (*3km u/s Munhin confluence*)			5	-	-	4-5	4	Unpolluted
Owenmore (*700 metres u/s Munhin confluence*)	-	-	4	4	4-5	4	4-5	Unpolluted
Sheskin Stream			5	4-5	4-5	4-5	4	Unpolluted

The following two paragraphs detail the EPA Assessments of the Owenmore and Munhin River (*EPA 2002*).

> *"**The Owenmore River** was surveyed in early August 2002. Water quality was satisfactory over its length and a good range of pollution-sensitive species present in spite of the ubiquitous presence of silt arising from commercially exploited peat bogs in the catchment. Siltation was especially notable in the upper sections (0050, 0150). Nonetheless an improvement in quality was noted at Stn 0150, downstream of Bellacorick village and power station, in comparison with 1999. In the middle reaches, as far as Bangor, quality was satisfactory (0270, 0300). A slight deterioration in quality was noted downstream of Bangor (4900) in comparison with 1999. Quality was again of a good to high standard at the last station sampled, which is downstream of the Munhin River, which flows from Lough Carrowmore.*
>
> ***The Munhin** was slightly polluted at the point sampled (0200). The Munhin is located downstream of Carrowmore Lake and an extensive area of Bord na Móna exploited bog. It is notable for its large population of the hemipteran, Aphelocheirus sp., which was still present in August 2002. However, none of the most pollution-sensitive macroinvertebrate species were found at the site in 2002 in contrast to 1999. Turbidity has always been noticeable at this site (0200) due to the peat workings upstream and it is also highly influenced by Lake Carrowmore, which has a surface area of over 900 ha. It is reported that Carrowmore Lake has yielded large numbers of salmon to the rod in recent years".*

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7.3.3 Fish

The main drain has been heavily impacted by Bord na Móna drainage activities (*see Section 9*). It is unlikely that the stream was ever a significant spawning or feeding area and its current status remains as such. The same applies to the other two drains within the development site.

The Munhin River is recognised as an important fishery (NWRFB 2002). It is also an

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important link for fish travelling from the Owenmore River upstream to spawning grounds in the tributaries feeding into Carrowmore Lake. Electro fishing was conducted in the streams that enter Carrowmore Lake during preparation of the baseline studies for the Bellanaboy Bridge Terminal Site. Species recorded were brown trout (*Salmo trutta*) and salmon (*Salmo salar*). The salmonid juveniles were considered to be moving towards Carrowmore Lake. They remained there until they became smolts and migrated to sea via the Munhin River.

Stickleback (*Gasterosteus aculeatus*), freshwater European eel (*Anguilla anguilla*) and lamprey (*Lampetra fluviatilis* or *Lampetra planeri*) were also recorded during the surveys and were in abundance in 2003. The introduced species, minnow (*Phoxinus phoxinus*), was also recorded.

7.3.4 Birds

There is no significant usage by birds of the freshwater habitats within the immediate area of the development site but species known to use the Munhin River include heron and cormorant.

7.3.5 Evaluation of ecological significance of the watercourses draining the proposed development site

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An attempt is made here to provide an evaluation of the aquatic habitats immediate to the development site, and also in relation to the areas into which the watercourses drain (those areas described as being of ecological significance). The evaluation follows the Regini (2000) guidelines for ecological evaluation (*see Section 6*). The ecological value of the drainage channels within the development site are considered to of **negligible value, G.** This category includes low grade and widespread habitats (Regini 2000). This is justified for the following reasons:

- There are no rare or protected species recorded within the main drain at the Srahmore site and/or the other minor drain.
- The drain-like character of the drainage channels and peat base suggests the site will never contribute to salmonid productivity in the Owenmore catchment (first order streams, low gradient, history of Bord na Móna deepening, etc.).
- The drains have no ecological value, except for their value to allow for treatment of the water from the development site before entering other watercourses.

For completeness, an evaluation is provided for the watercourses into which the Srahmore drains channels will flow. The aquatic ecology of the surrounding area is considered to be of **A, international value.** This category includes internationally designated or proposed sites such as SACs, or sites otherwise meeting criteria for conservation designation at international level. It also includes sites supporting populations of internationally important species. This assignment is justified for the following reasons:

- The presence of listed Annex II species, the Atlantic salmon in the Munhin River and

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greater Owenmore catchment.

- The presence of lamprey in tributaries entering Carrowmore Lake. Three lamprey species are found in Ireland, all of which are protected under the EU Habitats Directive and two were recorded from tributaries entering Carrowmore Lake (*Lampetra fluviatilis* and/or[11] *Lampetra planeri*).
- The recognised international and national ecological significance of Carrowmore Lake and Tullaghan Bay and the greater Blacksod Bay complex as SPAs, cSACs, pNHAs, IBAs and Ramsar designations. The designations are assigned because of the presence of listed rare and vulnerable bird species, the utilisation of the sites for migratory species and the presence of internationally significant numbers of migratory species each year.
- The significance of the link provided by the Munhin River between Carrowmore Lake (cSAC and habitat for Annex II species such as salmon and brook lamprey) and the Atlantic Ocean for migrating and spawning salmonids.
- While both the Munhin River and the Owenmore River are not presently designated as cSAC, the presence of Atlantic salmon is considered sufficient for these rivers to be treated as cSAC sites under this evaluation of ecological significance.
- There are listed habitats present within the designated areas within Blacksod Bay that are included as priority under the Habitats Directive and any indirect effects from the development could impact on these areas. While there are no listed rare species of plant recorded from the watercourses, or from the terrestrial habitats, it is the machair and sand dune complexes as a whole in the Mullet/Blacksod complex that justifies the designation of those areas.

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7.4 Characteristics of the Proposed Development

See Sections 2, 6 and 9.

The key features of the development are outlined in Section 2, with reference to the features that will impact on the ecology in Section 6. Those features that are important in consideration of the aquatic ecology are the proposed drainage infrastructure and the proposed sedimentation pond design. These are outlined in Section 9.

7.5 Potential Impact of the Proposed Development

The levels of magnitude of impact are assessed according to the Regini (2000) guidelines and the timeframes considered here allude to those outlined by region (2000) and not those outlined by the EPA (2002).

It is evident from the previous description of the watercourses draining the development site and their link to aquatic habitats of international ecological significance, that any activity within the development site must proceed with due consideration of this aspect and appropriate mitigation measures. The impacts of the development are considered here in the

11 There is some difficulty in species identification of juvenile forms of lamprey, although it is most likely the species recorded was *L. planeri*.

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context of temporary and permanent, and direct and indirect effects.

In contrast to the outline of potential impacts in Section 6, the impacts are considered in the context of the potential effects of elevated suspended solids content of drainage waters and/or a pollution incident. Direct effects are those within the development site and immediately adjacent (the Munhin River), with indirect effects referring to the impacts on designated areas that may be impacted upon by water flowing from the site. Habitats, fauna and designated areas are therefore broadly treated together.

7.5.1 Potential means by which the aquatic ecology may be impacted

First of all it is necessary to outline the possible means by which the development could impact on the aquatic ecology. The two main concerns are (a) excessive suspended solids entering watercourses off-site and (b) pollution incidences resulting in discharges to watercourses. The effects of both of these situations are outlined here for completeness.

7.5.1.1 Excessive suspended solids within watercourses

Suspended solids in relation to the development described in this Volume refer to peat particles. There is a certain level of naturally occurring peat sediment due to drainage waters flowing through peatland areas however, in the case where a large volume of peat will be deposited onto a cutover peatland, there is an increased potential for peat to go into suspension. The effects are outlined here, with a brief description of the impact:

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- *Smothering of fish spawning redds*

Salmon and trout eggs or fry present in spawning redds may be smothered by excessive deposits of silt, or spawning fish may avoid traditional spawning areas if these are covered in silt deposits.

- *Fish health damage*

Fish gills are susceptible to abrasion by excessive exposure to elevated suspended solids levels, which in turn can give rise to health problems in the form of gill disease. Juveniles tend to be more susceptible than older individuals.

- *Interference with angling*

Excessively turbid waters are likely to reduce angling success (game and coarse angling). It is this impact from suspended solids which is recorded first, before damage to fish health (Terminal Volume).

- *Smothering of macroinvertebrates*

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

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favouring less diverse assemblages.

- *Smothering or stunting of aquatic plant communities*

Aquatic plant communities (especially submerged growths) are likely to be eliminated or stunted by excessive deposition of suspended sediment, and effects may also occur through reduction in photosynthesis due to excessive water turbidity.

7.5.1.2 Pollution incidences resulting in discharges to watercourses

- *Pollution from Fuel Oil*

Spillage of fuel, lubrication or hydraulic oils either from bulk storage or from construction vehicles or plant and equipment operating close to watercourses or drainage ditches which connect to watercourses may cause damage to aquatic flora and fauna communities.

7.5.2 Temporary impacts during construction of infrastructure and deposition of material.

It is in the light of consideration of these potential effects arising from the development and the mitigation measures that are described in Section 9, that the temporary impacts are described. The mitigation measures include (a) a detailed drainage scheme with sedimentation ponds in series along the main outfall, (b) parallel terminal sedimentation ponds at the exit points of the drainage waters into the main drain in Areas 5 and 6, and (c) the provision of a floodplain facility in Area 7 to cater for an extraordinary rainfall event. The water leaving the development site flows through a sedimentation pond, which is currently covered by the Bord na Móna IPC Licence.

Temporary impacts relate to those potential impacts from the onset of development (short-term temporary) to long term temporary impacts (15-25 years following the onset of development). The short-term temporary period is considered in detail here.

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7.5.2.1 Temporary short-term impacts (direct)

The greatest level of activity will occur within the short-term temporary period. Once the mitigation measures outlined above and in Section 9 are implemented, the impact level should be of **very low magnitude**. This is justified in that following the initial introduction and shaping of the peat, there should be minimal potential for peat run-off and any water leaving the system will be pre-treated to EPA standards. Also, revegetation and stabilisation of the peat is expected to be complete within 5 years following peat deposition. There will therefore be no potential for elevated suspended solids to occur in waters either on-site or leaving the site. Therefore, there will be no loss of habitat through siltation of watercourses and no direct effects on fauna.

The proposed operation should be considered relative to the previous intensive industrial

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peat production operations by Bord na Móna since the 1960s. During that time peat was milled and dried to a fine crumb. While sediment ponds (up to 28 in total) operated in connection with peat production areas the potential for excessive suspended solids to occur in run-off was more significant. In the development described herein, wet peat will be introduced and maintained at a level wet enough to keep the peat in situ and encourage the establishment and spread of *Juncus effusus*.

7.5.2.2 Indirect effects in the temporary short-term

Implementation of the mitigation measures outlined above and in Section 9, will result in the indirect effects on designated areas that are hydrologically linked to the development site being of **very low magnitude**. There should be no elevated levels of suspended solids in the water leaving the site once mitigation measures are put in place. There will be no loss of habitat and no effect on faunal activity.

The effect of elevated suspended solids in a high rainfall event could have a negative impact on angling. This would occur through reducing visibility of salmonids through increasing turbidity. Due to the lack of spawning habitat in the Munhin and lower stretches of the Owenmore, there would be no indirect effect on productivity within the Owenmore catchment. However, the mitigation measures outlined should mitigate against potentially elevated suspended solids in watercourses leaving the peat deposition area.

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7.5.2.3 Impacts in the medium and long-term temporary period (direct impacts)

It is predicted (*see Section 6*) that the peat deposition area (Area 6) will have revegetated completely within 5 years. Following this period there will be minimal potential for peat to enter suspension, except where peat lies in drainage channels, which is unlikely to be at any significant level.

All other activities will have ceased following completion of the peat deposition and Area 5 will have been decommissioned and rehabilitated. This will be in tandem with the rehabilitation of the greater Bord na Móna holdings under the *Rehabilitation Plan* (*see* Appendix 2). Area 7 will have been rehabilitated prior to the completion of the development. Sedimentation ponds will continue to be excavated to ensure their efficient operation in accordance with the requirements of the EPA. Therefore, temporary medium and long-term impacts will be of a **very low magnitude**. Following cessation of the need to maintain drainage channels, replacement habitats will form in these channels and provide freshwater habitats for vertebrates such as frogs, and a range of micro- and macro-invertebrates, leading to an overall increase in biodiversity of the site.

7.5.2.4 Indirect impacts in the temporary medium to long-term

There are no indirect impacts envisaged in the temporary medium to long-term. Revegetation and rewetting of the peat deposition area and rehabilitation of Area 5 may lead

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to expansion of wetland habitat for wetland bird species. There is no anticipated indirect effect on productivity of salmonids within the Owenmore catchment. Therefore, indirect temporary medium and long-term impacts will be of a **very low magnitude**.

7.5.3 Permanent impacts of the proposed development (direct and indirect)

Any permanent impacts of the development will be of a **very low magnitude**, following from revegetation of the site and stabilisation of the peat, decommissioning and rehabilitation of the activity areas and maintenance of sedimentation ponds to work at maximum efficiency. Once the peat is stabilised and the site naturalises there should be a **negligible permanent impact**, both direct and indirect. There will be replacement freshwater habitats within drainage channels and sedimentation ponds that naturalise, will revert to sedge and/or reedswamp vegetation that will further contribute to the biodiversity of the site through enhancement of aquatic vegetative complexes. This would contribute to an overall positive impact with respect to aquatic habitats on the development site with negligible impact off-site.

7.6 Do Nothing Scenario

If the development did not proceed the site would be rehabilitated as described in the *Rehabilitation Plan* submitted as part of the IPC Licence application for the boglands of the Oweninny Works to the EPA (IPC Licence. No. 505) (Appendix 1) (*see Section 6*).

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7.7 Mitigation Measures

A number of mitigation measures have been considered in the course of design of the development.

7.7.1 Mitigation by avoidance

The nature of the site chosen for peat storage is an important element in mitigating against excessive suspended solids in run-off. The site is saucer-shaped and compartmentalised by high fields. This mitigates against any potential lateral movement of peat and any movement within low-lying bays will be towards the low point in the middle of the peat deposition area.

7.7.2 Mitigation by treatment of water before entering watercourses

The drainage scheme is outlined in detail in Section 9. Water draining the peat deposition area will be controlled through a series of sedimentation ponds with the provision of an overflow facility in Area 7 in the case of an extraordinary rainfall event. The drainage scheme has been designed in consultation with the *NWRFB* (*see Section 9*). Sedimentation ponds will be maintained over the course of the development and for a period until such time as outlined by the licensing authority.

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Oil traps and oil spillage kits will both be installed at the site to mitigate against pollution from fuel spillages and/or other potential pollutants. All wastewater from Area 5 will be taken off-site and sewage effluent will also be removed. Fuel oil will be stored in double skinned mobile tanks. These tanks will be filled while standing on the bunded reception area. The loading shovels will be refuelled on this bunded reception area, as will some of the other plant. The remaining plant will be refuelled at continuously changing points within the peat deposition area.

7.7.3 Mitigation by remedy and re-instatement

Revegetation of the site will stabilise the peat and knit the introduced peat into the former Bord na Móna production area. The vegetation will comprise predominantly *Juncus effusus* with a ground layer of bryophytes. These plants will cover the bare peat, and also filter rainfall passing through.

A number of possible re-instatement options are outlined in Section 6, and the appropriate option will be selected that will allow the system to naturalise and utilise the vegetative features to filter water on site and possibly restore peat-forming conditions.

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7.8 Predicted impact of the Proposed Development

7.8.1 Predicted direct impact

The predicted impact of the development is of **negligible impact magnitude**. This is due to the negligible ecological value of the drainage channels on site and the very low impact of the development as outlined previously.

7.8.2 Predicted indirect impact

In consideration of the mitigation measures outlined here and in Section 9, the indirect impact of the development on surrounding areas is expected to be negligible also. Due concern has been given to the fact that the watercourses draining the development site enter watercourses of international significance and strict environmental controls have been designed.

In the worst case scenario, given that there were no mitigation measures installed, there would be potentially significant run-off of peat from the site during the peat deposition stage and probably up until the first 12 months following peat deposition, but only in high rainfall events. This is because the peat will be wet and shaped to mitigate against sediment loading of drainage waters. This would have an indirect impact on angling (increased turbidity leading to reduced visibility and therefore reduced catch). There would be no impact on spawning of salmonids as this part of the Owenmore catchment is at its lowest reaches and

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there is no habitat suitable for spawning or nurseries available.

Given that the worst case scenario will never arise due to the installation of mitigation measures, the indirect impact of the development will be of **low to negligible magnitude**.

7.9 Monitoring

The water quality-monitoring regime will be set out by the regulatory bodies. However, water quality samples will continue to be taken from the locations sampled in October 2003 up until the onset of development. Following the onset of development in Areas 5 and 6, sampling will continue. Following cessation of activity (including decommissioning and rehabilitation) sampling will continue at intervals specified by the regulatory authorities.

A composite sampler will be installed at the main drainage channel to provide daily information on sediments in the run-off. This will be located at the entry point of run-off from the main sedimentation ponds the main drainage channel.

7.10 Reinstatement and Residual Impacts

There are no negative residual impacts foreseen at this time.

Re-instatement options are outlined in Section 6. The appropriate option will be selected in view of the best outcome for both the terrestrial and aquatic ecology.

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8 SOILS AND GEOLOGY

8.1 Introduction

TES Consulting Engineers have prepared the Soils and Geology section of the Volume. The information contained below is concerned with a description of the existing geological character of the site. This section also addresses the hydrogeological character of the site, as the groundwater environment is intrinsically linked to the geological material through which it flows.

The geological material existing within the site has been generated by the deposition of detritus over millions of years. The development of the blanket bog peat in north Mayo is considered to be recent in the geological timescale, having occurred in the last 4,500 years. Its formation is concurrent with human activity, as demonstrated by the identification of Neolithic field systems at Céide. The formation of blanket bog, which is the dominant landscape character in the region, occurred due to a significant change in climatic conditions approximately 4,500 year ago, bringing about wetter conditions and creating an ideal environment for peat formation.

The geological material underlying the blanket bog, both the Quaternary glacial mineral soil and the bedrock are concealed. The nature, extent and complexity of the geological material, from the surface downwards through the mineral subsoil to the bedrock, is detailed below.

The groundwater encountered in the various strata is also discussed, with respect to the hydraulic characteristics of the material through which the water flows.

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8.2 Study Methodology

This report has been prepared using the recommendations set out in the Environmental Protection Agency (EPA) document 'Guidelines on Information to be contained in Environmental Impact Statements' (2002). The guidelines and recommendations of the Institute of Geologist of Ireland (IGI) publication 'Geology in Environmental Impact Statements – A Guide' was also taken into account in the preparation of this section.

This section describes the geological material existing within the site, from the surface downward, through the mineral subsoil to the bedrock. The composition and the extent of these deposits are discussed. Groundwater and the hydrogeological setting of the site are also discussed in this section, as the nature of the geological material existing and the hydraulic characteristics of the various materials through which the water flows controls groundwater flow.

The information contained in this section has been divided into sub-sections, so as to describe the various aspects pertaining to soil and geology. In the preparation of this section

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the following protocol was used in order to assess the regional and site specific context and character of the site:

1. The site was assessed using regional geological publications and maps;
2. All available information was collected from the Geological Survey of Ireland in order to assess previous investigations in the area;
3. A site investigation programme was designed and undertaken within the site, that included topographic surveys, trial pitting of soils/subsoils, drilling into subsoils/bedrock, laboratory and field testing of the various materials and sampling; and
4. Preparation of this geological report was undertaken following the collation of all available information.

The characterisation of the site is considered detailed and sufficient to adequately characterise the geological setting of the site. The information included in this section is considered to meet the data requirements suggested in the IGI publication 'Geology in Environmental Impact Statements - A Guide".

All projects and developments that require an EIS are of a scale or nature that they have the potential to have an impact on the environment. It is therefore crucial that the significance of the potential impact is determined. In this Volume the potential impact on the geological environment resulting from the importation and deposition of peat onsite is assessed and mitigation measures are proposed to reduce any significant impacts. Based on the mitigation measures proposed the significance of the predicted impact on the geological environment is determined. A programme of monitoring is proposed to demonstrate that development is not impacting the surrounding geological environment.

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8.3 Receiving Environment

8.3.1 Topography and Topographic Landform

The topographic landform of this region is dominated by expansive tracts of land that are relatively flat, however the relief is broken by dramatic upland terrains (Nephin Beg and Owenduff area). Although the extraction of peat in this region has now ceased, the previous industrial activity has had a significant impact on the topographic landform and has resulted in exposed peat surfaces throughout the site.

As a result of the industrial harvesting of peat a large tract of land in North Mayo has been disturbed. A significant volume of the peat material has been exported from the region to fuel the peat fired power plant in Bellacorick.

The peat reserve to the west of Bangor has been broken up into worked areas, with the extent of each area defined by the natural margins of the bog, which have never been

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worked. Within each worked area, high fields, approximately 14m wide, traverse the cutaway areas.

The design of the worked areas took account of the difficulties in movement of plant and machinery across the peatlands. The high fields were left in-situ so that the milled peat could be exported from the site by rail. The railtracks were laid on top of the high fields during the extraction operations.

The areas where peat extraction has occurred, referred to as 'low fields', are approximately 2m below the natural topographic elevation of the land. The low fields are completely enclosed by the margins of the peatlands and the linear high fields traversing the worked areas. In effect, each low field is viewed as an elongated basin, which is completely bound by the elevated lands of the natural bog.

8.3.2 Soil

Reference to the General Soil Map of Ireland (published by National Soil Survey, An Foras Talúntais in 1980 at a scale of 1:575,000) indicates that the entire site is underlain by low level blanket bog. The Soil Map of West Mayo (published by the National Soil Survey, An Fóras Talúntais in 1974 at a scale of 1:126,720 indicates that the peat material is part of the Bellacorick-Glenamoy soil series of blanket bog.

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Blanket bog is so called because its development is mostly independent of basins or topographical features where water collects; rather it simply covers the landscape like a blanket. In Ireland the distribution of blanket bogs is confined to the western extremities of the country and upland areas, where precipitation is high (greater than 1,200mm annually) and evaporation is low. Blanket bogs are maintained by rainfall and thus have a low nutrient content. The pH of a blanket bog lies between 3.5 and 4.2.

On virgin blanket bogs there is a thin layer of highly decomposed peat, which acts as an impermeable barrier for infiltrating water and creates waterlogged conditions favourable for peat production. The peat in a blanket bog is generally consistent throughout the soil profile. The peat is derived from plant remains, mainly grasses, sedges and heathers. Blanket bog peat is generally very dense and highly decomposed, which results in a very slow downward movement of water through the soil profile. In its natural state, blanket bog is composed of 85-95% water.

Based on visual assessment of the proposed site, the peat material has not been completely exhausted within the subject site. Peat still occurs at the base of each farms production field. As part of the site characterisation, the thickness of the remaining peat material within the site was assessed.

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Bord na Móna undertook a survey of the Srahmore site in 1998, using a 'Hiller Borer' sampler, which is a hollow stem sampler. This sampler was pushed into the peat material and the hollow stem was used to indicate when mineral subsoil had been encountered. The results of the 1998 survey were adjusted to account for the extraction programme undertaken in the intervening period and the elevation was reduced. The elevation of the interface between the base of peat and the mineral subsoil are shown on Drawing 1169\01\207.

With respect to Area 5, the survey indicates that the peat thickness varies from 0.34m to 0.7m in the zone where it is proposed to construct the reception hardstand. The peat thickness along the access road from the R313 to the reception hardstand varies from 0.34m to 6m. The peat thickness is greatest immediately adjacent to the R313, where no peat extraction has been undertaken. With respect to Area 6, the Hiller Borer survey indicates that between 0.1m and 2.16m of peat overlies the mineral subsoil in the low fields.

As part of the site investigation programme and in order to verify the correction of the Hiller Borer results, 14 No. trial pits were excavated within the proposed site. The trial pit information was also valuable in that it allowed an opportunity to examine the nature and extent of the peat material. The trial pit logs are included in Appendix 4 and the locations where the trial pits were excavated are shown on Figure 8.1.

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A total of six of the trial pits were excavated within Area 5. Five of these trial pits (TP1, TP8 and TP9, TP13 &TP14) were undertaken in areas not assessed as part of the Hiller Borer Survey These trial pits encountered very thin peat cover to the southwest of Area 5 (TP8 and TP9), with between 0.2m and 0.4m cover of peat encountered, whereas 2.4m of peat cover was encountered to the northwest of Area 5 (TP1). The other trial pit (TP2) was excavated in the area of the proposed reception hardstand. The depth of peat encountered in this trial pit (0.65m) coincides exactly with the thickness of peat recorded from the Hiller Borer survey.

Five trial pits were excavated in Area 6. The information recorded from the trial pits (TP3, TP4, TP5, TP6 and TP7) coincides closely with the thickness of peat recorded from the Hiller Borer survey, with between 0.84m (TP7) and 1.8m (TP3) of peat recorded overlying mineral subsoil. In general, the thickness of peat is at a minimum to the west of Area 6 and appears to thicken to the south.

A further 3 No. trial pits were excavated in Area 7 (TP10, TP11 & TP12). The thickness of peat cover in this area was very thin, measured as varying from 0.1m to 0.3m thick.

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TP13
TP8
TP9
TP11
TP10
TP12
TP7
TP2
BH 3A/B
TP3
BH 2A/B
TP5
BH
TP4
TP6
BH 1A/B

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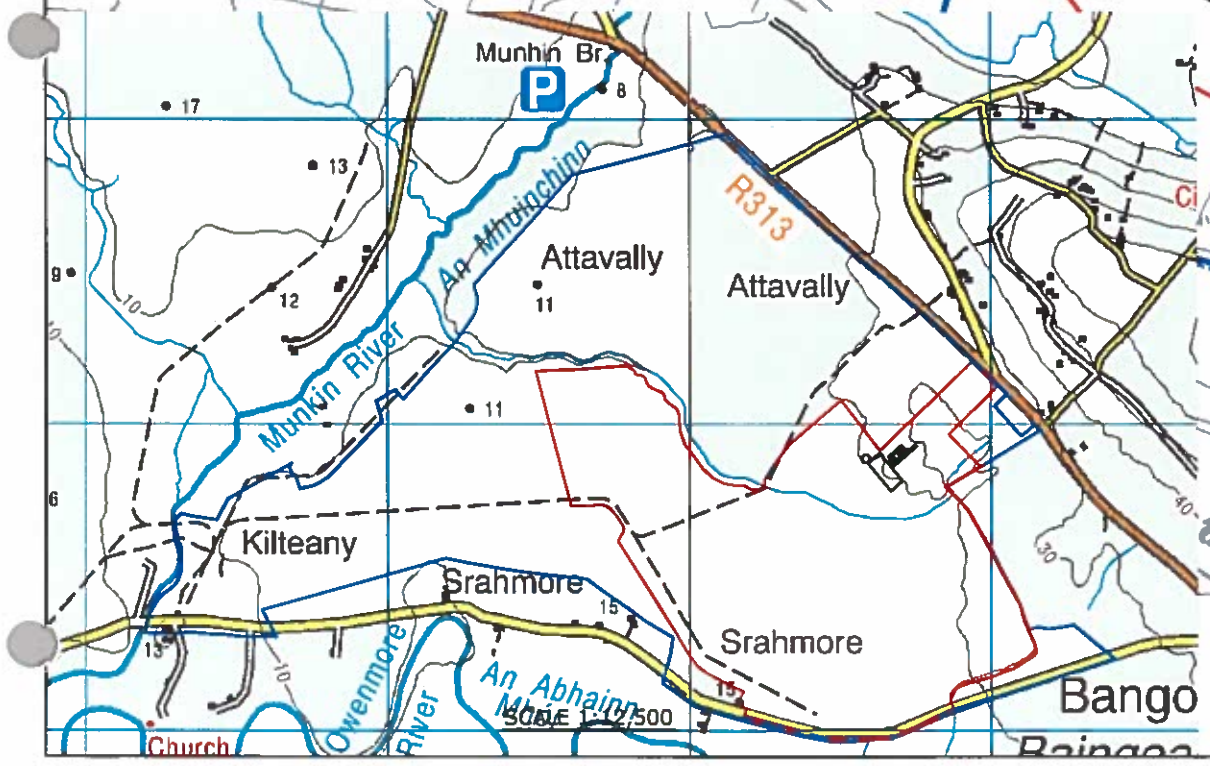

SCALE 1:2,500

TP5
BH 4

NOTE

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OS Sheet No. 18 & 26 Co. Mayo

All levels relate to Ordnance Datum at Malin Head

suffix	revisions	date	init.

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BORD NA MÓNA

Project
CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

Drawing Title
SITE INVESTIGATION
14 TRIALPITS AND 7 BOREHOLES
FOR SRAHMORE PEAT DEPOSITION SITE

Scale: VARIES @ A1

Drawn by	Checked by	Date
Colin Peacock	Damien Grehan	DECEMBER 2003

ENGINEER IN CHARGE: SEAN FINLAY

TES
CONSULTING ENGINEERS

Drawing No.
FIGURE 8.1

Rev.

8.3.3 Subsoil Geology/Superficial deposits

8.3.3.1 Subsoil Geology

The 14 No. trial pits excavated within the site continued to sufficient depth so that at all locations the mineral subsoil was encountered. This allowed the nature and composition of the subsoil material to be examined.

The trial pits were excavated to depths varying from 1.65m to 3.45m below ground level (bgl). Mineral subsoil was encountered at depths ranging from 0.1m bgl (TP10) to 2.4m bgl (TP1). The uneven elevation of the interface between the peat and the mineral subsoil is a function of the uneven elevation of the topography prior to the formation of the blanket peat and the uneven elevation of the current topography due to extraction of peat.

The mineral subsoil encountered in each trial pit was recorded and logged. All trial pit logs are included in Appendix 4, with the locations where the trial pits were excavated shown on Figure 8.1. The dominant subsoil is described as a predominantly light grey, clayey/silty, fine grained SAND, with angular to rounded cobbles and boulders of quartzite, schist, sandstone and gneiss.

A sample of the mineral subsoil encountered in each trial pit was obtained for laboratory testing. The particle size distribution (PSD) of each sample was examined to determine the exact composition of the subsoil. The PSD curves for each subsoil sample are contained in Appendix 5. The PSD curves confirm the field description of the subsoil. The laboratory description of the dominant subsoil is a pale grey, silty SAND with gravel. In general the percentage of fine material (fine sand, silt and clay) of each sample is high, and the percentage of gravel is high.

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Further to the excavation of the 14 No. trial pits, 7 No. boreholes were drilled within the site. The material encountered during drilling was recorded and logged. The borehole logs are provided in Appendix 6. The drilling programme provided information on the thickness of unconsolidated material (mineral subsoil and weathered rock) overlying bedrock.

At the margins of the site, shallow and deep boreholes were installed at three different locations upgradient and downgradient of the site. Bedrock was encountered in all deep boreholes around the margins of Area 6 (boreholes BH1B, BH2B and BH3B). The depth to bedrock recorded from these boreholes was 13.5m bgl at BH1B, 14.3m bgl at BH2B and 6m at BH3B. Borehole 4 was drilled close to the centre of Area 6 and continued to a depth of 30m and was terminated while still in unconsolidated material. A geological cross section is shown on Fig 8.2.

This indicates that the elevation of the bedrock across Area 6 can be viewed as a basin, which is closest to the surface at the margins of Area 6 and is deepest close to the centre of the site.

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Due to the gravelly nature of the mineral subsoil it was not possible to obtain undisturbed samples to determine the permeability of the material. Therefore in order to determine some basic hydraulic characteristics of the subsoil field tests were undertaken on the shallow boreholes that were isolated in unconsolidated material. Permeability tests were undertaken on boreholes BH1A, BH2A, BH3A and BH4, using recognised testing procedures. The method of testing involved two different procedures, the first involved undertaking a rising head permeability test (Slug Test) and the second method of testing involved recording the recovery of water levels following purging of the borehole standpipe. Hydraulic characteristics can be determined by monitoring the changes in water levels over recorded time.

The hydraulic permeability of the unconsolidated material, interpreted from the data recorded from the test and interpreted using aquifer analysing software (AQTESOLV) is presented in Appendix 7. The average permeabilities, based on a number of different interpretations of the data for each shallow borehole are listed below:

- BH1A: K(average) = 3.10 x 10^{-7}m/sec
- BH2A: K(average) = 3.59 x 10^{-7}m/sec
- BH3A: K(average) = 9.65 x 10^{-7}m/sec
- BH4: K(average) = 2.45 x 10^{-6}m/sec

Based on the range of permeabilities recorded within the site, which range from 2.45 x 10^{-6}m/sec at the upper range and 3.10 x 10^{-7}m/sec at the lower range of values, the permeability of the subsoil would be regarded as a low permeability material.

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8.3.3.2 Superficial Deposits

The superficial deposits within the area can be briefly classified into the following main types.

(1) Peat
(2) Glacial Till
(3) Weathered Rock

In general terms all superficial deposit types other than peat may be referred to as mineral soils. Exposures below the base of the peat are limited to trial pits, which indicate till underlying peat. The extent of weathered rock below till is not known, as boreholes were open-holed to top of competent rock.

Peat

Blanket peat originally covered the site. Most of the peat has been removed from the low fields, leaving typically less than 1m thickness of peat. Original peat depth was estimated as typically 3 to 4m. Locally deeper areas of peat, up to 6m adjacent to R313, were recorded.

Based on a general soil map of Ireland (An Foras Taluntais, 1980), the site is shown to be covered in low-level blanket peat.

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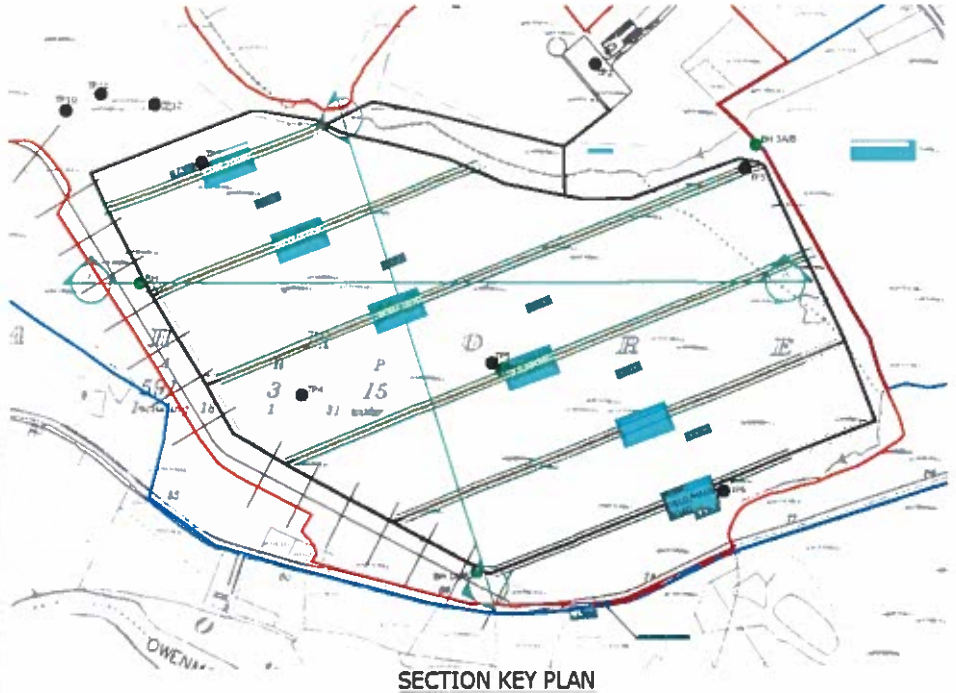

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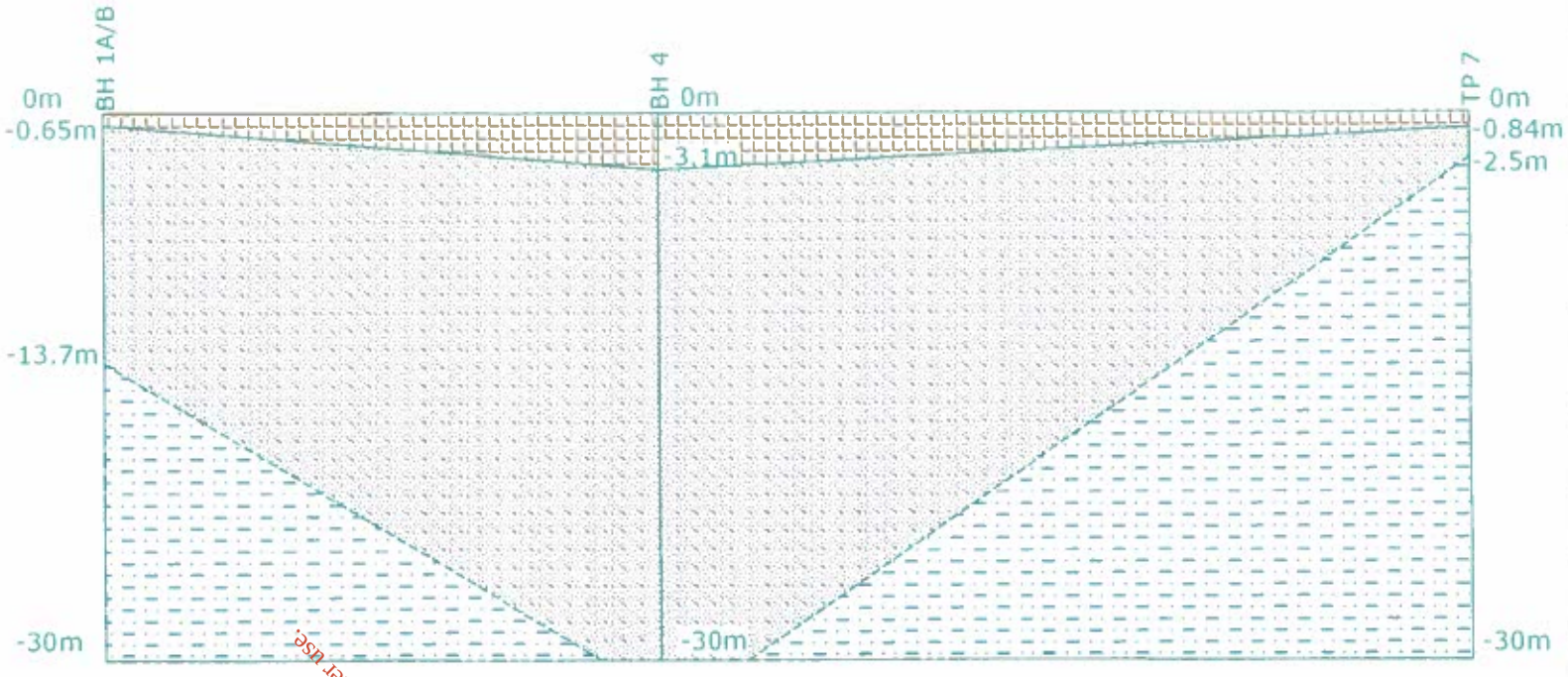

SECTION A-A

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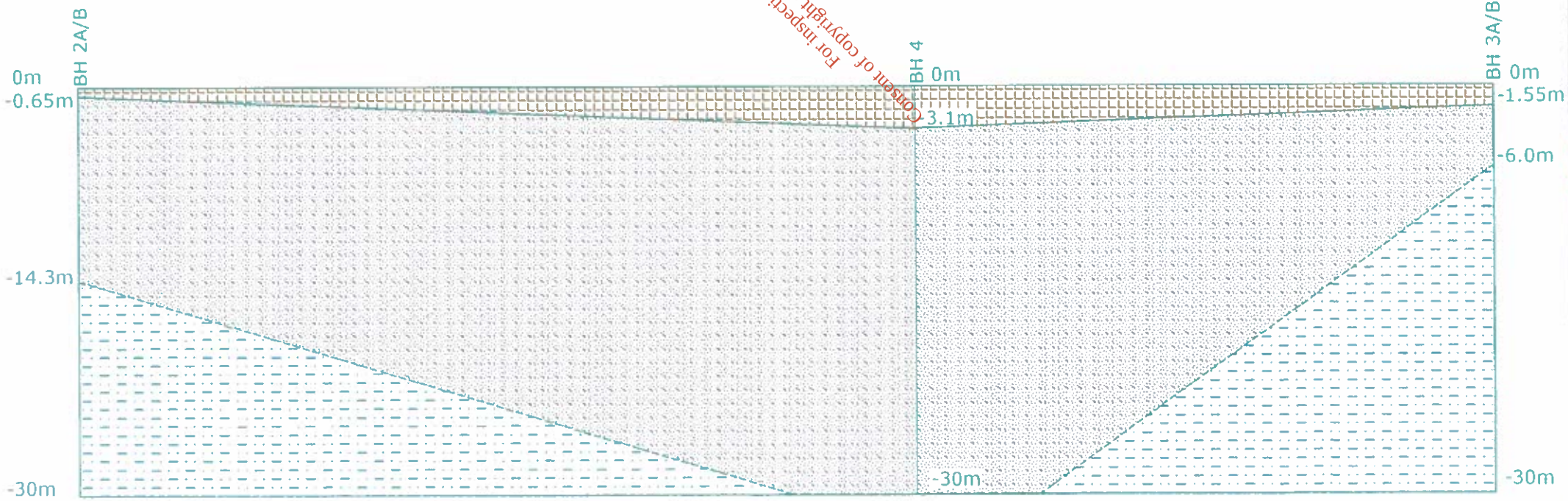

SECTION A-A

LEGEND

- SITE OWNERSHIP BOUNDARY
- SITE ACTIVITY BOUNDARY
- HAUL ROAD
- HIGH FIELD
- ACCESS ROAD
- EXISTING RAILWAY

STRATA

- PEAT
- CLAYEY/GRAVELLY SAND
- BEDROCK (QUARTZITE TO PSAMMITE)

NOTE

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OS Sheet No. 18 & 26 Co. Mayo

All levels relate to Ordnance Datum at Malin Head

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BORD NA MÓNA

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CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

Drawing Title

GEOLOGICAL CROSS-SECTIONS
FOR SRAHMORE PEAT DEPOSITION SITE

Scale	HOR. 1: 2000 VERT. 1: 200 @ A1		
Drawn by	Checked by	Date
David Commerford	Damien Grehan	DECEMBER 2003

ENGINEER IN CHARGE: SEAN FINLAY

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CONSULTING ENGINEERS

Drawing No.

FIGURE 8.2

The upper layer about 1m of peat is generally very fibrous and possibly desiccated which results in a relatively stronger and stiffer upper layer. Peat was described using BS: 5930 (BSI, 1999) as soft slightly moist brown PEAT with occasional fragments and large pieces of bogwood. Peat appeared to lie directly on glacial till.

Glacial Till

Till, typically derived from local bedrock, underlies the peat. The thickness of till in Area 6 is estimated to vary from 6 to 14m based on the depth of superficial deposits given in borehole logs. Borehole logs do not distinguish between till and weathered rock, and it is possible that weathered rock is present in the lower part of the superficial deposits.

Based on trial pit logs, till is present at some locations as an upper cohesive deposit underlain by a granular deposit. Till was described from trial pits using BS: 5930 as follows.

(1) Upper cohesive deposit. Described as generally firm brown sandy CLAY. Given the presence of bogwood in the peat, this suggests that prior to peat formation the site was formerly forested, and therefore a buried soil surface layer is likely present. The upper cohesive deposit possibly represents the remnants of a buried soil surface layer. This layer does not appear to be widespread.

(2) Lower granular layer. Described as generally grey to yellow/brown clayey to slightly clayey occasionally silty gravelly fine- to medium-grained SAND with occasional to some sub-angular to sub-rounded gravels, cobbles and boulders of quartzite, schist and red sandstone. The till is layered, with occasional GRAVEL layers also recorded, though no clear stratification between trial pits was recognisable. The lower granular till layer is widespread and is more commonly found immediately below peat.

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Weathered Rock

Extent and character of weathered rock is not known as borehole logs do not distinguish between till and weathered rock, and it is possible that weathered rock is present at depth. No weathered rock was identified from trial pits which were excavated to about 3m.

8.3.4 Bedrock Geology

Reference to Sheet No. 6 – Geology of North Mayo, published by the Geological Survey of Ireland (1992), indicates that the bedrock underlying the site is recorded as belonging to the Bangor Succession of the Dalradian Supergroup of rock types. The Dalradian Supergroup is composed entirely of metamorphic rocks (rocks altered by heat and pressure). An extract of Sheet No. 6, showing the proposed site is shown on Figure 8.2.

The rock types found in the Bangor area are principally metamorphosed sedimentary rocks. It should be noted that the delineation of rock units are interpreted from limited bedrock

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exposure due to the extensive cover of blanket bog and mineral subsoil over much of the low lying areas in the Bangor region.

The geological map delineates a number of rock types across the site, which are recorded as distinct formations. The map indicates that the Broadhaven Formation and the Benmore Formation from the Erris Group of rocks underlie the extreme southwest of the site. The Pollacappul Schist Formation, the Bellagarvan Formation, the Kinfinalta Formation, the Doon na Dell Schist Formation, the Ballybeg Park Limestone Formation and the Inver Schist Formation, which are all part of the Inver Group are recorded underlying the remainder of the site.

The lithological units of the Dalradian rocks are predominantly composed of quartizites, psammitic schists and pelitic schists, with minor units of metamorphosed limestones (marble).

All rock types occurring in the Bangor region have undergone significant structural deformation. The rocks have undergone metamorphism and structural faulting and folding at various times over the geological timeframe (i.e. over 590 million years) since deposition. This deformation has occurred during crustal stretching, crustal compression and various orogenic events.

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As part of the site investigation programme 3 No. of the 7 No. boreholes drilled within the site continued into bedrock (Boreholes BH1B, BH2B & BH3B). Bedrock was encountered within the interval 6m bgl (BH3B) and 14.3m bgl (BH2B). Borehole BH4, located within the centre of the peat deposition area, continued to a finished drill depth of 30m bgl without encountering bedrock.

The bedrock encountered within borehole BH1B, BH2B and BH3B was cored to obtain full details of the rock material underlying the site. Full details of the material encountered during the boreholes drilling are included in Appendix 6. With specific reference to the bedrock, the percentage core recovery was very high, with almost 100% recovery. The solid core recovery increased with depth, suggesting some weathering and fissuring of the rock at shallow levels.

The core recovered from BH2B and the upper portion of the core from BH1B comprised moderately weak to moderately strong, greenish brown, fine to coarse grained Psammite, which is moderately weathered. Psammite is a metamorphosed sedimentary rock, predominantly comprising quartz and a lesser percentage of feldspar and mica.

The core recovered from the lower portion of BH1B and the entire interval encountered in BH3B comprised strong to very strong, massive to faintly banded, fine to medium grained, micaceous Quartzite, which is fresh to slightly weathered.

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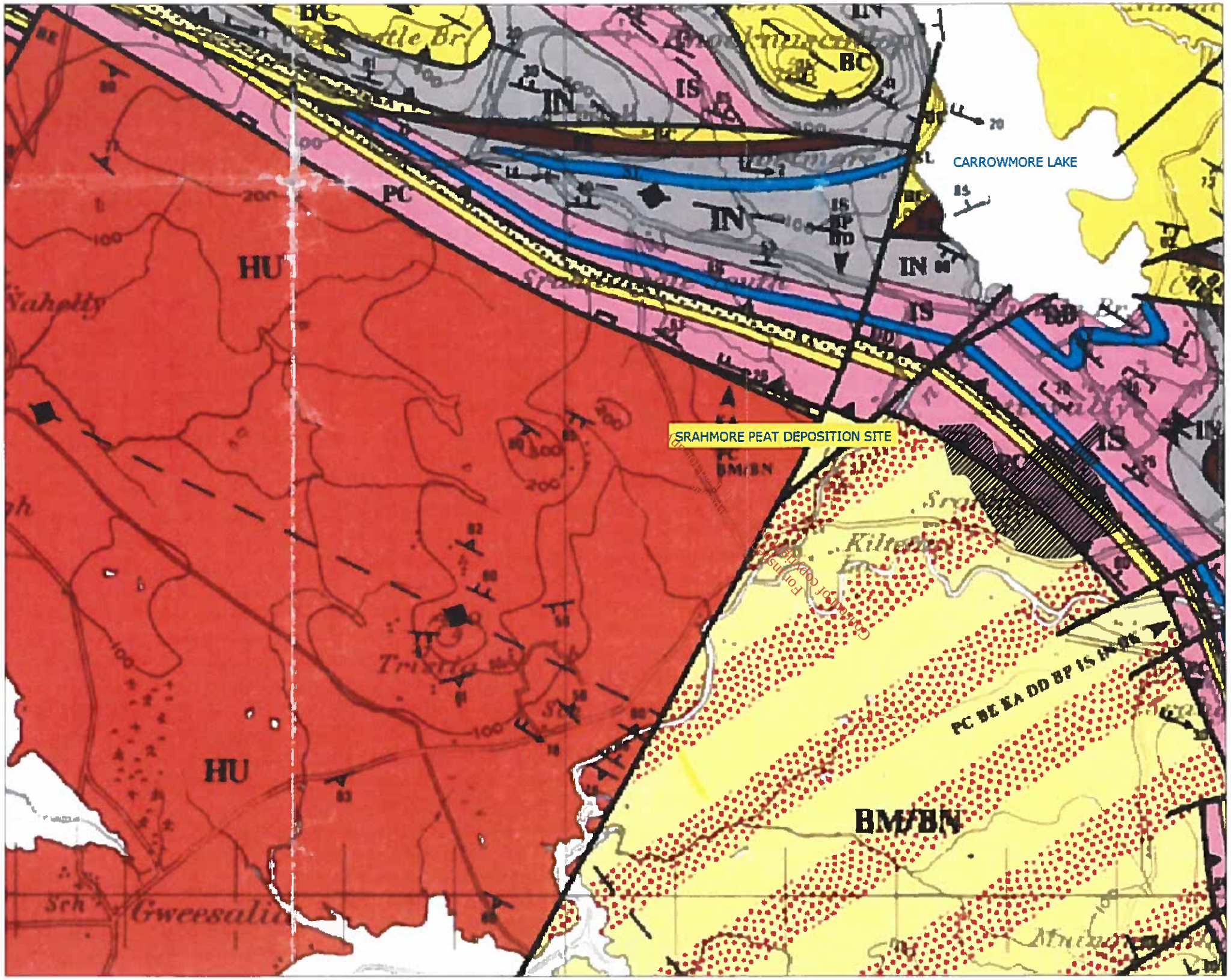

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LEGEND

HU	Annagh Division undifferentiated
PC	Pollacappul Formation
BE	Bellagarvaun Formation
BM/BN	Benmore Formation/Broad Haven Formation
KA	Kanfinalta Formation
IN	Inishderry Formation
IS	Inver Schist Formation
DD	Doon-na-Dell Schist Formation

Lithological Contact

Geological Fault Structure

Syncinal Axis

Anticlinal Axis

Unconformity

NOTE

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OS Sheet No 16 & 25 Co. Mayo

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BORD NA MÓNA

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CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

Drawing Title

EXTRACT BEDROCK MAP
FOR SRAHMORE PEAT DEPOSITION SITE

Scale 1:20000 @ A1

Drawn by	Checked by	Date
Colin Peacock	Damien Grehan	DECEMBER 2003

ENGINEER IN CHARGE SEAN FINLAY

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FIGURE 8.3

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The rock encountered underlying the site, as described from the borehole logs, is fully consistent with the description of the Dalradian rock types described in the GSI Sheet 6 – Geology of North Mayo.

8.3.5 Hydrogeology

Aquifer Classification

At present there is no published aquifer map for County Mayo. Information available from the Geological Survey of Ireland indicates that the aquifer potential for the Dalradian rock types is Poor and is generally unproductive, except in localised zones (GSI Aquifer Code: Pl).

The recovery of the bedrock material indicates that the rock is not highly fractured, with a very high total core recovery percentage (almost 100%). This indicates that the rock has undergone significant dissolution. The solid core recovery percentage is lower, but increases with depth. This suggests that the rock is rock is slightly fissured or fractured close to rockhead, however the rock becomes progressively tighter and unfissured/unfractured with depth, with a very high solid core recovery at the base of each borehole.

Bedrock Permeability

As part of the site investigation programme the hydrogeological properties of the bedrock were tested to determine the hydraulics of the bedrock and the aquifer potential. In total 3 No. packer test were undertaken on borehole BH1B, BH2B and BH3B. The results of the packer tests are included in Appendix 8. A packer test (or Lugeon test) gives a measure of the acceptance potential of undisturbed rock by injection of water under pressure. In essence, it comprises the measurement of the volume of water that can escape from an open section of rock in a given time under a given pressure. The permeability values determined from the tests vary from 3.23 x 10^{-6}m/sec (BH1B) to 8.01 x 10^{-6}m/sec (BH3B). The permeability of the rock was tested over significant lengths of the open cored holes. The permeability values determined for the bedrock underlying the site are considered to be very low, in relation to other Irish rock types. The in-situ hydraulic tests confirm the poor aquifer potential of the bedrock.

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Mineral Subsoil Permeability

With respect to the mineral subsoil, in-situ permeability tests were undertaken on the shallow boreholes within the site. The pearmeability of the mineral subsoil ranges from 2.45 x 10^{-6}m/sec at the upper range to 3.10 x 10^{-7}m/sec at the lower range of values and so the subsoil would be regarded as a low permeability material.

Piezometry and Groundwater Flow Direction

The natural piezometric levels in this region are considered to have been permanently altered due to the artificial drainage of the blanket bog areas and the extraction of the

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majority of the peat material. This artificial drainage would have resulted in a general lowering of the perched watertable associated with the virgin blanket bog.

All boreholes drilled within Area 6 were retrofitted with screen and casing to act as groundwater monitoring points. The paired boreholes around the margins of Area 6 permit water level entry within the unconsolidated material and the bedrock separately to determine if there was any piezometric head difference between the two strata. The static water level in each borehole was monitored on the 04th November 2003 with the measured data detailed below:

Borehole	Grid Ref.	Topographic elevation of boreholes	Water Level 04/11/03 (m to top casing)	Water Level 04/11/03 (mOD)
BH1A (Subsoil)	E084447, N323042	17.56	2.57	15.088
BH1B (Bedrock)	E084447, N323042	17.524	2.85	14.794
BH2A (Subsoil)	E083900, N323514	17.204	3.25	14.104
BH2B (Bedrock)	E083900, N323514	17.171	3.23	14.091
BH3A (Subsoil)	E084908, N323738	20.287	2.02	18.517
BH3B (Bedrock)	E084908, N323738	20.26	2.24	18.02
BH4 (Subsoil)	E084490, N323371	17.218	2.51	14.808

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Table 8.1: Piezometric Levels within Srahmore site

The first issue regarding the water levels is that the watertable in Area 6 is almost entirely below the peat, (i.e. water table is located in the mineral subsoil). The perched watertable associated with virgin blanket bogs has been altered by artificial drainage of the bog and the peat extraction activity.

The water level recorded in the overburden boreholes is slightly higher than the water level in the bedrock. The difference in piezometric head suggests a downward hydraulic gradient, resulting in recharge conditions. The downward hydraulic gradient measured within this site is very slight.

Further analysis of the water level data indicates that, based on the piezometric levels of the overburden, the groundwater flow direction is generally towards the west to southwest within the site. The piezometric levels of the bedrock also indicate that groundwater flow is to the west to southwest, almost mirroring the flow direction of the overburden

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groundwater. Based on the available data, a groundwater flow map for the overburden is shown in Figure 8.4, which shows schematic groundwater flow contours and the inferred groundwater flow direction. The groundwater flow in the bedrock is very similar to that of the overburden.

8.3.6 Groundwater Vulnerability

Groundwater vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities. The vulnerability category is based on the relative ease with which infiltrating water and potential contaminants may reach groundwater in a vertical or sub-vertical direction. The permeability and thickness of the subsoil, which influence the attenuation capacity of a subsoil, are important aspects in determining the vulnerability of groundwater.

At present there is no published groundwater vulnerability map for County Mayo. However based on the site specific information gathered and using the guidelines for Groundwater Vulnerability categorisation, it is possible to determine the vulnerability rating for the Srahmore site.

The borehole records for the site indicate that rockhead varies from 6m bgl to greater than 30m bgl. The remaining peat material is low permeability and the hydraulic testing of the mineral subsoil indicates that it is also low permeability. Therefore, based on the site specific information and the GSI guidelines, the vulnerability rating for the site is assessed as Moderate or Low Vulnerability around the margins of the site and Low Vulnerability within the centre of the site.

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8.3.7 Groundwater Abstraction

As part of the baseline assessment all domestic dwelling within 500m of the proposed peat deposition site were identified. The survey indicates that 20 No. domestic dwellings (17 No. to the north and 3 No. to the south), 14 No. agricultural buildings and 6 No. derelict houses exist within 500m of the proposed peat deposition site boundary.

The aquifer potential of the mineral bedrock and mineral subsoil is considered to be poor. No boreholes or wells were identified during the baseline assessment and local information indicates that all drinking water for the region is derived from Carrowmore Lake, to the north of the proposed site.

Carrowmore Lake is a major public drinking water supply source in this region of north Mayo. The Carrowmore Public Supply is operated and maintained by Mayo County Council. During the baseline assessment the water reservoir for Bangor was identified on elevated land to the north of the site. The storage capacity of the reservoir is approximately

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2,250m^3, which is recharged from Carrowmore Lake as required. The capacity of the reservoir is capable of meeting the peak requirements of the population of Bangor village and its hinterland. This surface source is utilised due to the poor aquifer potential of the bedrock and subsoil.

8.3.8 Geotechnical Assessment

A preliminary geotechnical assessment of the Srahmore Peat Deposition site was carried out by Applied Ground Engineering Consultants Ltd. (AGEC); a copy of AGEC's Report is presented in Appendix 9.

AGEC undertook a ground invetigation, assessed found conditions and examined the current stability of the deposition area and its stability following peat deposition; the stability of proposed internal and perimeter haul roads were also examined, as was the proposed access and peat reception area.

AGEC's conclusions are as follows;

Factors of Safety for the global stability of the deposition area are considerably in excess of the requirements of British Standard BS 6031 for both the present and filled condition;

Factors of Safety for the internal haul roads are in excess of the requirements of BS 6031; careful maintenance of the more heavily used sections of haul roads is recommended;

Various construction options for the access road and peat reception areas were assessed and where peat is left in place a biaxial geotextile laid on granular material will be required along segments of the entrance road.

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8.4 Characteristics of the Proposed Development

It is proposed to deposit approximately 450,000m^3 of peat material sourced from Bellanaboy within an approximate 117 hectare site owned by Bord na Móna at Srahmore, Bangor-Erris, County Mayo. The peat will be excavated from the Bellanaboy terminal footprint in a controlled manner, as per their extraction plan. Following treatment of the peat within the terminal site, involving draining and windrowing to reduce the water content of the peat, the material will be transported by road vehicles to the Srahmore site.

The activities associated with the development are summarised below and are dealt with in more detail in Section 2 herein:

- The material transported by road from the terminal site will access the proposed deposition site from a purpose built road south of the R313, in Area 5 of the Bord na Móna land;
- All road vehicles will unload the peat in a purpose built reception hardstand area to be constructed in Area 5;

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LEGEND

TP5 TRIAL PIT LOCATION

BH 4 BOREHOLE LOCATION

DIRECTION OF FLOW

INFERRED GROUNDWATER CONTOURS (mOD)

NOTE

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OS Sheet No. 18 & 26 Co. Mayo

All levels relate to Ordnance Datum at Malin Head

TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP9 TP10 TP11 TP12

BH 1A/B 14.924
BH 2A/B 14.15
BH 3A/B 18.21
BH 4 14.838

14.00 14.50 15.00 16.00 17.00 18.00

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Shell E&P Ireland Limited

BORD NA MÓNA

CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

PIEZOMETRIC GROUNDWATER CONTOURS
FOR SRAHMORE PEAT DEPOSITION SITE

Scale 1:2500 @ A1

Drawn by	Checked by	Date
Colin Peacock	Damien Grehan	DECEMBER 2003

ENGINEER IN CHARGE SEAN FITZLAY

TES CONSULTING ENGINEERS

Drawing No. FIGURE 8.4

Rev

- The peat will be loaded onto specialist low ground bearing machinery for transport to the deposition area;
- It is proposed that all the peat will be deposited in Area 6 of the Bord na Móna site;
- The transport vehicles will unload the peat on the high fields and the peat will be moved to the bays by means of an excavator;
- The peat will be bulldozed towards the centre of each bay to create a cambered surface, with the ridgeline close to the centre of each bay and sloping downwards towards drains adjacent to the high fields;
- The shape of the deposited peat has been designed to enhance water run-off from the peat to the drains so as to minimise the risk of surface water pooling on deposited peat;
- Drainage of the bays will be an important aspect of the overall project. Drains will be excavated and maintained in the bays, immediately adjacent to the high fields. All runoff from the deposited peat will be collected in these drains and transmitted to a perimeter swale;
- The perimeter swale will discharge the water collected from the site to the adjoining surface watercourses, following settlement to lower the suspended solid content.
- Following the placement and shaping of the peat, it is proposed that the peat surface will be anchored by vegetation. It is anticipated, due to the high soft rush (*Juncus effusus)* seed content of the Bellanaboy peat, that there will be a flush of rush seedlings establishing within the first growing season, and rapid spread and establishment of vegetation on the site in the following 4 to 5 years.

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It is proposed that a portion of Area 5 will be utilised to accept the peat and for unloading/loading purposes. Water runoff from Area 5 will be controlled to ensure activities within the facility do not impact the surrounding environment.

Area 6 will be utilised for the deposition of the peat. Drainage systems are proposed in order to allow effective drainage of the peat to ensure the longterm stability of the peat.

A portion of Area 7 has been included in the site boundary. This area will be utilised as a controlled overflow area for the drainage system to be constructed within Area 6. The drainage system has been designed to cater for a 31mm rainfall event in 1 hour. In the event of a higher rainfall event occurring, the controlled overflow area will be utilised to skim off the excess water so as not to damage the integrity of the treatment structures constructed to lower the sediment content of the runoff.

8.5 Potential Impact of the Proposed Development

With respect to the regional soil and geology environment, the past industrial activity has resulted in an impact, in the form of removal of peat from the surface. This activity has impacted the shallow geological environment. The peat harvesting has resulted in a change in the topographic landform and the lowering of the topographic elevation within worked

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areas.

This proposed peat deposition development will not impact on the surrounding environment outside the boundary of the proposed peat deposition site.

In order to minimise any potential impact on the environment, including the soil and geological environment, 'Avoidance of Impact' was incorporated into the design of the development. Bord na Móna has an extensive knowledge base for the handling and deposition/storage of peat.

Due to the nature of the development, i.e. importation and deposition of peat, there is the potential for impacting the shallow soil and geology environment. The magnitude of the impact is considered slight to moderate. The assessment of the magnitude has taken account of the deposition of peat on peat and also the fact that the industrial activity has resulted in the exposing of base peat surfaces. Therefore, the deposition of peat onto an exposed peat surface will not significantly impact the geological environment, other than to raise the topographic elevation.

It is essential that the peat be deposited in a manner that ensures it is stable and does not pose a risk of movement.

The impact on the mineral subsoil and the bedrock environment is considered negligible due to the activities associated with the development.

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The aquifer potential of the mineral subsoil and the bedrock has been demonstrated to be poor. The deposition of peat material within areas of exposed peat surface would be considered to pose a negligible impact to hydrogeology of the area.

Based on the water levels recorded from the boreholes installed within the site, the watertable varies in depth from 2.2m bgl to 3.2m bgl, and is located in the mineral subsoil layer. The perched watertable associated with virgin blanket bogs has been removed as a result of drainage and peat extraction.

Based on comparison of subsoil and bedrock water levels, the vertical hydraulic gradient is downwards, indicating the water flow downwards. These factors taken together indicate that the potential impact on the stored peat, as a result of an elevated watertable is negligible.

8.6 Do Nothing Scenario

The industrial harvesting of peat by Bord na Móna has now ceased in County Mayo. It is not envisaged that this site will be worked for peat extraction in the future.

In the event of no further activities within the site, it is proposed to implement the

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rehabilitation plan for the Oweninny Works, which is currently covered by an IPC Licence. The rehabilitation envisages that the existing cutaway surface would be colonised with natural vegetation and the remaining peat stabilised (Refer Appendix 2).

In the event that the peat is not deposited in the Srahmore site, the geological environment will not be further impacted.

8.7 Mitigation Measures

The principal mitigation measure to ensure that the proposed facility does not impact on the soil and geology environment is that all works associated with peat deposition will be limited to optimal weather conditions. The timeframe envisaged for actual peat deposition is up to six months and will be determined based on weather conditions during operations. All peat deposition will be undertaken by and supervised by Bord na Móna, who have extensive knowledge of working peat.

In order to stabilise the peat within the storage area, the material will be deposited and shaped to enhance water runoff from the peat. This will involve creating a cambered surface to reduce the risk of rainwater being retained on the surface of the peat. The cambered surfaces will be graded to perimeter drains. All bays where peat is stored will drain to a perimeter swale to prevent the risk of water being retained onsite. This drainage is proposed to ensure the deposited peat does not become saturated.

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The site investigations have determined that the watertable across the site is located below the peat and there is a downward vertical hydraulic gradient. However, it is proposed to retrofit piezometers in the peat mounds when deposited and shaped. These piezometers will be monitored to ensure there is no build up in the water level in the peat.

During the construction of the reception area, sediment control measures will be employed to reduce the risk to the surrounding environment. Exposed soil surfaces have the potential to flow from the site to surface water channels. Temporary and permanent water control measures, comprising temporary sediment control measures and permanent settlement ponds, are proposed to control the quality of any water discharged from site. Details of the water control measures are included in Section 9 (Hydrology and Drainage).

All potentially polluting materials, including hydraulic fluid, engine oil and fuel, will be stored in specified areas, which will be bunded to ensure total containment in the unlikely event of total failure of the storage tank. This will reduce the risk of soil contamination due to activity of plant and equipment.

Due to the minimal disturbance of the geological environment, the mitigation measures are restricted to the stabilisation of exposed soil surfaces.

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8.8 Predicted Impact of the Proposed Development

The predicted impact due to the placement of peat within the site will be restricted to a change in topographic elevation in Area 6. This change will be permanent in duration, however it is not considered to present a significant hazard to the soil and geology environment.

8.9 Monitoring

It is proposed to implement a monitoring programme prior to, during and following operations within the site. The water levels in the boreholes installed within the site will be monitored on a monthly basis to determine any seasonal fluctuations. This monitoring has already commenced and will continue during the review of this application.

Immediately following the deposition and shaping of the peat mounds, it is proposed to undertake a topographic survey of the peat mounds. This survey will be repeated for selected points along the mound every two months for the first year and quarterly or biannually thereafter to monitor the settlement/compaction due to the oxidisation/shrinkage of the peat. This will be outlined by the regulatory body.

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The stability of the peat is not considered to represent a risk to the surrounding environment as it will be completely contained within the bays and bound by the high fields and the margins of Area 6.

In order to monitor water levels in the mounds of peat, it is proposed to install a piezometer within each mound. Water level monitoring in the piezometers will be undertaken following construction of the peat mounds. These piezometers will be monitored to ensure there is no build up in the water level in the peat.

Each mound will be visually assessed on a monthly basis or following heavy rainfall by site operatives to check that the topographic camber has not settled to allow ponding of free water. If such settlement occurs the mound will be reshaped if possible, however if such reshaping is not feasible, drainage channels will be excavated to allow water flow to the arterial drains adjacent to the high fields. Such monitoring will further ensure the stability of the peat mounds.

Prior to, during and following deposition of the peat it is proposed to monitor the groundwater chemistry of the overburden and the bedrock environment to ensure there is no significant deviation in water quality from background levels. The placement of the peat from Bellanaboy Bridge Terminal Site on a cutover peatland, will not impact groundwater quality.

An annual assessment of the vegetation cover will be conducted. It is envisaged that the mounds will be completely stabilised within 5 years of placement and complete vegetation

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cover will have established across the site.

The drainage channels will be maintained to transmit water offsite during this period. Any further rehabilitation plans will only be reviewed when Bord na Móna and the regulatory authorities are completely satisfied that the peat is completely stabilised and there are no inherent risks to the surrounding environment.

8.10 Reinstatement and Residual Impacts

Reinstatement options are outlined in Section 6. There are no negative residual impacts on soils and geology forseen.

Due to the previous industrial use of the Srahmore site and the nature of the proposal to deposit peat in the low elevation bays, it is considered that there will be no residual impact in this area. The timescale of activities within the site is relatively short in duration and thereafter, the only activities will be associated with maintaining drains and monitoring the stability of the peat.

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9 HYDROLOGY AND DRAINAGE

9.1 Introduction

TES Consulting Engineers have prepared the Hydrology and Drainage section of the Peat Deposition Site Volume of this EIS. The information contained below is concerned with a description of the surface water and groundwater catchment area of the subject site. Localised drainage details are provided together with water quality data.

The existing hydrological setting of the site, as it occurs at present is addressed, together with details of the artificial drainage system employed within the Srahmore site by Bord na Móna in order to drain the cutover peatland. This area was utilised for industrial peat extraction up until summer 2003. This has resulted in a topographic landform that comprises banks of peat, known as high fields (14m wide), with intermittent lower elevation, cutover production fields, known as low fields. The high fields are approximately 2m higher elevation than the low fields. The high field banks are separated by up to 10 low fields. The low field production areas are grouped and refered to as "lays". Therefore Area 6 is effectivelty divided into seven bays where it is proposed to deposit the peat.

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The topographic landform of this region is dominated by expansive tracts of land that are relatively flat, however the relief is broken by dramatic upland terrains (Nephin Beg and Owenduff area). Although the extraction of peat in this region has now ceased, the previous industrial activity has had a significant impact on the topographic landform and has resulted in exposed peat surfaces throughout the site. The artificial drainage of large areas of blanket bog and the subsequent extraction of peat has impacted the natural hydrology of the area.

9.2 Study Methodology

This report has been prepared using the recommendations set out in the Environmental Protection Agency (EPA) document 'Guidelines on Information to be contained in Environmental Impact Statements' (2002). The guidelines and recommendations of the Institute of Geologist of Ireland (IGI) publication 'Geology in Environmental Impact Statements – A Guide' was also taken into account in the preparation of this section, whereby groundwater issues are included in the Hydrology and Drainage Section.

This section describes the hydrological setting of the site and refers to the information available from a number of published sources. An assessment of the artificial drainage of the Srahmore site has also been addressed. The artificial drainage of the bog has been ongoing for a significant period in order to allow for the industrial harvesting of peat from the region.

The information contained in this section has been divided into sub-sections, so as to describe the various aspects pertaining to water environment. In the preparation of this

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section the following protocol was used in order to assess the regional and site specific context and character of the site:

- The site was assessed using published information and regional hydrological data;
- All available information was collected from the Environmental Protection Agency with respect to historical water quality in this region;
- A site investigation programme was designed and undertaken within the site, that included topographic surveys, mapping of drainage channels and water sampling; and
- This hydrology and drainage report was prepared following the collation of all available information.

The characterisation of the site is considered detailed and sufficient to adequately characterise the hydrological setting of the site.

All projects and developments that require an EIS are of a scale or nature that they have the potential to have an impact on the environment. It is therefore crucial that the significance of the potential impact is determined. In this Volume the potential impact on the surface water environment resulting from the importation and deposition of peat onsite is assessed and mitigation measures are proposed to reduce any significant impacts. Based on the mitigation measures proposed the significance of the predicted impact on the hydrological environment is determined. A programme of monitoring is proposed in order that data is available to demonstrate that the development is not impacting on the surrounding surface water environment. The monitoring programme will also act to determine long term trends in water quality.

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With respect to the proposed importation and deposition of peat from the Bellanaboy Bridge Terminal site, the potential impacts on the hydrology of the area have been assessed. The artificial drainage of the peat deposition site will be altered to ensure that all water captured onsite is channelled through settlement structures prior to outfall to ensure adequate retention to allow sediment to fall out of suspension.

9.3 Receiving Environment

9.3.1 Catchment Area

The proposed peat deposition area at Srahmore is situated within the catchment of the Owenmore River. This watercourse flows approximately 140m to the south of the nearest edge of the proposed peat deposition area.

The Owenmore River is formed by the confluence of the Oweninny and Altnabrocky Rivers at Bellacorick. The Oweninny River flows southwards from Slieve Fyagh and is joined by the Altnabrocky River, which flows north from the Nephin Beg Range.

Following the confluence of the Oweninny River and the Altabrocky River, the Owenmore

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River flows in a westerly direction from Bellacorick to its discharge point at Tullaghan Bay. The total length of the Oweninny/Owenmore River is 42km, as referenced from the EPA Water Quality of Ireland report. The total catchment area of the Owenmore River is approximately 340km^2, which includes the catchment areas for the Oweninny and the Altabrocky Rivers.

The proposed peat deposition area is located at the lower catchment zone of the river, approximately 3km from the discharge point of the watercourse at Tullaghan Bay.

A tributary of the Owenmore River, the Munhin River flows in a southerly direction and joins the Owenmore River approximately 1.2km to the west of the proposed peat deposition area. The Munhin River flows through the blanket bog terrain that has been subject to peat extraction in the past. The closest edge of the proposed peat deposition area to the Munhin River is approximately 750m.

The flow in the Munhin River results from a surface water outflow from Carrowmore Lake. Carrowmore Lake, which occupies approximately 960 hectares, is fed by the Glencullin River, the Glenturk River and the Bellananboy River.

The main drain from the Bord na Móna property discharges to the Munhin River approximately 1km south of the R313. This main drain is a man made feature, excavated to facilitate the large scale drainage of the bog. This main drain separates the proposed peat reception area and the peat deposition area. The main drain converges with the Munhin River approximately 920m to the west of the proposed extent of activities.

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Another fact that is accounted for in the drainage pattern and catchment area is the groundwater component of flow. The total flow in the watercourses in this area is composed of a surface water catchment and a groundwater catchment. Surface water catchments are the area of land where rainwater run-off from land collects in drains, forms streams and ultimately feeds the surface flow by joining with the main watercourse.

Groundwater catchments can also be defined for significant watercourses, whereby groundwater baseflow contributes to total surface flow. Groundwater baseflow can be an important aspect in maintaining flows during summer periods, when there is prolonged periods of low rainfall. The surface water and groundwater catchments usually coincide closely.

In the north Mayo area, the surface run-off to drains forms the dominant flow mechanism in the watercourses. Groundwater contributions to watercourses are considered minor, due to the low infiltration capacity of the peat and low permeability of the mineral subsoil and the bedrock.

All water falling on the Srahmore site ultimately drains to the Owenmore River and/or its

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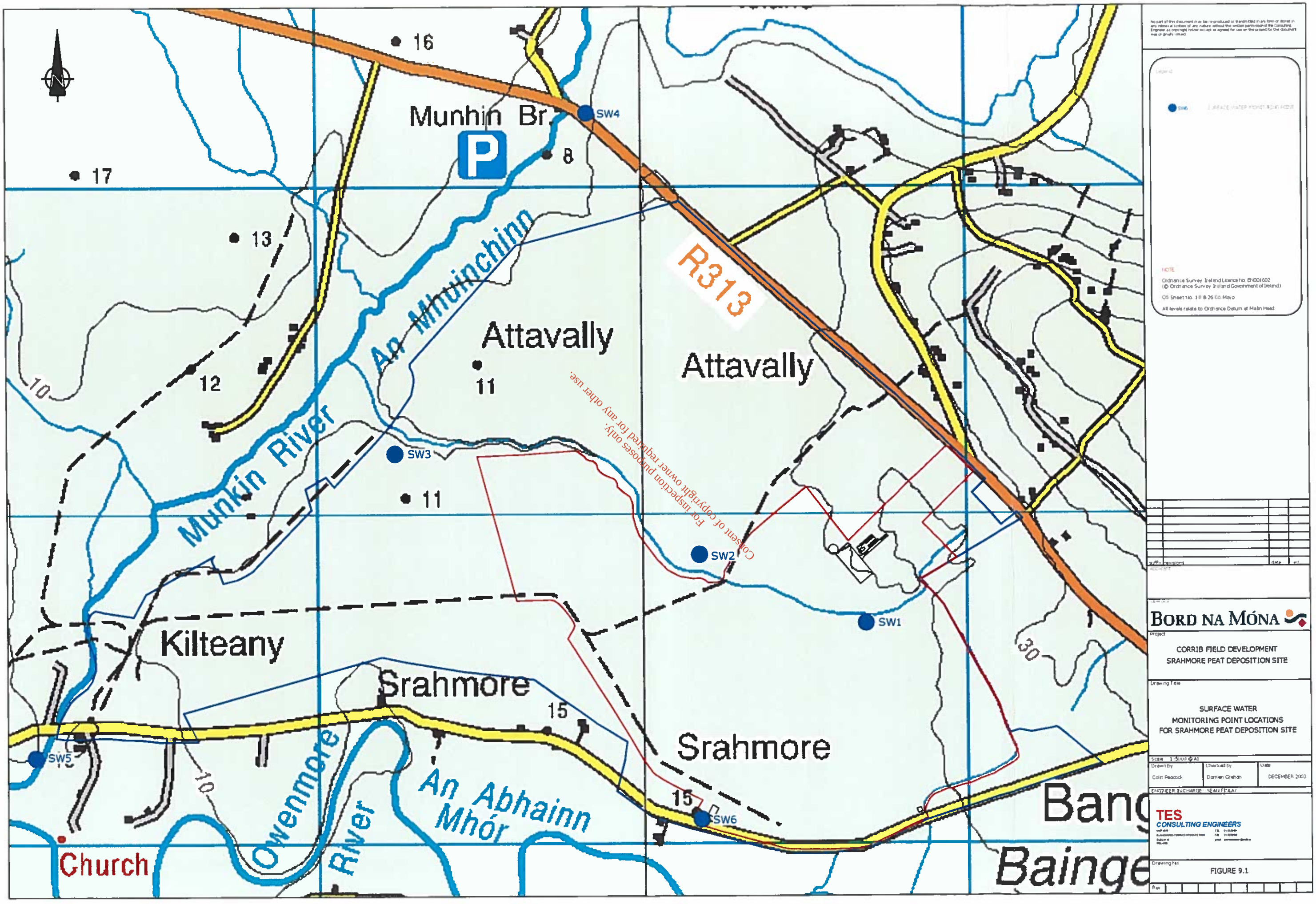

tributaries, the Munhin River and Srahmore Stream.

Drainage from Srahmore Bog

In its natural state, an undisturbed bog is predominantly water, with a moisture content of approximately 85-90% at the surface, reducing to approximately 85% in deeper layers, due to the compaction of the material. A natural bog naturally regulates the release of water, leading to very little seasonal fluctuation in the watertable.

However, due to the excavation of artificial drainage channels within the bog and the historical industrial activity undertaken within the site, the drainage system has been significantly altered. The drainage of the bog facilitates runoff of precipitation from the site, in order to efficiently keep the peat surface largely free of standing water.

The site has been divided into a number of worked areas, referred to as bays. Each bay is contained by the margins of the bog and internally by the high fields, which represents the natural topographic elevation of the bog. The bays are approximately 2m below the elevation of the high fields. Within each bay linear artificial drains have been excavated at a spacing of approximately 14m, parallel to the high fields, to a depth of approximately 0.5m to 1m. Water runoff captured in the bays is transmitted offsite through culverts.

The water draining from the bays is discharged, via culverts to adjoining watercourses following settlement in ponds (prior to discharge) or in settling ponds (following discharge) to lower the sediment content. This drainage arrangement has been effective in allowing working to proceed throughout the year in the Bangor region during extraction of peat by Bord na Móna.

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9.3.2 Water Quality

Existing Water Quality Data

Reference to the EPA Interim Report on the Biological Survey of River Quality (Results of 2002 Investigations) details the most recent published water quality data for the surface water environment adjacent to the proposed peat deposition area.

The Owenmore River water quality was considered satisfactory over its entire length. The EPA indicate that a good range of pollution sensitive species were present in the river, however the commercial exploitation of the peatlands adjacent to the watercourse was leading to sediment run-off. The report indicates that a slight deterioration in water quality was noted at the Bangor Bridge, however the quality improved downstream of Bangor, both upstream and downstream of the confluence with the Munhin River.

The EPA results suggest that run-off from the Srahmore Bog into the Owenmore River is not having an adverse impact on the surface water quality. Owing to the fact that there are

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controlled outfalls to the Owenmore River, between Bangor and the confluence with the Munhin River, it may be argued that the settlement ponds are acting to lower the sediment content of the outfall and are not resulting in significant sedimentation of the river bed.

With regard to the Munhin River, the EPA survey indicates that the water quality is slightly polluted at the sampling point just upstream of the confluence with the Owenmore River. Turbidity has always been a recorded feature of the River Munhin water quality. Flows in the Munhin are highly influenced by Carrowmore Lake.

Site Specific Surface Water Chemistry

As part of the site investigation programme 6 No. surface water samples were obtained, on the 29th October 2003, from flowing water channels adjacent to the site. The locations where the samples were obtained are shown on Drawing No. 1169\01\204, with the results of the analysis presented in Table 9.1.

Sample SW1, SW2 and SW3 were obtained from the main drain. On the day sampling was being undertaken, Bord na Móna were undertaking remedial works along this drain, to excavate peat that had accumulated within the drainage channel and remove vegetation that was choking the watercourse. This remedial works was required to improve the overall efficiency of the main drain, with respect to flows.

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Sample point SW3 was also taken from the main drain, downstream of a stilling pond within the watercourse and just before its confluence with the Munhin River. Samples SW4 and Sw5 were taken upstream and downstream of the Bord na Móna lands. Sample SW4 was obtained at Munhin Bridge along the R313 roadway. This sample location is considered to be upstream of all Bord na Móna workings. Sample SW5 was taken downstream of Bord na Móna working, just before the confluence of the Munhin River with the Owenmore River. Sample SW6 was obtained from the from the outfall point of settlement pond S5-2. The water diverted through settlement pond S5-2 is collected in a land drain that contributes to the Owenmore River.

The results of the water sampling survey are included in Table 9.1. The samples were submitted to ALcontrol Geochem (who are a UKAS and ISO 17025 accredited laboratory) for analysis. The samples were analysed for a suite of parameters based largely on the 'Baseline Water Monitoring Parameters' listed in the EPA Landfill Monitoring Manual Several other parameters were added to this list so that sufficient parameters were included so the surface water could be fully assessed. These parameters included the major anions and cations, organic compounds, inorganic compounds and metals.

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Table 9.1 Surface Water Parametres

Parameter	Units	M.A.C.	SW1	SW2	SW3	SW4	SW5	SW6
pH		6.5-9.5	6.42	6.74	6.37	5.96	7.09	7.24
Electrical Conductivity EC	µS/cm	2500	225	210	274	207	201	167
Dissolved Oxygen DO	mg/l	n/a	8.3	7.6	8.2	9	9	8.9
BOD	mg/l	5	6	5	3	4	2	<2
COD	mg/l	n/a	436	617	433	682	522	584
Total Solids	mg/l	n/a	632	249	556	30	475	103
Total Suspended Solids	mg/l	n/a	116	172	92	<10	72	33
TOC	mg/l	n/a	26	25	22	27	18	16
Total hardness (as CaCO3)	mg/l	60 (MRC)	46	46	44	32	16	14
Total alkalinity (as CaCO3)	mg/l	30 (MRC)	30	30	20	20	20	20
Ammoniacal nitrogen (NH4-N)	mg/l	0.23	39	1	1.2	0.5	0.2	<0.2
Nitrate as NO3	mg/l	50	2.8	2.1	3	2	0.6	<0.3
Nitrite as NO2	mg/l	0.5	0.11	0.14	0.12	<0.05	<0.05	0.09
Total Oxidised Nitrogen (TON)	mg/l	n/a	0.7	0.5	0.7	0.5	<0.3	<0.3
Sulphate as SO4	mg/l	250	23	31	32	24	9	5
Chloride Cl	mg/l	250	32	32	31	31	28	26
ortho-Phosphate as PO4	mg/l	3.35	0.24	0.27	0.35	0.1	0.26	0.05
Potassium K	mg/l	12	1.6	2.2	1	1.2	1	0.8
Sodium Na	mg/l	200	26.5	24.5	27	27.5	21.5	22.5
Calcium Ca	mg/l	200	6.65	6.99	4.55	3.69	5.53	6.03
Magnesium Mg	mg/l	50	4.94	3.88	4.47	5.41	3.02	2.76
Aluminium	mg/l	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Iron Fe	mg/l	0.2	0.24	0.333	0.183	0.098	0.228	0.248
Manganese Mn	mg/l	0.05	0.034	0.032	0.024	0.016	0.006	0.003
Zinc Zn	µg/l	1000	<5	<5	<5	<5	<5	<5
Lead Pb	µg/l	10	<5	<5	<5	<5	<5	<5
Copper Cu	µg/l	500	<5	<5	<5	<5	<5	<5
Mercury Hg	µg/l	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel Ni	µg/l	50	<10	<10	<10	<10	<10	<10
Arsenic As	µg/l	10	<2	<2	<2	<2	<2	<2
Chromium Cr	µg/l	50	<1	<1	<1	<1	<1	1
Cyanide CN	µg/l	50	<50	<50	<50	<50	<50	<50
Cadmium Cd	µg/l	5	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Tri-butyl-tin	ng/l	1	<50	<50	<50	<50	<50	<50
Tri-phenyl-tin	ng/l	1	<50	<50	<50	<50	<50	<50
Simazine	µg/l	1	<1	<1	<1	<1	<1	<1
Atrazine	µg/l	1	<1	<1	<1	<1	<1	<1

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Parameter	Units	M.A.C.	SW1	SW2	SW3	SW4	SW5	SW6
PRO (C5-C9)	µg/l	10	<10	<10	<10	<10	<10	<10
PRO (C10+)	µg/l	10	<10	<10	<10	<10	<10	<10
DRO	µg/l	10	<10	<10	<10	<10	<10	<10
Mineral Oil	µg/l	10	<10	<10	<10	<10	<10	<10
Benzene	µg/l	10	<10	<10	<10	<10	<10	<10
Toluene	µg/l	10	<10	<10	<10	<10	<10	<10
Ethylbenzene	µg/l	10	<10	<10	<10	<10	<10	<10
Total Xylene	µg/l	10	<10	<10	<10	<10	<10	<10
Total Coliforms	c.f.u./100ml	0	1120	2160	3040	204	480	252
Faecal Coliforms	c.f.u./100ml	0	1140	2496	576	182	296	52

The pH of the surface water is generally slightly acidic, with the exception of SW5 and SW6. Water runoff from bogs is generally acidic. The electrical conductivity of the water is low, within the range 167 to 274µS/cm. The dissolved oxygen concentration is within normal levels, ranging from 7.6-9mg/l O_2.

The BOD and COD concentrations, which are indications of the depletion of oxygen by biochemical activity (BOD) and chemical activity (COD) is an important factor because of the setting of the site in a peat rich area. The BOD ranges from <2mg/l O_2 (detection limit of laboratory) to 6mg/l O_2. The maximum admissible concentration for drinking water is 5mg/l O_2, however in raw surface water features slightly elevated concentrations may be expected. The COD concentration is very elevated and is considered to be due to the peat rich environment in which the water is generated. Peat is chemically active, but biologically inert, therefore the elevated COD and the relatively low BOD are considered normal for the setting of the site.

The suspended solid concentration of the watercourse has been highlighted as an important aspects. High concentrations of suspended solids in the watercourses will result in sedimentation of the watercourse base and a deterioration in fish populations and spawning/nursery grounds. The suspended solid concentration upstream of all Bord na Móna lands, at Munhin Bridge on the R313 (SW4) is below the detection limit of the laboratory (<10mg/l). The concentration of suspended solid in the water sampled from the Main Drain is consistently elevated above normal levels (TSS <35mg/l). Samples SW1 (116mg/l), SW2 (172mg/l) and SW3 (92mg/l) were obtained from the Main Drain, however it should be noted that remedial measures to remove the sediment occurring within this watercourse was occurring during the sampling survey. Furthur sampling will demonstrate more typical suspended solid concentrations (levels were elevated due to operation of excavator on main drain). The suspended solid concentration of the Munhin River,

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downstream of the confluence with the Main Drain was also elevated at 72mg/l, again the is considered to be a result of the remedial works along the Main Drain. The suspended solid concentration of the outfall water from settlement pond S5-2 was 33mg/l, which is within the acceptable range of values. This suggests that settlement pond S5-2 is operating efficiently to lower the sediment loading of runoff water from the cutaway bog.

The hardness and alkalinity of the surface water is very low, which is a feature of the low calcium environment in which the water arise. The sulphate, chloride and ortho-phosphate concentration are low and within normal background levels.

The ammonia concentration of all surface water samples is highly variable. The ammonia concentration range from <0.2mg/l N to 39mg/l N. High ammonia concentrations occur naturally in peat rich areas, due to the reduction of Nitrogen in an anaerobic environment. The low concentration of nitrate and slightly elevated concentration of nitrite also suggest a reducing environment.

The concentration of the major cations (calcium, potassium, sodium and magnesium) is not elevated and is within normal levels, although the calcium concentration is low, however this is due to the geological setting of the site.

The trace metal concentrations, with the exception of iron and manganese, are also low. Elevated concentrations of iron and manganese are also a common occurrence in peat rich areas.

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The concentration of all organic compounds, including hydrocarbon compounds, are all below the detection limit of the laboratory, indicating that the surface water is not impacted by an industrial discharges or compounds.

The microbial analysis indicates that the raw surface water is impacted by total and faecal coliforms, however this is not unexpected in raw waters. The openness of the surface water features to livestock/wildlife and decaying vegetation would results in elevated coliform counts.

In summary, the surface water quality is quite good, however it does not naturally meet drinking water standards. The elevated concentration of ammonia, which is considered to result from the environment in which the water flows, would render the water unsuitable for potable supply. The high suspended solid concentrations are considered to result from the historical activities undertaken within the site. Remedial measures to remove sedimentation from the stream bed were being undertaken during the surface water sampling survey.

Site Specific Groundwater Chemistry

As part of this baseline study groundwater samples were obtained on the 5th/6th November 2003 from all boreholes installed within the site. Prior to sampling each borehole was

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purged of two borehole volumes to ensure the samples obtained represented fresh groundwater. Particularly high sediment concentrations were noted in each of the shallow boreholes. While the groundwater from the deeper boreholes was clearer, sediment was also noted. The samples were obtained on the 5th and 6th of November, stored in a coolbox and delivered to AlControl Geochem Ltd. on the evening of 6th November 2003.

The baseline groundwater chemistry results are shown on Table 9.2, with the locations where the samples were obtained shown on Drawing No. 1169\01\204 The samples will act a background chemistry results, which will be added to prior to the commencement of activities and during the peat deposition to ensure there is not change in the chemistry of the groundwater.

Table 9.2 Groundwater results

Parameter	Units	M.A.C.	BH1A	BH1B	BH2A	BH2B	BH3A	BH3B	BH4A
pH		6.5-9.5	6.67	6.88	5.6	6.16	5.79	6.02	7.32
Electrical Conductivity EC	µS/cm	2500	685	569	284	355	231	279	521
Dissolved Oxygen DO	mg/l	n/a	7.5	7.9	7.8	6.1	5.7	6.7	8.4
COD	mg/l	n/a	234	209	303	240	641	342	234
Total Solids	mg/l	n/a	2219	381	13137	917	9177	261	687
Total Suspended Solids	mg/l	n/a	1852	62	33660	316	49340	236	472
Total hardness (as CaCO3)	mg/l	60 (MRC)	340	260	260	180	100	280	236
Total alkalinity (as CaCO3)	mg/l	30 (MRC)	780	260	80	60	80	100	250
Ammoniacal nitrogen (NH4-N)	mg/l	0.23	3.2	2	2.9	2.7	2.5	1.2	1.2
Nitrate as NO3	mg/l	50	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Nitrite as NO2	mg/l	0.5	<0.05	<0.05	0.12	0.1	0.09	<0.05	0.22
Total Oxidised Nitrogen (TON)	mg/l	n/a	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Sulphate as SO4	mg/l	250	<3	14	32	46	24	9	19
Chloride Cl	mg/l	250	26	22	40	32	27	23	16
Fluoride	mg/l	1	0.2	0.2	0.8	0.5	0.5	0.5	0.4
ortho-Phosphate as PO4	mg/l	3.35	<0.03	<0.03	0.44	<0.03	<0.03	<0.03	<0.03
Potassium K	mg/l	12	1.6	2.2	28.4	3.2	24	3.8	2.6
Sodium Na	mg/l	200	37.5	42.5	45.5	68	25.5	34	26
Calcium Ca	mg/l	200	97.18	68.97	9.24	14.95	8.29	16.22	68
Magnesium Mg	mg/l	50	6.93	6.07	8.21	4.31	5.57	5.08	10.4
Aluminium	mg/l	0.2	<0.05	<0.05	2.97	0.79	3.78	0.79	<0.05
Iron Fe	mg/l	0.2	1.309	0.171	3.018	4.277	0.598	2.727	0.031
Manganese Mn	mg/l	0.05	0.478	0.461	0.286	0.334	0.297	0.562	0.542

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Parameter	Units	M.A.C.	BH1A	BH1B	BH2A	BH2B	BH3A	BH3B	BH4A
Barium	mg/l	0.5	0.09	0.25	0.15	0.18	0.24	0.49	0.1
Boron	mg/l	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc Zn	µg/l	1000	35	17	38	27	16	21	71
Lead Pb	µg/l	10	<5	<5	<5	<5	<5	<5	<5
Copper Cu	µg/l	500	<5	<5	<5	<5	<5	<5	<5
Mercury Hg	µg/l	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel Ni	µg/l	50	<10	<10	<10	<10	<10	<10	<10
Arsenic As	µg/l	10	<2	<2	<2	<2	<2	<2	<2
Chromium Cr	µg/l	50	<1	<1	3	1	2	2	<1
Cyanide CN	µg/l	50	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium Cd	µg/l	5	<0.4	<0.4	<0.4	1	<0.4	<0.4	<0.4
Selenium	µg/l	10	<2	<2	<2	<2	<2	<2	<2
Silver	µg/l	10	<10	<10	<10	<10	<10	<10	<10
PRO (C5-C9)	µg/l	10	<10	<10	<10	<10	<10	<10	<10
PRO (C10+)	µg/l	10	<10	<10	<10	<10	<10	<10	<10
DRO	µg/l	10	<10	<10	<10	<10	<10	<10	<10
Mineral Oil	µg/l	10	<10	<10	<10	<10	<10	<10	<10
Benzene	µg/l	10	<10	<10	<10	<10	<10	<10	<10
Toluene	µg/l	10	<10	<10	<10	<10	<10	<10	<10
Ethylbenzene	µg/l	10	<10	<10	<10	<10	<10	<10	<10
Total Xylene	µg/l	10	<10	<10	<10	<10	<10	<10	<10
MTBE	µg/l	10	<10	<10	<10	<10	<10	<10	<10
Total Phenols	mg/l	0.005	<0.01	<0.01	0.05	<0.01	<0.01	0.04	<0.01
Total Coliforms	c.f.u./100ml	0	112	44	2496	3120	2340	130	140
Faecal Coliforms	c.f.u./100ml	0	62	<1	102	200	21	70	4

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All groundwater samples, with the exception of BH4, are slightly acidic in nature, with pHs ranging from 5.6-6.9. The acidic nature of the groundwater is considered to be due to the material through which the water percolates (i.e. peat). The pH of BH4 is slightly basic. This borehole is terminated in mineral subsoil at 30m and the groundwater may have been significantly altered during is downward percolation. The electrical conductivity is quite low for Irish groundwaters. The Chemical Oxygen Demand (COD) concentration is high, which is considered to be due to the peat material existing at the surface and through which all infiltrating water comes in contact with. The total solid concentration and the suspended solid concentration is elevated for all samples. It should be noted that these are newly drilled boreholes and the agitation due to drilling would have resulted in a degree of sedimentation inflow to the standpipe.

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With respect to the chemical signature of the groundwater, the Ammonia concentration is significantly elevated above the Maximum Admissable Concentration (MAC). High levels of Ammonia are a common feature in areas of blanket bog, where there is a reducing, anaerobic environment due to depleted free oxygen. The concentration of Nitrate is below detection limit, with occasional concentrations of Nitrite, indicating that the groundwater in this region occurs in a reducing environment.

With respect to the concentration of metals in the water some significant concentration are noticeable from the results. The concentration of Iron and Manganese are significantly elevated above normal ranges, together with Aluminium and Barium. The concentration of all other metals is low and/or below the detection limit of the laboratory.

As part of the baseline assessment the concentration of hydrocarbons in the groundwater was assessed. The concentration of all hydrocarbons was below detection limit, as was expected, however this will act as a reference for future monitoring. The concentration of Phenols was slightly elevated for borehole BH2A and BH3B. The occurrence of Phenol in the groundwater is considered to be associated with the Peat soil material, as naturally occurring Phenol in groundwater is linked with decomposing organic matter.

The occurrence of Total Coliforms in the groundwater may be anticipated as the samples were obtained from boreholes that are not constantly pumped and have not been disinfected. The presence of Faecal Coliforms in the groundwater is unusual as likely sources of such material is not common in the region. Faecal coliforms are usually associated with biofouling of groundwater from animal or human waste.

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Based on the chemistry the water obtained from the onsite boreholes, the groundwater is not naturally suitable for human consumption. It is acknowledged that the boreholes onsite are not representative of a drinking water well which is regularly pumped. However, the high elevation of Ammonia and metal concentration, which are not considered to be linked to borehole design, would render the groundwater unfit for potable water supply.

9.4 Characteristics of the Proposed Development

It is proposed to deposit approximately 450,000m^3 of peat material sourced from Bellanaboy on a 117 hectare site owned by Bord na Móna at Srahmore, Bangor-Erris, County Mayo. The peat will be excavated from the Bellanaboy terminal footprint in a controlled manner, as per their extraction plan. Following treatment of the peat within the terminal site, involving draining and windrowing to lower the free water of the peat, the material will be transported by road vehicles to the Srahmore site.

The activities associated with the development are summarised below and are dealt with in more detail in Section 2 herein:

- The material transported by road from the terminal site will access the proposed

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deposition site from a purpose built road south of the R313, in Area 5 of the Bord na Móna land;

- All road vehicles will unload the peat in a purpose built reception hardstand area to be constructed in Area 5;
- The peat will be loaded onto specialist low ground bearing machinery for transport to the deposition area;
- It is proposed that all the peat will be deposited in Area 6 of the Bord na Móna site;
- The transport vehicles will unload the peat on the high fields and the peat will be moved to the bays by means of an excavator;
- The peat will be bulldozed towards the centre of each bay to create a cambered surface, with the ridgeline close to the centre of each bay and sloping downwards towards drains adjacent to the high fields;
- The shape of the deposited peat has been designed to enhance water run-off from the peat to the perimeter drains so as to minimise the risk of surface water pooling on deposited peat;
- Drainage of the bays will be an important aspect of the overall project. Drains will be excavated and maintained at the periphery of the bays, immediately adjacent to the high fields. All runoff from the deposited peat will be collected in these drains and transmitted to a perimeter swale;
- The perimeter swale will discharge the water collected from the site to the adjoining surface watercourses, following treatment to lower the suspended solid content.
- Following the placement and shaping of the peat, it is proposed that the peat surface will be anchored by vegetation. It is anticipated, due to the high soft rush (*Juncus effusus)* seed content of the Bellanaboy peat, that there will be a flush of rush seedlings establishing within the first growing season, and rapid spread and establishment of vegetation on the site in the following 4 to 5 years.

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It is proposed that a portion of Area 5 will be utilised to accept the peat and for unloading/loading purposes. Water runoff from Area 5 will be controlled to ensure activities associated within the facility do not impact the surrounding environment.

Area 6 will be utilised for the deposition of the peat. Drainage systems are proposed in order to allow effective drainage of the peat to ensure the long term stability of the peat.

A portion of Area 7 has been included in the site boundary. This area will be utilised as a controlled overflow area for the drainage system. The drainage system has been designed to cater for a 31mm rainfall event in 1 hour. In the event of a higher rainfall event occurring, the controlled overflow area will be utilised to skim off the excess water so as not to damage the integrity of the treatment structures constructed to lower the sediment content of the runoff.

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9.5 Potential Impact of the Proposed Development

The principal potential impact as a result of the development is considered to relate to an impact of the surface water quality as a result of sediment laden runoff from exposed peat surfaces, which could result in siltation of a watercourse bed. The runoff of sediment laden water from the peat deposition site has the potential to adversely impact upon the aquatic environment. Sedimentation of watercourses results in loss of diversity and abundance of aquatic invertebrates and vertebrate communities. It also has the potential to directly impact upon fish populations by reducing spawning and nursery grounds.

A second significant potential impact is the stability of the peat mounds when placed in the site. The effective drainage of the peat mounds, the limiting infiltration of rainwater into the mounds and the expected growth of rushes will significantly reduce the risk of the deposited peat impacting on the surrounding aquatic environment.

The construction of the access road and the reception area will result in the introduction of impervious surfaces to the site which will need to be drained to prevent water ponding. Poor drainage within the reception area will lead to wetting the peat material, which would be undesirable for working and shaping when placed in the peat deposition area.

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9.6 Do Nothing Scenario

In this scenario, the site will remain in its current state and topographic elevation. The site is currently covered by an IPC Licence and in the event of no further activity occurring the rehabilitation plan for the Owenmore Works will be implemented (See Appendix 2). Compliance monitoring and water quality limits are incorporated into the IPC licence so that the surface water environment is not impacted.

9.7 Mitigation Measures

The design of the facility has taken account of the potential impacts of the development and the risks to the surface water environment. During consultations with statutory bodies and various interested parties, the importance of maintaining and/or improving the surface water quality was stressed. The mitigation measures proposed below, which provides details and calculations for the infrastructure design, are proposed to ensure that all water generated by rainfall is captured, controlled, and outfalls are regulated through settlement structures to ensure the adjacent watercourses are not impacted by sediment laden runoff.

The detailed design of the drainage infrastructure for Area 6 is presented below. Area 6 is the site where peat will be deposited. A similar design criteria has been used in the design and sizing of the drainage infrastructure for Area 5 also.

The rationale for the drainage design and the calculations for the sizing of the drainage

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infrastructure is presented below.

Introduction

It is proposed to drain all water runoff from the deposited peat within the Srahmore site. Within each bay and immediately adjacent to the high field bank, it is proposed to excavate a drain, approximately 2m wide at the top to 1m wide at base and approximately 1m deep. Each deposited peat mound will be shaped to create a fall from the crest of the mound to drains. The drainage system is designed to collect and transmit all water collected within the bay drains situated at the toe of the high fields. The peat deposited within the bay will be shaped to create a camber and fall from the centre of the mound to the drains.

With respect to the sizing of the drainage infrastructure it was important that a storm event of sufficient magnitude was chosen as a basis for the design. The data available from the Belmullet Synoptic Station is considered to be representative of the proposed site, as they are both at similar elevation. The extreme rainfall matrix for Belmullet, updated to account for the most recent climatic data (up to November 2003), was requested from Met Eireann so as to provide a rational to the rainfall event used in the design process. The rainfall matrix is shown on Table 9.3 below.

The drainage design is proposed to collect and afford all water runoff from the peat mounds, generated by a 31mm rainfall event. The system will provide adequate retention time for the runoff to allow sediment to fall out of suspension.

The design rainfall event of 31mm precipitation equates to a 100 year storm event of 1 hours duration. This design storm is considered intense and of a magnitude that may result in soil erosion and sediment laden runoff. The drainage infrastructure is designed to safely collect, store and regulate discharges from the site to ensure that adjoining watercourses are not adversely impacted.

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Location: Belmullet Synoptic Station Average Annual Rainfall: 1108mm Maximum rainfall (mm) of indicated duration expected in the indicated return periods								
	Return Period (years)							
Duration	**1/2**	**1**	**2**	**5**	**10**	**20**	**50**	**100**
1 minute				1.7	1.9	2.2	2.8	3.1
2 minute				2.9	3.3	3.9	4.8	5.4
5 minute				5.1	5.9	7.0	8.7	9.9
10 minute				7.4	8.6	10.2	12.8	14.7
15 minute	4.7	5.9	6.6	8.9	10.8	12.9	16.4	19
30 minute	6.2	7.8	8.7	11.7	14.1	16.8	21	25
60 minute	8.3	10.1	11.3	15	17.9	21	26	31
2 hour	10.9	13.4	14.7	19.1	23	26	32	37
4 hour	14.8	17.8	19.4	25	29	33	40	46
6 hour	17.9	21.4	23	29	34	39	46	53
12 hour	22.9	27	30	37	42	48	57	65
24 hour	28	33	36	45	51	58	68	77
48 hour	35	41	44	54	61	69	81	91
Notes: Larger margins of error for 1, 2, 5 and 10 minute values and for 100 year return periods								
	M560: 15		M52d: 51		M560/M52d: 0.29			

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Table No. 9.3: Rainfall Matrix for Belmullet Station (Met Éireann, November 2003)

As detailed it is proposed to regulate the discharge of water generated within the site, therefore the swale and field drains have been sized to temporarily store water that will drain to the settlement ponds at a regulated flow rate.

In the unlikely event that the chosen 100 year rainfall event is exceeded, the drainage design includes an overflow area. This controlled overflow area is located in Area 7 of the Bord na Móna land. The controlled overflow area will only receive water generated in Area 6 when the design storm is exceeded. The controlled overflow area will skim off the excess water from the perimeter swale so that the integrity and operation of the treatment system is not compromised. Such controls and contingencies will ensure that drainage system and settlement ponds operate efficiently 100% of the time.

The drainage system is entirely a gravity feed system, which is designed such that all rainwater falling within the site and collected in the drainage channels will flow by gravity to the collection swale and thereafter to the settlement ponds in a controlled manner.

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The Modified Rationale Method was used as the design rationale in the calculation of the peak discharge generate by the storm event. The 'Modified Rationale Method is described in Volume 4 of the Wallingford Procedure (Design and analysis of urban storm drainage). The flow condition in the artificial drains and the swale was calculated using Manning's Equation.

Drainage Calculation Rationale

The Modified Rationale Method gives the peak discharge from the bay. This peak discharge is generated by the 31mm rainfall event using the following formula:

$$Q = C \times i \times A$$

or

$$Q = C_R \times C_V \times i \times A$$

where **Q** **= Peak discharge from the bay**
Cc **= the routing coefficient;**
Cv **= volumetric runoff coefficient (0.9);**
I **= rainfall intensity (mm); AND**
A **= area (hectares).**

The flow in open channels is determined by Manning's Equation:

$$Q = 1/n \times A \times R^{2/3} \times S^{1/2}$$

where **Q** **= Flow rate in the channel;**
n **= the Manning roughness coefficient;**
A **= Cross sectional area of flow channel;**
R = Hydraulic radius (where R=A/P, A=Cross sectional area and P= wetted perimeter or the perimeter of the channel in contact with the water flow

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In the interpretation of the calculations, reference should be made to Drawing Number 1169\01\218 (Site Drainage Layout Plan), for indication of drainage compartments/bays and the location of drains, swale, etc.

Drainage Calculations

Table 9.4 below provides details and calculations of the drainage from each of the bays where it is proposed to deposit the peat.

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Table 9.4: Design Calculation of peak runoff and regulated runoff to Swale

Bay	**Dimensions (m)**	**Area (m^2)**	**Flow (m^3/sec)**	Cumulative Flow (m^3/sec) **No Controls**	**Cumulative Flow (m^3/sec) With Controls**
1	30mx645m	19,350	0.194	0.194	0.097
2	140mx750m	105,00	1.057	1.251	1.234
2	120mx920m	110,400	1.111	2.362	1.498
4	150mx1000m	150,000	1.51	3.872	1.762
5	150mx750m	112,500	1.133	5.005	2.026
6	150mx350m	45,500	0.458	5.463	2.29
7	45mx320m	14,850	0.150	5.613	2.44

The flow from the bays will drain to the perimeter swale. The cumulative flows in the swale are calculated for two scenarios.

The first scenario is the flows to the swale by gravity feed with no controls. The bays are completely bound by the higher elevation margins of the bog and the high fields, therefore it will be necessary to excavate a channel and lay a culvert so that water can drain by gravity to the swale. The 'No Control Scenario' refers to the control of flow of water and in this scenario all water drains immediately to the swale without any retardation or restriction.

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The second scenario is that the culvert laid to drain the water from the bays to the swale acts to retard water in the drains and empties to the swale in a controlled manner over time. The drains in the bays and the perimeter swale have been sized to completely contain all runoff water.

The controlled discharge of water from the drains to the swale was chosen as the preferred option to discharge to the swale. This controlled and regulated discharge to the swale will lower the velocity of the runoff water, which will enhance primary settlement prior to outfall to the swale.

The design of the swale has also been designed to accommodate the water outfall from the bays. The sizing of the swale also took account of the controlled outfall to the settlement ponds. It is proposed to regulate the maximum flows to the settlement ponds so as to ensure that the quality of the outfall meets the required quality, with respect to Suspended Solid Concentration, for discharge to the adjacent watercourses.

The dimensions of the swale vary throughout the site, based on the cumulative inflows. The dimensions of the swale at various locations throughout the site are shown on Drawing Number 1169\01\219. It is proposed to create earthen barriers to flow at 100m lengths

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within the swale. These structures are proposed to enhance progressive settlement of sediment within the swale prior to final treatment in the settlement ponds. The earthen barriers will be created by laying a 450mm culvert and mounding soil within the swale to 75% the depth of the swale. During low flow conditions water will flow through the culvert. During higher rainfall events the flows will be retarded by the capacity of the pipework. This will result in a slight backup in the flows in the swale and will act to lower the velocity of the water. When the water levels reach the height of the earthen barrier (75% total height) it will overtop the structure and continue to flow in the adjoining compartment of the swale network. The earthen barriers will act to lower the velocity of the water in the swale and will enhance progressive settlement of sediment.

At the end of the swale it is proposed to construct a terminating chamber. Within this chamber a 525mm culvert will channel water towards the final settlement pond. This culvert is the main regulation for discharges to the final settlement pond. In the event that the capacity of the culvert is exceeded the water in the swale will start to backup. The dimensions of the swale have been designed to allow for such an event. The swale is of sufficient size (plus a factor of safety of 33%) to completely retain all runoff from the design rainfall event and allow regulated discharges to the outfall points.

In the unlikely event that the design storm event is exceeded, i.e. greater than 31mm rainfall in 1 hour, the excess water will be skimmed off from the swale and will discharge to the controlled overflow in Area 7. This will ensure that the drainage infrastructure operates at design specification at all times.

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The discharge of runoff water from the swale will be via 3 No. discharge points. All water will be diverted through structures to enhance settlement prior to outfall. It is proposed to utilise the existing settlement ponds S5-1 and S5-2, however the volume of water allowed to flow to these structures will be regulated to ensure that the operate at optimal performance at all times. It is proposed to construct a new settlement pond arrangement to the northwest of Area 6. The new settlement pond structure will act as the main discharge point for runoff from the site.

The existing settlement ponds will continue in operation as part of the drainage infrastructure. Settlement pond S5-1 is approximately 16m wide x 16m long x 1.5m deep. Settlement pond S5-2 is approximately 18m wide x 37m long x 1.5m deep. The flows into these structures will be maintained at a low level to ensure settlement of peat prior to outfall. It is proposed to allow a maximum outfall of $0.025m^3$/sec and $0.05m^3$/sec from S5-1 and S5-2 respectively and divert all other runoff to the perimeter swale.

The new settlement ponds will be constructed to comprise two compartments, with the dimensions of each compartment as follows:

- Length: 100m;
- Width: 8m;

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- Height of retained water: 1.5m;
- Ponds constructed into mineral subsoil;
- Settlement ponds constructed at :1:1.5 gradient;
- All water flowing to the pond will be regulated so that maximum discharge to pond will be $0.15m^3$/sec;
- Invert and outfall levels from the settlement pond will be equal, so that inflows will displace settled water to watercourse;
- The maximum discharge to adjoining watercourse is $0.15m^3$/sec, which equates to approximately 2.7litres/second/hectare;
- A composite sampler will be installed within chamber prior to outfall to adjacent watercourse. A daily sample will be taken to ensure the Suspended Solid concentration is within accepted limits; and
- Based on the sizing of the of the settlement pond and the regulated maximum inflow to the settlement pond, at worst case scenario, all water entering the settlement pond will be retained for a minimum of 5 hours prior to discharge;

The drainage infrastructure has been designed to ensure that all water generated within the site is captured and controlled to ensure that there are no uncontrolled discharges from the site. The regulation and retardation of flows, within the peat deposition field drains, the swale and the flow to the settlement ponds, will allow for progressive settlement along the flowpath and final settlement in the final settlement structures. Regular monitoring of the outfall quality will be undertaken to ensure that onsite activities do not impacting the water quality.

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As stated above the drainage from Area 5 has been designed using the same set of criteria used for Area 6. There is a break in the artificial drainage of Area 5. The northern portion of Area 5 drains to the north, to an artificial drainage channel. This northern drainage channel is effectively the commencement of the Main Drain through the Bord na Móna site. The southern portion of Area 5 drains to the south. The hardstand reception area for the peat imported to the site is located within the southern portion of Area 5.

It is proposed to construct 1 No. settlement pond for the northern portion of Area 5 and 2 No. settlement ponds for the southern portion of Area 5, to allow retention and settlement of runoff water. It should be noted that activities associated with the proposed reception of the peat will occur on a very small portion of Area 5, however the treatment structures propose to treat all water draining from the area.

The areas where no activity occurs throughout the lifetime of the facility will remain unchanged and will revegetate.

In active areas of the site, the drainage infrastructure will divert the water to the settlement ponds, prior to discharge to the main drain.

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Within the reception area it is proposed to incorporate a number of measures within the design of the hardstand to ensure that sediment runoff from the impervious slab does not pose a risk to the aquatic environment. It is considered that the activity of machinery and equipment in this area poses a risk to the environment therefore various measures have been incorporated in the design on the reception slab to minimise these risks.

The entire reception hardstand will be fully bunded and will be constructed to falls such that surface water runoff is channelled towards a concrete opendrain and the centre of the reception slab. All water captured in this drain will outfall to a deep settlement tank. The water will continue to a grit trap, oil interceptor and final retention in the settlement ponds (to settle any fine suspended solids) prior to outfall to the Main Drain. The deep settlement tank, the grit trap and the oil interceptor will be cleaned out on a regular basis. The oil interceptor is proposed to control any accidental spillages or leakages of hydrocarbon and/or hydraulic fluid due to activities of machinery. The liquids pumped from the interceptor will be exported from the site by a licensed contractor.

With respect to the office/canteen area, the volume of effluent generated will be low. Because of the temporary nature of activities, it is proposed to install chemical toilets. There will be no effluent discharged to ground or surface waters as a results of these. All washwater from the accommodation building will be diverted to a secure holding tank. This tank will be periodically emptied and exported from the site to an approved waste water treatment plant.

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All potentially polluting material will be stored in a temporary proprietary bunded oil/lubricant storage area.

It is envisaged that based on the design of the reception area the risk to the surface water environment is not considered significant. Measures have been designed to ensure there are no uncontrolled emissions from the site. All water draining from the reception area will be treated initially close to the reception area and final polishing of the runoff water will be afforded in the settlement ponds.

9.8 Predicted Impact of the Proposed Development

The drainage infrastructure has been designed to ensure that all runoff from the areas where peat is deposited is afforded treatment prior to discharge. This treatment will ensure that there is no adverse effect on the watercourses adjacent to the site as a result of the development.

In the design of the infrastructure a design rainfall of 31mm of rainfall in 1 hour was chosen for sizing of infrastructure. This rainfall event equates to a 100 year storm event of 1 hours duration, which is considered a robust rationale for design purposes. However, in order to provide an increased factor of safety, the infrastructure will be capable of catering for all

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rainfall events above the design rainfall.

9.9 Monitoring

Prior to any development within the site it is proposed to obtain a monthly sample of surface water from the locations shown on Drawing Number 1169\01\204. This monitoring has commenced already and will continue throughout the regulation process for this facility, in order to compile a detailed database on chemistry results.

As detailed in the mitigation measures, it is proposed to install a composite sampler at the outfall point of the settlement ponds to the northwest of Area 6. This composite sampler will obtain a daily sample to determine the total solid concentration and the total suspended solid concentration of the outfall water. This sampling programme will ensure that all discharges from the site are within permitted discharge limits.

Regular sampling as prescribed by regulatory bodies will be conducted during the construction and operation of the facility to determine if there is any impact on the surface water chemistry as a result of activities onsite. These samples will be compared to the background surface water chemistry database.

Following the deposition and shaping of the peat material, sampling will continue to monitor the surface water chemistry. This will be carried out in accordance with any conditions from the Waste Licence.

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9.10 Reinstatement and Residual Impacts

Reinstatement options are outlined in Section 6. There are no residual impacts foreseen.

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10 EFFLUENT

10.1 Introduction

TES Consulting Engineers have prepared this section of the Peat Deposition Site Volume. The following describes the effluent arising from the development and the measures taken to ensure that this effluent does not pose a risk to the surrounding environment.

Reference should be made to Section 9 of this Volume, which deals with Hydrology and Drainage, as mitigation measures are proposed to ensure protection of surface water and groundwater as part of the development.

10.2 Study Methodology

This Section has been prepared using the recommendations set out in the Environmental Protection Agency (EPA) document 'Guidelines on Information to be contained in Environmental Impact Statements' (EPA, 2002).

It should be noted at the outset that the runoff water from cutover peatlands and from the proposed peat deposition bays is dealt within Section 9 herein. Runoff will be treated to settle out suspended solids, however this is not considered an effluent in a true sense, as following settlement the water is of good quality and appropriate for outfall to the surrounding watercourses without harm or risk to the aquatic environment.

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10.3 Receiving Environment

The Srahmore Peat Deposition Site has been used previously for the industrial harvesting of peat. However this activity involved a relatively low intensity of industrial activity. Peat harvesting was undertaken with plant and machinery developed by Bord na Móna to produce milled peat, which was then exported from the site.

With respect to effluent, the peat harvesting would not have resulted in the generation of effluent. Therefore, for the purpose of this report, the existing environment is considered void of potential effluent sources.

10.4 Characteristics of the Proposed Development

It is proposed to deposit approximately 450,000m^3 of peat material sourced from Bellanaboy Bridge Terminal site on approximately 63 hectare of cutover peatland owned by Bord na Móna at Srahmore, Bangor-Erris, County Mayo. The peat will be excavated from the Bellanaboy terminal footprint in a controlled manner. Following treatment of the peat

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within the terminal site, involving draining and windrowing to shed free water from the peat, the material will be transported by road vehicles to the Srahmore site.

The activities associated with the development are summarised below and are dealt with in more detail in Section 2 herein:

- The material transported by road from the terminal site will access the proposed deposition site from a purpose built road south of the R313, in Area 5 of the Bord na Móna land;
- All road vehicles will unload the peat in a purpose built reception hardstand area to be constructed in Area 5;
- The peat will be loaded onto specialist low ground bearing machinery for transport to the deposition area;
- It is proposed that all the peat will be deposited in Area 6 of the Bord na Móna site;
- The transport vehicles will unload the peat on the high fields and the peat will be moved to the bays using excavators;
- The peat will be bulldozed towards the centre of each bay to create a cambered surface, with the ridgeline close to the centre of each bay and sloping downwards towards drains adjacent to the high fields;
- The shape of the deposited peat has been designed to enhance water run-off from the peat to the perimeter drains so as to minimise the risk of surface water pooling on deposited peat;
- Drainage of the bays will be an important aspect of the overall project. Drains will be excavated and maintained at the periphery of the bays, immediately adjacent to the high fields. All runoff from the deposited peat will be collected in these drains and transmitted to a perimeter swale;
- The perimeter swale will discharge the water collected from the site to the adjoining surface watercourses, following treatment to lower the suspended solid content.
- Following the placement and shaping of the peat, it is proposed that the peat surface will be anchored by vegetation. It is anticipated, due to the high soft rush (*Juncus effusus)* seed content of the Bellanaboy peat, that there will be a flush of rush seedlings establishing within the first growing season, and rapid spread and establishment of vegetation on the site in the following 4 to 5 years.

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It is proposed that a portion of Area 5 will be utilised to accept the peat and for unloading/loading purposes. Water runoff from Area 5 will be controlled to ensure activities associated within the facility do not impact the surrounding environment.

Area 6 will be utilised for the deposition of the peat. Drainage systems are proposed in order to allow effective drainage of the peat to ensure the long term stability of the peat.

A portion of Area 7 has been included in the site boundary. This area will be utilised as a controlled overflow area for the drainage system. The drainage system has been designed to cater for a 31mm rainfall event in 1 hour. In the event of a higher rainfall event occurring,

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the controlled overflow area will be utilised to receive the excess water so as not to overload the settlement ponds.

10.5 Potential Impact of the Proposed Development

The potential sources of effluent within the site are considered to result from human and/or mechanical activity onsite.

The principal source of potential effluent will be at the reception area, where an office/canteen building is proposed for the onsite operatives. Toilet facilities and washwater are considered an effluent and should be dealt with accordingly to protect the surrounding water environment.

The reception area will be the interface between the import of peat from the Bellanaboy Terminal site and the transport of peat to the deposition area. The vehicular activity in this area poses a risk with respect to uncontrolled emissions, through leakages or accidental spillage of potentially polluting material. The potential impact of such an event would adversely impact the aquatic environment.

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10.6 Do Nothing Scenario

In this scenario, the site would remain unchanged. No effluent would be generated, as no human activity would occur within the site.

The site is currently covered by an IPC Licence and in the event of no further activity occurring, the rehabilitation plan for the Oweninny Works will be implemented. Compliance monitoring and water quality limits are incorporated into the IPC licence so that the surface water environment is not impacted.

10.7 Mitigation Measures

In order to minimise the generation of effluent within the site a number of proposals. have been incorporated into the design of the facility. These measures are of proven technology and will ensure minimal impact on the surrounding environment. Due to the temporary nature of the development, the infrastructure proposed can be removed easily and the site can be returned to its predevelopment state.

With respect to the office/canteen building, it is proposed that chemical toilets will be installed to eliminate the generation of toilet effluent. Chemical toilets are considered appropriate to the development, due to the temporary nature of workings within the site. All washwater will be collected in a holding tank, which will be emptied periodically by an approved contractor and exported from the site to an approved waste water treatment plant. These measures will ensure that there is no discharge of waste water or domestic sewage to

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the receiving environment.

A permited waste contractor will be employed for the export of canteen waste. This waste will be exported to an approved facility for disposal. Any recyclable materials will be separated and exported to an appropriate facility for recovery.

With respect to the control of potentially polluting material arising from the concrete hardstand, appropriate measures have been designed to significantly reduce the risk to the surrounding environment. The reception area will be fully bunded and will be laid to falls such that any precipitation/surface water runoff is channelled toward a concrete open drain at the centre of the reception slab. The runoff from the slab will be culverted through a deep settlement tank to allow primary settlement of sediment. The runoff water will be then diverted through a grit trap (secondary settlement) and oil interceptor, to ensure that any potentially polluting material is retained at source.

The grit trap and oil interceptor will be periodically monitored and emptied by an approved licensed contractor when required.

All water outfall from the oil interceptor will be finally diverted through the settlement pond to the south of Area 5. The outfall water following treatment within the reception area is not considered an effluent. The only possibility of effluent runoff is from leakage of fuels from machinery or accidental spillages. Oil spill kits will be stored on site to be utilized in the the case of spillage. The treatment arrangement proposed will ensure any such occurrence is dealt with effectively and the material is retained within the reception area. The water outfall to the settlement lagoons is not considered an effluent and the treatment of surface water runoff is dealt within in Section 9 herein.

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It is intended not to use conventional static tank storage for fuel oil. The approach to be taken instead will entail mounting a double-skinned mobile tank on the chassis of a Haku trailer. This tank will be filled from a fuel supplier's tanker truck while standing on the bunded reception area. It will then be drawn by tractor to refuel the operating plant wherever convenient. The loading shovels will be refuelled at the reception area, on the drained hardstand, which will be oil-trapped. The remainder of the plant will be re-fuelled at continuously changing points within the peat deposition area.

As the capacity of this tank will be 5,000 litres and as the projected daily consumption is also 5,000 litres, it may be necessary to utilise two of these mobile tank units to ensure continuity of supply.

A temporary bunded oil/lubricant storage facility will be provided on-site.

Some of the trucks employed to haul the peat from the Terminal Site at Bellanaboy to the deposition site reception area will also be refuelled at the reception area. This will be

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effected by using a fuel supplier's tanker-truck with the entire operation taking place on the drained and oil trapped hardstand area.

10.8 Predicted Impact of the Proposed Development

The development will not result in the generation of effluent. The only source of effluent is from leakages from machinery within the reception area, as all other potential effluents will be exported offsite.

The treatment arrangement within the reception area is proposed to retain any fuel effluent arising from the reception area, through leakages or accidental spillage. The grit traps and oil interceptor will be emptied periodically to ensure the surrounding environment is not impacted.

10.9 Monitoring

The toilet and canteen facilities will be inspected on a daily basis to ensure the toilet and canteen facilities are of a good standard of hygiene. The waste will be exported from the site on a regular basis, however a regular visual assessment will be undertaken to ensure that the waste is managed in an appropriate manner.

The deep settlement tank, the grit trap and the oil interceptor will be inspected on a weekly basis to ensure that they are operating efficiently. These will be periodically emptied to appropriate facilities based on the monitoring undertaken.

All vehicles used on site will be regularly visually assessed to ensure there are no leakages. All leakage of fluid will be immediately reported and the vehicle will be diverted for service.

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10.10 Reinstatement and Residual Impacts

At the end of the deposition period the accomadation building and toilet facilities will be removed. The reception area will remain for a further five years and will be drained and oil trapped. At the end of that period the remaining facilities will be decommissioned. There will thereafter be no effluent and therefore no residual impact.

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11 AIR EMISSIONS

11.1 Introduction

Emissions to atmosphere will arise as a result of the transfer of peat from the Bellinaboy Bridge terminal site to the peat deposition site at Srahmore

Dust may be generated during the placement of peat at the deposition site. If uncontrolled, elevated dust deposition can occur beyond the site boundary and lead to complaints arising from soiling of property. Haulage and onsite vehicles and equipment will also generate exhaust fumes.

This section has been prepared by RSK ENSR Environment Ltd.

11.2 Study Methodology

This study aims to identify and assess the sources and potential impact of atmospheric releases from the transfer and deposition of peat.

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Potential emissions during the peat deposition phase will include dust generation from the various construction activities including earth or peat works, vehicle movements and wind blowing over open ground or dusty materials. Potential emissions may also include fine particles of a size that can be inhaled into the lungs (PM_{10}) if not effectively controlled.

Dust deposition is often highly localised with most dust particles falling to ground within several hundred metres from the dust source. Dust generation itself is highly dependant on climatic conditions, the type of material and nature of dust generating activities. Any predictive assessment of dust generated during construction activities can be prone to a significant level of uncertainty. It is consequently often considered more appropriate to ensure an effective management strategy is in place to minimise dust releases rather than attempt to quantify them directly. An effective dust management strategy will be introduced to control dust emissions and prevent its generation. The strategy is based on dust suppression or containment. Given the inherent moisture content of the peat, dust generation however is not expected to be significant.

Emissions will also be generated moving peat from the proposed gas terminal site to the peat deposition site. The emission components from vehicles with the greatest potential to impact on health are oxides of nitrogen (NOx) and specifically nitrogen dioxide (NO_2). Screen modelling using an appropriate assessment technique has been carried out to predict how releases from the haulage vehicles in particular will disperse in the atmosphere. The assessment has then determined the potential levels of exposure at sensitive locations including nearby houses.

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Forty vechicle units will be used in the internal transfer and deposition of peat. These units will generate emissions similar to the haulage vehicles.

The remainder of this section is set out as outlined below:

- emission characteristics of the proposals to re-position peat from the proposed gas terminal;
- the legislative context that defines air quality standards and limits;
- description of the background air quality;
- identification of potential interactions with other sources;
- a summary of mitigation measures that will minimise releases to air;
- impact assessment;
- potential microclimate considerations;
- air quality monitoring that will be carried out;
- conclusions and summary; and,
- any residual impacts

11.3 Emissions Characteristics of the Proposed Development

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11.3.1 During Peat Transfer from the Proposed Gas Terminal Site

Peat will be transferred to the peat deposition site in trucks using the route identified in the traffic impact assessment (see Section 16). Road traffic emissions will consist mainly of carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NOx), particulates (PM) and hydrocarbons (HC). Vehicle fuels have low concentrations of sulphur and sulphur dioxide emissions from vehicles are typically only significant in highly trafficked, urban areas.

11.3.2 During Peat Deposition at the Deposition site

In common with other vehicles on the local road network, vehicles accessing and traversing the site will emit carbon monoxide, nitrogen oxides, particulates and hydrocarbons.

Forty machines or vehicles are expected to operate at the peat deposition site. These units will comprise of :

- 20 tractors
- 11excavators
- 7 dozers
- 2 loading shovels

Most machinery at the deposition site will be powered by diesel engines. In order to control the emission of excess exhaust fumes and smoke, the contractor will ensure that all items of

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plant and equipment are correctly adjusted and maintained.

Dust may also be generated from vehicle movements and the transfer of material from stockpile to deposition site.

11.3.3 After Peat Deposition

Once peat is deposited at the site, dust emissions have the potential to arise from dust entrainment as wind blows across the site. The moisture levels of peat layers following deposition will however mean such emissions will be very low and degradation of the peat is not expected to occur.

11.4 Legislative Context - Air Quality Standards and Limits

Air quality standards have been developed and incorporated into Irish statute to protect human health and the environment. International agreements have also been drawn up to identify performance standards and limit the generation of air quality pollutants at a regional, national and global level. Relevant legislation and agreements have been discussed below:

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11.4.1 Air Quality Standards and Guidelines

The European Commission (EC) has formally adopted the Air Quality Framework Directive (96/62/EC). The first daughter directive, 99/30/EC (adopted April 1999), set specific limits for four air pollutants: nitrogen dioxide, sulphur dioxide, PM_{10} and lead. There are no sources of lead associated with the development and lead is not described further. In December 2001, the EC adopted the second daughter directive, 2000/69/EC, relating to limit values for benzene and carbon monoxide (CO) in ambient air. These directives have been transposed into Irish legislation by the Air Quality Standards Regulations, 2002 (SI No. 271 of 2002). These limit values are presented in Table 11.1 below:

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Table 11.1: Relevant Air Quality Standards and Guidelines

Pollutant	Averaging Period	Standard ($\mu g/m^3$)	Percentile	Maximum Exceedences per year	Target Date
NO_2	1 hour	200	99.8th	18	Jan 2010
	1 hour	200	98th	175	Now
	Annual	40			Jan 2010
	Annual (vegetation)	30			Now
SO_2	1 hour	350	99.7th	24	Jan 2005
	24 hours	125	98.9th	3	Jan 2005
	Annual (ecosystems)	20			Now
PM_{10} Stage 1	24 hours	50	-	35	Jan 2005
	Annual	40			Jan 2005
PM_{10} Stage 2	24 hours	50		7	Jan 2010
	Annual	20			Jan 2010
CO	8 hours	10,000	-	-	Jan 2005
Benzene	Annual	5	-	-	Jan 2010

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Various international initiatives, Protocols and Directives exist to limit and reduce emissions at a national level including ensuring for example, vehicles meet emission standards.

11.4.2 Dust Deposition

Whether dust deposition becomes a problem is a subjective issue and depends on a variety of factors including the sensitivity of nearby locations, the repetitive nature of any deposit occurring and the nature of the particulate itself. The colour of particulate can be influential in determining sensitivity with for example coal dust causing dust problems at lower deposition rates in comparison to dust derived from soils. Due to this subjectivity there are no statutory limits on dust deposition and the focus is on the prevention of nuisance and minimising air borne dust emissions where practicable.

A number of rule of thumb measures exist to identify whether the potential for deposition can cause dust problems. These are based on two different types of measure, namely mass

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deposition rate and effective area coverage. Baseline dust monitoring has been carried out at the proposed site by Bord na Móna to monitor deposition rates from existing peat extraction activities. The method of assessment has determined a mass deposition rate and therefore dust guidelines described in this section have focussed on this measure.

Mass deposition rates determine the quantity of material deposited per unit area over a given reference period. Two commonly applied guidelines include a UK based rule of thumb of 200 mg/m^2/day (expressed over a 30 day average) and the German (TA Luft) guideline of 350 mg/m^2/day. Below these thresholds dust problems are considered less likely.

11.5 Background Air Quality Data

11.5.1 Air Quality

No publicly available air quality data for the region has been identified. To assess the current levels of certain key air pollutants an extensive sampling programme has been carried out at the proposed Bellanaboy Bridge terminal site with additional monitoring at the proposed peat deposition site.

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Three sampling surveys have been undertaken at the proposed gas terminal site over the following periods:

- September-October 2001
- January-February 2002
- September-October 2003

In addition, monitoring has been carried out between October and November 2003 at the peat deposition site. The monitoring carried out in the vicinity of the Bellanaboy Bridge terminal would be considered to be indicative of air quality at the peat deposition site given the similarity of land use between the sites (rural aspect) and the absence of other significant sources in the area.

The results are summarised in Table 11.2

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Table 11.2: Background Air Quality

	Concentrations ($\mu g/m^3$)		
Substance	Overall Measured Average at Proposed Gas Terminal	Measured concentration at Peat Deposition site (Oct-Nov 2003)*	Limit value
Nitrogen dioxide	2	2 to 3	40 *
Sulphur dioxide	2	Not measured	20
Benzene	0.6	<0.5	5
Total VOC	228	25	N/A
PM_{10}	12	Not measured	50

* based on average of five sampling locations.

- a standard of $30\mu g/m^3$ is also present for the protection of ecosystems for oxides of nitrogen (including NO and NO_2)

The results show that the air quality in the region is very good, with pollutant levels well below the relevant air quality standards. This is as expected for a rural area with little road traffic and few industrial sources of air pollutants.

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11.5.2 Dust Deposition

The owner of the proposed site, Bord na Móna, has carried out dust monitoring using dust deposition gauges (Bergerhoff gauges) for comparison with the TA Luft threshold of $350mg/m^2/day$. Monitoring has been carried out at Munhin village in the townland of Attavally during 2002 and 2003. The site is located approximately 1.5km from the peat deposition site and is positioned to be reflective of dust deposition close to peat extraction activities. The grid reference of the monitoring location is F 827 244 . Tampering with monitoring equipment prevented results from 2001 from being reported. All results are reported to the Environmental Protection Agency.

The results are summarised below in Table 11.3.

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Table 11.3: Measured Dust Deposition Rates (Munhin Village)

	Mass Deposition ($mg/m^2/day$)			Guideline Value ($mg/m^2/day$)
Date	Minimum	Maximum	Average	
2002 (Aug-Oct)	4	17	10	350
2003 (May-Sept)	14	48	29	

Note: Monitoring and reports prepared by Bord na Móna.

The monitoring results show that dust deposition rates in close proximity to the site are very low with all monitoring results are well within the TA Luft threshold value. The highest measured deposition rate during any month was less than 14% of the threshold and occurred during the summer months when soil conditions are drier and dust generation rates tend to increase. During winter when the soil is typically moist, lower deposition rates occur. This demonstrates the effectiveness of water in controlling dust.

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It should also be noted that the monitoring has been carried out to determine the dust deposition rates in the local area arising from the existing peat extraction process, where peat is dried before being taken offsite. Dust levels would be expected to be lower for the Proposed Peat Deposition as the moisture content of the peat will be significantly higher than milled peat rendering it dust free.

11.6 Interactions with Other Sources in the Region

Other emission sources in the vicinity of the peat deposition site include road traffic.

Contributions from existing road traffic will have been recorded in the air quality monitoring described previously. They have additionally been included in screening assessments of vehicle activity described in this section. However as dust is a highly localised issue with deposition occurring close to its source significant interactions with other dust generating activities are not likely to be significant.

Fine dust with the potential to affect health (PM_{10}) can be generated from both vehicle emissions and dust generating activities. Dust suppression techniques will minimise releases of PM_{10} and releases from vehicles are assessed later in this section. Background levels of PM_{10} where both of these sources are already present show very low levels in comparison to air quality standards.

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11.7 Summary of Mitigation Measures

Potential air quality impacts during peat deposition include releases to air from haulage vehicles and the generation of dust. Traffic emissions will be minimised through appropriate vehicle maintenance and route selection to and from the peat deposition site. Route selection is described in Section 16. Dust will be mitigated by the application of best practice dust suppression and containment techniques including the prevention of dust accumulation and ensuring dusty materials are either moist or sheeted. Dust control measures to be employed may include where necessary:

- The surface of roads around the construction area will be sprayed with water during dry periods;
- Haul roads will be surfaced and road sweepers employed to ensure spillages of materials are collected and a build up of mud or dusty material does not occur;
- Speed restrictions onsite will apply, particularly where travelling on unpaved areas;
- Vehicles will preferentially have upward-directed exhausts to reduce disturbance;
- Where mud can be transferred to vehicles, a wheel wash system will be provided to prevent the subsequent transfer of mud onto local roads;
- Any vehicle carrying fine materials will remain sheeted for as long as possible to prevent dust blow and spillages; and
- Existing trees and shrubs will provide filtering of wind-borne dust and reduce near-ground wind speeds (and subsequent dust entrainment).

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The continued monitoring of dust deposition at the proposed site will assess the effectiveness of the mitigation measures introduced (as prescribed by the regulatory body).

11.8 Predicted Impacts of the Peat Deposition site

11.8.1 During Peat Deposition

Controlling the flow of vehicles can help minimise emissions from traffic. To assist in the prevention of congestion, a traffic management plan will be in place to manage the movements of heavy goods vehicles (HGV) during peat removal from the proposed gas terminal site and transfer to the peat deposition site. Traffic management and route selection is described further in Section 16.

Dust generation during peat deposition is unlikely to cause a significant impact given the wet nature of the site and the material being deposited. As identified above, should very dry conditions occur, standard techniques of dust suppression will be used. Minimising dust generation will reduce the potential for dust deposition problems from occurring at sensitive locations and additionally reduce to a minimum the generation of fine particulate with the potential to affect health (PM_{10}).

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The greatest potential for air quality impact will occur from the HGV movements taking peat along the haul route between the proposed Bellanabaoy Bridge terminals and peat deposition site. This is due to the proximity of the vehicles in relation to sensitive locations along the proposed haul route. In contrast, emissions from onsite vehicles and machinery at the peat deposition site will be spatially separated and located a significantly greater distance away from nearby sensitive locations. In areas where very good background air quality exists, such as identified at the deposition site and surrounding area, even releases from major arterial roads or motorways rarely lead to exceedances of air quality standards beyond distances of 200 metres or so from the roadside and associated emission sources. Releases from onsite vehicles are hence unlikely to have a significant impact on local air quality.

An assessment of air quality impacts associated with HGV movements has been carried out to identify potential impacts on local air quality along the haul route.
Up to 800 HGV movements (400 return trips) along the haul route are anticipated per day. To assess the impact on emissions from these movements in combination with existing traffic flows and the prevailing background air quality, a screening assessment methodology developed by the UK Highways Agency has been used. The procedure identified in the Design Manual for Roads and Bridges (DMRB, Volume 11, Section 3 Part 1) has been used to compare predicted air quality at sensitive locations along the proposed haul route with ambient air quality standards.

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The DMRB procedure calculates concentrations for pollutants up to 200 m from the roadside using emission factors for the vehicle mix and traffic speeds on the roadway. Where sensitive locations are within 200 metres of different roads, the contributions from each road are aggregated together even though this is normally prevented by the direction of prevailing winds. The assessment incorporated this and other conservative estimates of traffic flows and vehicle speeds to ensure a robust assessment of likely air quality impacts during construction activities.

Concentrations of benzene, carbon monoxide and oxides of nitrogen were predicted. Certain houses are located approximately 20 metres from the haul route including the R314, R313 and local road LP1204. The highest concentrations at any sensitive location were calculated to be less than 30% of any air quality standard identified in the Air Quality Standards Regulations, 2002.

No significant air quality impacts are predicted to arise from the peat deposition site.

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11.8.2 Upon Completion of Peat Deposition

Few, if any vehicle movements will occur on the Srahmore site once the peat has been deposited. Potential air quality impacts will hence not occur.

Dust generation will primarily be limited to dust entrainment by wind once the peat has been deposited. Generation rates will be expected to be lower than during the deposit phase. Any dust deposition is also likely to be lower than currently measured for existing operations at the site.

11.9 Micro-climate considerations

The site and surrounding area within 1km is relatively flat and open and good dispersion conditions are expected. The wind direction is expected to be prevailing south-westerly however localised land-sea effects of wind direction can be expected. Such effects are likely to lead to higher localised winds than would otherwise be the case, again aiding dispersion.

A hill ridge lies to the east of the haul road and includes the peaks of Glenturk Beg, Slieve Fyagh and Carrafull. Steep gradients do not typically occur however within 1km of the haul road site, other than a rise up to 134m above ordnance data near Glencullin Lower and again good dispersion conditions would be expected. The hill ridge does not form a basin where land rises steeply on all sides. Such basins can lead to poor dispersion characteristics under certain weather conditions (known as inversions). The hill ridge may cause localised influence in wind direction and wind speeds but such effects will not decrease the level of dispersion expected.

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11.10 Air Quality Monitoring

No monitoring of air quality associated with traffic emissions is proposed. The screening assessment described previously predicted that air quality would be well within air quality limits at sensitive locations in close proximity to the haul route.

Existing dust deposition monitoring will be continued at the site during the period of peat positioning to ensure proposed mitigation measures are effective (as prescribed by the regulatory body).

11.11 Conclusions and Summary

As a result of this study, atmospheric emissions resulting from the peat deposition site are not deemed likely to have a significant impact on the local environment either through emissions from vehicles or from dust generation.

11.12 Residual Impacts

No residual air quality impacts are anticipated as a result of the peat deposition site.

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12 NOISE

12.1 Introduction

The development proposals will involve the transfer, deposition and spreading of 450,000m^3 of peat. The scale of the scheme is such that there will be an inevitable noise impact generated by the transfer of material to the site and movement within the site. This section assesses the extent of that impact in the context of current relevant standards and guidance, and identifies any requirements or possibilities for mitigation.

12.2 Methodology

12.2.1 Noise Terminology

The primary noise measurement parameters used in this assessment are $L_{Aeq,T}$, $L_{Amax,T}$ and $L_{A90,T}$. These represent the average, maximum and minimum levels occurring during a given period, T, and are referred to as such elsewhere in this section. Comparisons between ambient prevailing values of these indices and those likely to be generated by the scheme are useful indicators of noise impact, as are benchmark comparisons against standards set as absolute values.

All references to sound pressure level are in decibels, related to the standard reference pressure of 20 μ Pa. Sound power level references are in decibels relative to the standard reference power level of 1pW.

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12.2.2 Guidance and Policy

Published Irish standards and guidance are relied upon wherever possible, or in their absence suitable EU or UK documents have been used. The consultation draft Guidelines for Noise Impact Assessment recently published by the Institute of Acoustics and Institute of Environmental Management and Assessment have also been referred to for additional technical guidance.

12.2.3 Overview of Assessment Procedure

The assessment procedure involves determining noise levels likely to be generated by the proposed development, comparing these with measured baseline conditions, and with other sources of existing impact in the area, and assessing this effect in the context of the duration of the project and other relevant factors. To provide comparisons with baseline conditions, surveys of background noise levels around the site and the main peat haul route have been carried out, along with a road condition overview survey and observations of traffic movements.

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12.3 Baseline

12.3.1 Background Noise Survey

It is accepted practise to carry out measurements of pre-existing background noise levels to assess the likely impact of any new noise source introduced into that climate. Baseline conditions are established in this way. A detailed survey of background noise conditions around the peat deposition site, and along the main peat access route (L12044) was carried out between 13th and 16th October 2003. Background noise levels were quantified during both prevailing and worst case (calm) weather conditions during this period.

Sample noise measurements were made at a number of significant locations around the proposed site with respect to the nearest sensitive receptors (dwellings) and along the main peat access route from Bellanboy Bridge.

Detailed survey measurements were carried out employing both manned and automated monitoring equipment to establish fluctuations in prevailing noise levels over time, and provide qualitative assessments of dominant ambient noise sources during both daytime and night-time periods. It is understood, however, that although the activity will mostly take place, it may also occur outside of those hours to take advantage of favourable conditions.during normal working hours (7am –7pm). Full details of these noise survey measurements are available on request, but are summarised in this section for ease of reference.

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For the purposes of this assessment, a 24-hour period has been divided into daytime (07:00-19:00), evening (19:00-23:00) and night-time (23:00-07:00).

Daytime

Daytime noise levels around the site are dominated by traffic movements along the R313, which carries significant volumes of traffic, with a high proportion of heavy goods vehicles and agricultural machinery. Proximity to this and the Geesala road determines ambient noise levels in the area around the deposition site. The closest, and potentially most affected residential properties to the site are also those closest to the existing daytime traffic noise sources. Daytime minimum background noise levels have been measured at around 30 dB L_{A90}, but typical L_{Aeq} levels are generally above 45 dB, increasing to 70 dB in close proximity to road noise sources.

Along the peat access route, background noise levels fell to similar minima in the range 30 to 35 dB. A number of locations experienced higher background levels, however, particularly during prevailing wind conditions, due to their more exposed location. Passing vehicles along the local road, a high proportion of which are commercial / agricultural, generated significant noise levels throughout the daytime period, with typical roadside average levels of 55 to 60 dB.

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Evening

Ambient noise levels vary throughout the daytime and evening period, but do not show a marked 'working hours' dominated profile as might be expected in a less rural environment. The survey measurements show that ambient noise levels dominated by traffic movements start to decrease slightly after 18.00 hours in a gradual decay throughout the evening period, falling by approximately 10 dB by 23.00 hours.

Measurements and observations made along the peat access road at the end of the daytime period indicated that traffic noise levels along the local road do not fall dramatically until later in the evening.

Night-time

At night, noise levels can drop to very low values when all activity on nearby roads reaches a minimum. Background noise levels are consistent with those occurring during lulls in activity during the day and evening, but with more frequent opportunities to approach minimum values.

The survey measurements show levels falling dramatically after about 0200 hours when road traffic along the R313 drops dramatically.

Although relatively infrequent, calm conditions at night can result in lowest background L_{A90} values of around 20 dB. During typical conditions however, involving some element of meteorological noise, levels of around 30 dB can be considered representative.

No night-time noise data was gathered along the peat access route.

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12.3.2 Wind Data, Background Noise Levels and Noise Propagation

Weather data from Met Eireann for the area over the period June 2002 to March 2003 has been used to establish typical prevailing conditions and their affect on both background noise levels and noise propagation.

The modal wind direction for the period studied is from 190 degrees, with a mean wind speed in that direction of 16.7 knots, or 8.6 m/s.

Prevailing conditions, therefore, can be assumed to assist noise propagation from the proposed Peat Deposition Site to the north and north-east, and impede its propagation in a southerly and south-westerly direction. Calculations indicate that this would result in a downwind increase in noise levels of the order of 5dB, and a similar decrease in noise upwind of the site.

Background noise levels increase with wind speed also, however, and serve to offset some of the increase in downwind noise levels due to increased masking effects. Research on this

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relationship carried out for wind farm developments indicates that vegetation and meteorological noise due to wind speeds above 5m/s becomes significant in elevating background noise levels.

12.3.3 Observations of Road Conditions and Vehicle Movements

A preliminary road condition survey was carried out during the course of the background noise survey visit to site to establish characteristics of the (L1204) local road which may influence the noise impact assessment.

This involved a number of driven examinations of the road surface to identify especially rough and noisy sections, as well as significant bumps, potholes and other discontinuities which can result in impact noise generation, particularly in unladen heavy vehicles. The results of this examination were then compared with a visual survey of the proximity of nearby dwellings, categorising those within approximately 50m and 100m of the carriageway.

Areas in which concerns of a noisy or discontinuous road surface coincided with dwellings within 50m were identified as *'mitigation required'* and those with dwellings between 50m and 100m were labelled *'mitigation to be considered'*.

A sample traffic count was carried out between 0700 and 0800 on 15th October 2003. This was not a rigorous traffic assessment, but enabled noise survey measurements to be set in the context of the traffic movements at that time. The two-way hourly flow was estimated at 76 vehicle movements. Of these, 47% were commercial or heavy goods vehicles (including school buses and vehicles with livestock trailers).

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A series of measurements was also made at a single static position to quantify noise levels generated by those vehicles currently using the peat access route. This included a single vehicle of the type expected to haul peat along this route to the proposed deposition site, which was thought to have come from a local quarry. Comparable or higher noise levels were generated by the majority of the commercial traffic measured, including curtain-sided HGVs, an articulated timber delivery from the logging site on the L1204, a Bank of Ireland security van and agricultural vehicles.

12.4 Predicted Impact of the Proposed Development

12.4.1 Construction

For the purposes of this assessment, the construction phase is described as all enabling and construction works required on the site in preparation for the arrival of the first peat delivery.

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These works are expected to be limited to the following operations;

- Construction of a new site entrance and road junction
- Construction of site facilities
- Upgrading / making good of sections of the local road between the application site and Bellanboy Bridge
- Construction of hard standing for peat lay-down
- Site fencing

These activities can be expected to last approximately for up to 6 months and would not be expected to result in any greater noise levels than other carriageway and site enabling works.

The greatest impact from this phase will occur at the newly formed site entrance, with dwellings relatively close by on the opposite side of the R313. The work would occur during daytime working hours, and should be set against the relatively high ambient noise levels which occur in the vicinity of this junction during those hours.

12.4.2 Operation

Although the proposed peat deposition project is not a common operation, and comparable sites are not readily available, the day to day operational noise generated by the deposition process can be likened to that of a landfill operation, of which there are numerous comparable examples.

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Noise measurements and predictions from Alan Saunders Associates' database have been used to estimate the likely noise levels to be generated by the deposition operation. It has been assumed that material processing and sorting operations, such as rock crushing, wood chipping and soil extraction will not be necessary, as only peat will be brought to the site.

The peat distribution and grading process, therefore, involving tracked mobile plant and vehicles, is estimated to result in typical average (L_{Aeq}) noise levels of about 65 dB(A) at 100m from each of the operations concerned. Worst case levels at the receptor locations have been calculated to fall within 55 to 60 dB(A), depending on the proximity of the closest working approach to a given receptor.

During daytime hours these noise levels will exceed background noise levels at the nearest dwellings and give rise to an impact. This should be considered against the absolute limits recommended in guidance documents such as MPG11 'The Control of Noise at Surface Mineral Workings (April 1993)'.

This recommends average daytime noise levels below 55 dB(A) for more permanent facilities, such as quarries and other mineral extraction sites. Such operations are often also subject to IPC licensing, with similar threshold levels imposed.

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In comparison, noise levels generated by the deposition process during most of the scheme are not expected to significantly exceed this figure at the nearest residences, due to the relatively large propagation distances involved. Some excesses of this target, which may give rise to some degree of disruption, can be expected when deposition occurs in the areas of site closest to the receptor dwellings. In such cases, additional emphasis on best practise on site and operational noise mitigation will be required of the site contractors.

The noise impact should also be considered against the existing and previous use of the site, as peat milling and extraction processes carried out previously are likely to have generated equivalent (if not greater noise) levels.

If there were an imperative to continue operation of the site later into the evening than the intended 2100 hours curfew, a significantly greater noise impact could be expected. As ambient noise levels decrease by 10dB(A) during the course of the evening, the subjective intrusion of noise from the site would double.

Night-time operation after 2300 hours would give rise to very significant noise impact, in comparison with very low background noise levels.

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12.4.3 Traffic

Peat deliveries to the proposed site are understood to be proposed at a rate of 400 movements per day, using the L1204 access road. Although this represents a significant increase, it is anticipated that the total flow will still be below the 'low flow' threshold described in CRTN: 1988: 'Calculation of Road Traffic Noise: Department of Transport & The Welsh Office'.

For a comparison between traffic flows below the minimum calculation threshold, and in the 'low flow' region, it is more appropriate to consider the noise levels generated by individual vehicle movements than to model them as a continuous line source to estimate overall daytime noise levels.

Survey measurements have shown that existing vehicle movements are frequently as noisy as those proposed under the development, such that this does not constitute the introduction of a new noise source.

Such events, however, will be more frequent. The most significant impact will be observed at the dwellings in areas identified in the road condition survey as close to noisy and uneven road surfaces, sharp bends and steep inclines.

12.4.4 Decommissioning

Decommissioning on completion of the peat deposition operation would involve removal of

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the site facilities, hardstanding and road access, and making good generally, including any damage to the L1204 road.

The noise impact of this phase can be assumed to be less significant than construction, and likely to be of shorter duration. As for construction, the most affected receptors would be dwellings on the opposite side of the R313.

12.5 Mitigation

12.5.1 Construction

Mitigation of the inevitable noise generated by the construction phase will be required to protect the amenity of the dwellings immediately opposite the site.

This will be achieved using a combination of good site practice, use of modern methods and equipment (which complies with EU directive 2000/14/EC) and expeditious site management to minimise the duration of noise exposure.

Local residents will be given prior notice (at least one week) of any specific activities or processes likely to generate unusually high noise levels. Contact details for the person responsible for day-to-day management of the site will also be made freely available.

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12.5.2 Operation

Noise emissions from the site throughout the six month deposition process are not expected to be excessively noisy considering the location and previous history of the site, and the projected duration of the scheme.

A form of mitigation is provided by prevailing wind conditions which promote noise propagation in the direction of the higher ambient noise levels (close to the R313) and generate significant background noise.

In accordance with methodologies recommended by several authorities within the Republic, general control of noise emissions from the site will be provided by observing the guidance given in BS5228 'Noise Control on Construction and Open Sites', and by using modern and well maintained plant and vehicles.

12.5.3 Traffic

Peat lorry movements along the L1204 local road will result in a moderate to high short term impact on receptors along that route. A package of mitigation has been defined in order to minimise this impact.

Road surface works will be carried out in the areas identified by the road condition survey as *'mitigation required'* (two sections identified)and a need for them will be investigated in the areas defined as *'mitigation may be required'*.(two such sections identified)

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In addition, road sections in which physical features have raised concerns which cannot be addressed by resurfacing works, will be subject to a speed restriction for site traffic of 30 mph.

A strict curfew will be applied to drivers on the peat haul route, with clear instructions on considerate use of the local roads. Anyone failing to observe these requirements will be sanctioned.

12.5.4 Decommissioning

As for the construction phase, good practice on site and prior notice to nearby residents would be sufficient to minimise this minor and very short term impact.

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13 LANDSCAPE AND VISUAL IMPACT

13.1 Introduction

This Section assesses the likely significant landscape and visual impacts of the proposal to transport peat, excavated from the proposed Bellanaboy Bridge Terminal Site at Bellanaboy, to a cutover peatland site at Srahmore and Attavally, west of Bangor in County Mayo.

This landscape and visual impact assessment was undertaken by Brady Shipman Martin between August and November 2003, and builds upon an existing detailed knowledge of the proposed Bellanaboy Bridge Terminal site, its wider environs and includes information gathered in consultations with Shell E&P Ireland Limited (SEPIL), Bord na Móna and Mayo County Council.

13.2 Study Methodology

The Landscape and Visual Impact Assessment assesses the following:

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Landscape Impacts, including:

- direct impacts upon specific landscape elements within and adjacent to the site;
- effects on the overall pattern of the landscape elements which give rise to the landscape character of the site and its surroundings; and
- impacts upon any special interests in and around the site.

Visual Impacts:

- direct impacts of the development upon views in the landscape; and
- overall impact on visual amenity.

Visual impacts may be defined under 'Visual Intrusion' and 'Visual Obstruction', where: -

- Visual intrusion is impact on a view without blocking, and
- Visual obstruction is impact on a view involving blocking thereof.

Significance Criteria

Various significance criteria are commonly used in assessing landscape and visual impacts. Many of these are particular to individual practices and based on years of professional

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experience in the area of landscape and visual impact assessment[12]. Yet others are suggested by particular bodies in relevant fields[13] or as standardisations of significance criteria across a wide range of environmental issues[14]. The criteria as set out in the EPA *Guidelines on Information to be contained in Environmental Impact Statements* is just such a standardisation and being general in their description, present difficulties in the direct relevant application and description of landscape and visual impacts.

The following Table sets out the significance criteria ratings as used for this assessment. The project criteria are based on those given in the Guidelines from the Landscape Institute but cognisance has also been taken of the EPA Guidelines.

Table 13 .1 Significance Criteria

Project Criteria	EPA Rating
None/ Negligible - No or only a very small part of the development, or work or activity associated with it, is discernible.	Imperceptible - An impact capable of measurement but without noticeable consequences
Slight - The proposals constitute only a minor component of the wider view, which might be missed by the casual observer or receptor. Awareness of the proposals would not have a marked effect on the overall quality of the scene.	Slight - An impact which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate - The proposals form a visible and recognisable new element within the overall scene and may be readily noticed by the observer or receptor.	Moderate - An impact that alters the character of the environment in a manner that is consistent with the existing and emerging trends
Major - The proposals form a significant and immediately apparent part of the scene that affects and changes its overall character.	Significant - An impact which, by its character, magnitude, duration or intensity alters a sensitive aspects if the environment

Project Criteria (con't)	EPA Rating
Severe - The proposals become the dominant feature of the scene to which other elements become subordinate and they significantly affect and change its character.	Profound - An impact which obliterates sensitive characteristics

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12 2002, The Landscape Institute & Institute of Environmental Managements & Assessment: Guidelines for Landscape and Visual Impact Assessment (2nd Ed.)

13 2002, Department of Environment (UK) Design Manual for Roads and Bridges, Vol. 11, Section 3, Part 5.

14 2002, EPA Guidelines on information to be contained in Environmental Impact Statements, Glossary of Impacts.

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Impact ratings may have negative, neutral or positive application where: -

- Positive impact – A change which improves the quality of the environment.
- Neutral impact – A change which does not affect the quality of the environment.
- Negative impact – A change which reduces the quality of the environment.

Terms relating to the duration of impacts are as described in the EPA Guidelines as: -

- Temporary Impact - lasting one year or less
- Short-term Impact - lasting one to seven years
- Medium-term Impact - lasting seven to fifteen years
- Long-term Impact - lasting fifteen to sixty years
- Permanent Impact - lasting over sixty years

13.3 References

The assessment included a review of relevant statutory documents, including the Mayo County Development Plan 2003-2009 and the associated Landscape Appraisal for County Mayo.

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The following documents where reviewed in the course of the assessment: -

- Aalen, F. H. A, Whelan, K. & Stout, M. (1997) *Atlas of the Irish Rural Landscape*, Cork University Press, Cork;
- An Foras Forbartha: (1977) *Inventory of Outstanding Landscapes in Ireland*, An Foras Forbartha, Dublin;
- A Topographical Dictionary of Ireland, Lewis, S 1837;
- EPA: Advice Notes On Current Practice (in the preparation of Environmental Impact Statements) 1995;
- EPA: Guidelines On Information To Be Contained In Environmental Impact Statements 2002;
- The Landscape Institute / Institute of Environmental Management & Assessment: Guidelines for Landscape and Visual Impact Assessment, Second Edition 2002.
- Mayo County Development Plan 2003-2009, Mayo County Council, 2003;
- Appendix X Landscape Appraisal of County Mayo, County Development Plan 2003-2009, Mayo County Council2003;

In addition various amenity and landscape publications and other information relating to the local environment were studied.

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13.4 Outline of the Proposed Development

The site comprises 117 hectares much of which is cutover peatland. Approximately 63 hectares of Area 6 will be used for final deposition of the peat. The remaining site areas are made up of the peat reception area (Area 5), the entrance and access areas, settlement ponds, a controlled overflow area (part of Area 7) and fringe bog areas. Drawing No. 1169\01\203 details the Areas 1-8. The proposed peat reception area (Area 5) and proposed peat deposition area (Area 6) lie to the east of the view.

Area 5, the peat reception area, has short-term use for the duration of the peat reception activity and for some years thereafter for monitoring purposes until the peat has fully stabilised. Actual peat importation is expected to take up to 6 months (though timeframe is weather dependent and may be spread over two seasons) and thereafter any temporary buildings etc. will be removed. The entrance off the R313 Bangor – Belmullet Road and the associated site roads will be retained during the monitoring process.

Area 6, the peat deposition area, is a saucer shaped, cutover peatland set lower than the surrounding fringe bog habitats. A number of 'high fields' located within the area are some 1 to 2 m higher than the adjoining 'low fields'. The deposition of the peat will see the low areas (bays) recovered to depths of on average 1.4-1.8m. It is envisaged that complete re-vegetation of the peat will take up to 5 years primarily by soft rush (*Juncus effusus*), Thereafter it is proposed to monitor and evaluate various options, which may include re-wetting in order to facilitate reinstatement of peat forming conditions.

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Photo 1: View north-east over cutover Area 6, the proposed peat deposition location.

Drainage channels will be retained around the deposited peat and these will route any runoff through a series of settlement ponds prior to draining to the west of the site.

The development will comprise the following principal elements, which are to be considered as part of the landscape and visual impact assessment:

- transportation of some 450,000 m^3. of peat excavated from the proposed Bellanaboy

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Bridge Terminal site.

- the establishment of a temporary peat reception area on cutover peatland (Area 5) south of the R313 Bangor - Belmullet Road;
- transport to and deposition of peat to an average 1.4-1.8m over an adjoining area (Area 6) of cutover peatland between the R313 Bangor - Belmullet Road to the north and the L1206 Bangor - Geesala County Road to the south; and
- revegetation and stabilisation of peat.

Other features of the development include:

- new access and entrance road running south from the existing junction between the R313 Bangor - Belmullet Road and the L1204 Bangor - Bellanaboy County Road; and
- temporary reception / administration buildings, car-parking, weighbridges etc.

Mayo County Council will also carry out improvements along the L1204 Bangor - Bellanaboy County Road, a distance of some 11km;

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13.5 Receiving Environment

Located some 1km west of Bangor, the proposed peat reception/deposition site is set within a large, roughly triangular area of peatland bounded by the R313 Bangor - Belmullet Road to the north and the L1206 Bangor - Geesala County Road (and Owenmore River) to the south. This large area of peatland is less defined to the west as it continues over the Munhin River rising gradually to low uplands at Drummanaffrin (122m AOD) and TRISTA (132m AOD).

Photo 2: View west from Geesala Road over southern portion of Area 6 towards Trista (132m AOD) and Drummanaffrin (122m AOD) uplands.

In general the site and its immediate surrounds are low-lying and appear visually level. General site levels vary between 10 and 20m AOD with depressions of cutover peatland, some 1 to 3m lower than their immediate surrounds. These areas are prominent only because of their lack of vegetation and the uniform dark brown colouring defined against a

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variable green and green-purple vegetated landscape.

Photo 3: View north from Geesala Road over cutover peat in Area 6

Trees and scrub are generally absent with some sparse planting around improved grassland and residential properties. See Photoviews generally. Isolated patches of scrub occur along the main drainage channels and along the railway lines on the cutover peatland areas. Two small areas of mature coniferous plantation lie south/south-west of the site near the L1206 Geesala Road. See Photo 2.

Away from the development site land rises prominently to the north-west, north-east and south-east towards Knocknascallop (239m AOD), Carrafull (269m AOD) and Knocklettercuss (370m AOD) respectively. Low-lying lands extend south over the Owenmore River and continue for some distance.

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Photo 4: View north-west from Geesala Road over an indistinct Area 6 towards Knocknascollop uplands (239m AOD).

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Photo 5: View north-east from Geesala Road over southern portion of Area 6 towards Currafull uplands (269m AOD).

As previously noted, the site comprises two areas of cutover peatland within the larger Bangor cutover peatland area which straddle the Munhin River south of the R313 Bangor – Belmullet Road. Cutover peat production areas 1, 2, 3 & 8 all lie west of the Munhin River, over 1km from the development site. The site, principally comprising Areas 5 & 6, lies to the eastern side of the Bangor production area with cutover Areas 4 and 7 located centrally between the site and the Munhin River. The Owenmore River flows east - west some distance south of the cutover peatland. Carrowmore Lake lies to the north of the site and the R313 Bangor – Belmullet Road.

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Bangor, a small town[15], lies over 500m east of the development where the R313 Bangor – Belmullet Road meets the L1206 Bangor - Geesala Road. Residential property is prominently located on rising ground north of the R313 at Attavally where approximately 16 properties overlook the Site.

Photo 6: View west along R313 near Attavally. Residential property overlooking road and site to south (left).

[15] Mayo County Development Plan 2003-2009

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Photo 7: View south over site from elevated ground at Attavally.

Residential development is also increasingly prominent along the Darraragh Local Road south of the Site and the Owenmore River. More distantly residential development is often clustered around improved grassland areas on rising ground. See Photo 4 above. Otherwise the area is sparsely populated, particularly west and south-west of the Site, with individual, often isolated dwellings and farmhouses, well spaced and scattered throughout the area.

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Photo 8: View south-west from L1206 Geesala Road towards properties along Darraragh Local Road.

As previously noted residential development is prominent on elevated ground north of the site at Attavally. Further north and on higher ground, similar development is also prominent at Cloontakilla from where panoramic views are possible to the north-west over Carrowmore Lake. Residential development is also increasingly prominent along the L1204 Bangor – Bellanaboy County Road, particular at Attavally & Cloontakilla, Glencullen, Glenturk More and near Bellanaboy Bridge.

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Photo 9: View north-west from Cloontakilla over L1204 Bangor – Bellanaboy County Road and Carrowmore Lake.

A series of 24 circular and linear walks including the Bangor Trail and the Western Way are promoted by Siúlóidí Iorrais throughout the Barony of Erris, all of which follow public roads. Among the nearest are the Glencullen (Bangor) Circular walk, the Tarsaghaun Loop and the Ederglen Loop walks. Starting at Bangor, the Glencullen walk follows the R313 Belmullet Road then turns north through the elevated lands at Attavally and Cloontakilla before following the L1204 Bellanaboy Road to the Glencullen River. The route turns east and then south around Carrafull Hill returning to Bangor. The Tarsaghaun Loop follows the N59 south from Bangor for some 7km before eventually returning to Bangor via part of the Bangor Way on the western slopes of Knocklettercuss. The Ederglen Loop follows the R313 west from Bangor, passes around Ederglen and then leads south to the L1206 Geesala Road which is followed back to Bangor Development site. In effect this route encircles the Bangor Bog Complex which includes the site.

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The long distance Bangor Trail runs south from Bangor along the western flank of Knocklettercuss and the Nephin Beg Range. The fifteen-piece North Mayo Sculpture Trail, 'Tír Sáile', which extends from Ballina to Blacksod via Belmullet, has one piece, '*Stratified Sheep*' located along the L1204 Bangor – Bellanaboy Local Road near its junction with the R314 Belmullet-Ballycastle Road. The routes are illustrated on Figure 13.1 Site Context.

The western shore of Carrowmore Lake is accessed at a number of points along the L1204 Bangor – Bellanaboy Local Road. A recently renovated Marian Shrine is located prominently at the Junction of the R313 Bangor - Belmullet Road and the L1204 Bangor - Bellanaboy Local Road. A roadside memorial to Martin Healy is located east of the L1204 Bangor - Bellanaboy Local Road north of Cloontakilla.

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Photo 10: View of Marian Shrine at Junction of R313 Bangor – Belmullet and L1206 Bangor – Bellanaboy Local Road.

13.6 Do Nothing Scenario

If the proposed development did not proceed it is expected that the *Rehabilitation Plan* proposed for the site and covered by Condition 10 of the existing Bord na Móna IPC Licence cutover peatland would proceed. The effect of such works on the receiving environment would be a positive impact in terms of landscape rehabilitation and visual integration.

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13.7 Impact on Landscape

It is considered that with the exception of the temporary peat transfer and deposition aspect, the proposal has potential for an overall positive impact in terms of landscape and visual amenity. There will be significant traffic aspects in the short term related to the peat transportation.

13.8 Impact on Visual Amenity

The greatest potential for visual impact arises from the traffic aspects of the peat transfer from Bellanaboy Bridge Terminal site. This will be most prominent along the L1204 Bangor – Bellanaboy Road and adjoining areas. However, this is a temporary aspect of the development . The actual peat handling and deposition may have some initial impacts especially from elevated landscape at Attavally, Cloontakilla and less so from more distant elevated locations at Carrafull and Knocklettercuss, etc. However, the proposal will have an overall positive impact in terms of landscape and visual amenity

Visual Impact from Properties

Impacts will be most significant for properties located close to or directly fronting the L1204 Bangor – Bellanaboy Local Road and that section of the R314 Ballycastle – Belmullet Road from its junction with the local road near Bellanaboy Bridge to the entrance

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to the Bellanaboy Bridge Terminal Site. For such properties the traffic associated with the peat transportation will be visually and directly disruptive. However the duration of the major temporary negative impact will be short.

Photomontages have been prepared to illustrate the nature of the development as seen from the elevated ground to the north of the site at Attavally. The post revegetated view is given (Figure 13.1) together with a second view incorporating the existing view, the view after peat deposition and the post revegetated view (Figure 13.2). Rehabilitation measures to be applied to areas outside of the site (with the exception of those parts in Area 5) under current Bord na Móna IPC Licence have not been included in the views as they do not form part of the proposed development.

Visual Impact from Roads and Surrounds

The impact from surrounding roads is similar to the traffic associated with the peat transportation, which is the most readily noticeable and major negative impacting feature – though temporary in duration. The impact will be most prominent along the L1204 Bangor – Bellanaboy Road and along a short section of the R314 Ballycastle – Belmullet Road at the Gas Terminal Site. After cessation of peat transportation the proposed development will have negligible impact from roads and surrounds with an eventual slight positive impact in terms of viewing over the re-vegetated site.

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Night Time Visual Impact

At night, the local landscape in the vicinity of the development site is almost completely dark, with very limited sources of light, primarily from the scattered residential properties and more distantly from Bangor. The local roads immediate to the site are unlit.

It is proposed to provide limited temporary illumination from the R313 south in to the peat reception area (Area 5) to facilitate project operations Otherwise illumination associated with truck movements would be the principal project related illumination.

13.9 Impact on Landscape Planning

The statutory and non-statutory landscape planning aspects relating to the area can be considered in terms of national, county and local status.

National Landscape Designations or Listings

The 'Inventory of Outstanding Landscapes in Ireland', prepared by An Foras Forbartha in 1977 has no listing pertaining the site. Listing Nr 17 Nephin Beg Range, is an extensive mountain area running south from the L1206 Geesala Road immediately south of the site. However, given the nature and temporary/short-term aspect of the proposed development it is considered that no adverse impact will arise and there will be a positive and permanent effect of the revegetate development site.

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CORRIB FIELD DEVELOPMENT – SRAHMORE PEAT DEPOSITION SITE

Visual Impact - Photomontage

Prepared by:
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Dartry
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On behalf of:
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PHOTOMONTAGE METHODOLOGY

Reference points

A topographic survey and a 6" map of the site and the surrounding area was available. There were numerous features evident on the survey such as trenches and junctions of trenches, which are clearly visible with the eye when viewed from the high ground to the north of the site.

Photography

A photograph was taken using a 50mm lens on a Hassleblad medium format camera. This lens has a horizontal field of vision of 57°. The camera height above ground was recorded along with the time the photograph was taken.

Survey Information

The position of the camera was recorded on a copy of the 6" map. Angular measurements were taken with a theodolite from the camera position to a number of features visible in the view. The camera location was plotted and the camera level was calculated relative to existing features on the site. The surveyed features as they appeared in the photograph were then marked on the photograph. The sight lines from the camera position to these features were then plotted, together with the outer edges of the field of vision. These sight lines were then taken and overlaid onto the combined topographic survey and 6" map of the area, and positioned so as to align with the corresponding points on the map.

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Photomontages

A digital model of both the existing and proposed contours was generated. A perspective view was then generated to replicate the actual photograph, and overlaid onto the background photograph. An accurate fit was achieved by matching existing features in the topography with the corresponding points in the background photograph.

Presentation

The photograph was taken using a lens which has a horizontal field of vision of 57°. The photomontages are presented on A3, with an image width of 368mm. At this size, a reading distance of 339mm will render the image the same size as if the reader was observing the real scene. As photography cannot present what the eye sees in reality, it is intended that the photomontages are used as a tool to aid visual assessment, and should be viewed on site and compared with the real scene.

The photomontage is presented on 2 sheets. The first shows only the post re-vegetation scenario. The second sheet is an analysis sheet which comprises three versions of the photograph as follows:

1 Existing
2 Post Deposition
3 Post Re-vegetation

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57°	50°	40°	ANGLE OF VISION SCALE	40°	50°	57°

Camera Level: 48.0m AOD
Grid Reference: E 85245; N 324260
Date / Time of photograph: 17 October 2003/ 10:46am
Camera / Lens: Hassleblad / 50mm

View from local road on high ground at Attavally, looking south west.

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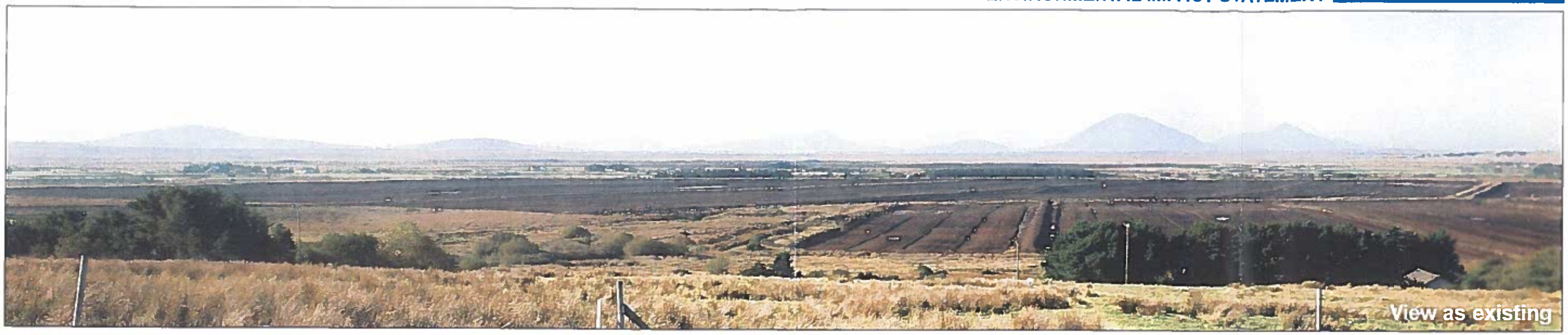

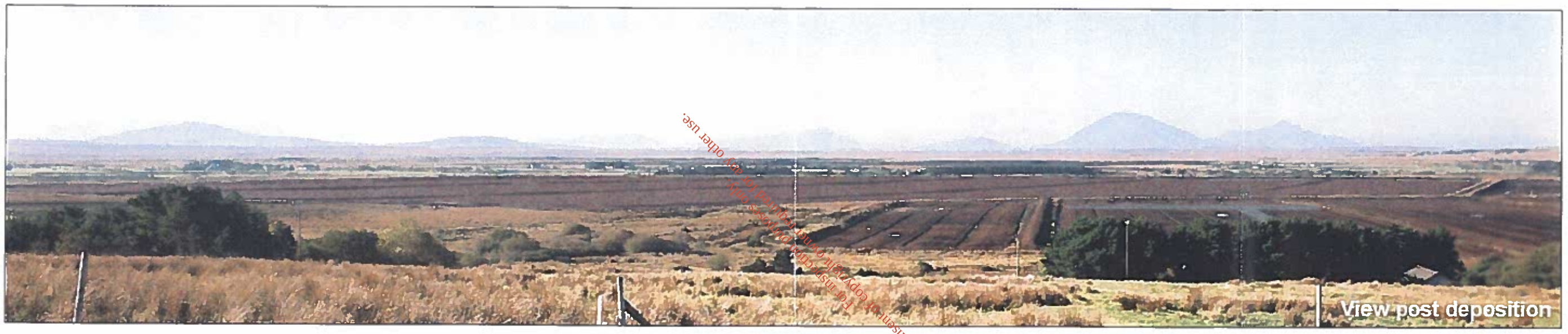

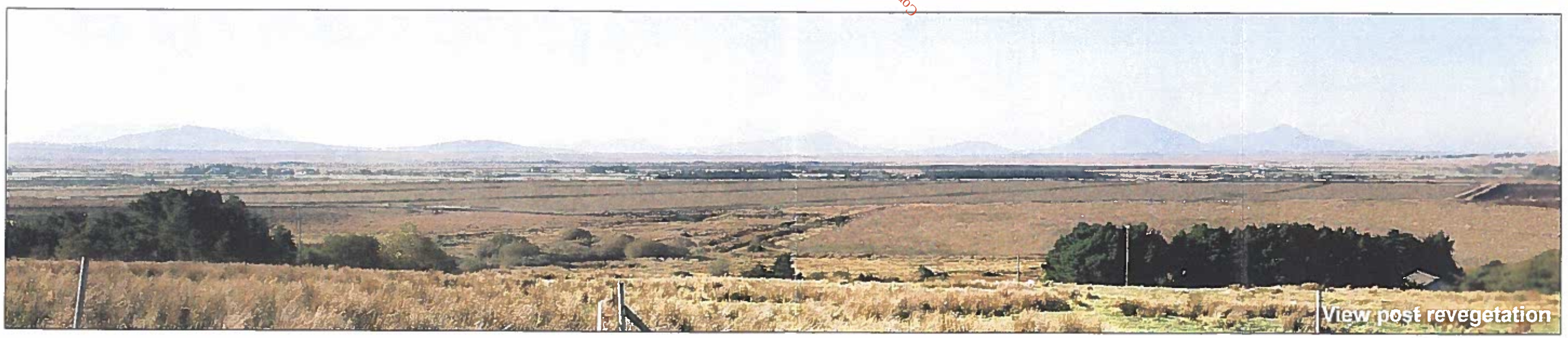

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57° | 50° | 40° ANGLE OF VISION SCALE 40° | 50° | 57°

Camera Level:	48.0m AOD
Grid Reference:	E 85245; N 324260
Date / Time of photograph:	17 October 2003/ 10:46am
Camera / Lens:	Hassleblad / 50mm

View from local road on high ground at Attavally, looking south west.

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County Landscape Designations or Listings

The **County Mayo Development Plan 2003** is the statutory planning control document pertaining to the study area. The Plan includes at Appendix X, a Landscape Appraisal for County Mayo.

County Mayo Development Plan 2003

In Section 3.1.5. – Environment, Heritage & Conservation, the Draft Plan includes the following principal landscape / visual related references:-

Policies EH-LC1 and EH-LC2 specifically relate to Landscape Character. Policy EH-LC1 confirms that it is an objective of the Council through the Landscape Appraisal of County Mayo "*to recognise and facilitate appropriate development in a manner that has regard to the character and sensitivity of the landscape, to ensure that development will not have a disproportionate effect on the existing or future character of a landscape, in terms of location, design, visual prominence, that development will have regard to the effects of the developments on views from the public realm towards sensitive or vulnerable features and areas*".

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Policy EH-LC2 confirms that it is an objective of the Council "*that all development in the County shall be considered in the context of the policies set out for the four Principal Policy Areas defined in the Landscape Appraisal of County Mayo, provided such policies do not conflict with the County Development Plan*". "

Policy EH-VP1, states that it is the policy of the Council "*to ensure that development does not adversely interfere with views and prospects and the amenities of places and features of natural beauty or interest when viewed from the public realm. Views and prospects worthy of preservation and protection are indicated on Map 12.*"

Map 12 entitled Scenic Views indicates there are no Views and Prospects pertaining to the site itself or its immediate surrounds. The plan does indicate that both Highly Scenic Views and Scenic Views are available along the western shoreline of Carrowmore Lake to the north-west of the site. This road has no visual connection with the proposed site however, additional traffic associated with the peat transportation will be noticeable on the L1204 Bangor – Bellanaboy Road running east of the lake. It is assessed that any impact associated with the transportation is of a temporary nature and being some 1 to 3km distant is considered to be moderately negative at most. The issue of Scenic Routes and Areas Designated as Highly Scenic Vistas are also included in the Landscape Appraisal discussed below.

No Tree Preservation Orders as listed in Appendix VIII of the Plan pertain to the site.

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Landscape Appraisal of County Mayo 2003-2009
In Section 2.4, the Landscape Appraisal sets the proposed peat reception /deposition site at the eastern end of landscape character unit, Area C – North West Coastal Bog.

The key characteristics of this large landscape unit are described as:-

"*...low lying bog strip, located between the western coastline and the Beg Range to the east. It has a homogeneous, exposed, moorland appearance throughout. The topography is smoothly contoured with bog/moor type grasses being the predominant vegetation.*

The land use is described as essentially peat bog, with areas of agriculture (i.e. complex cultivation patterns) and coniferous forestry also being present. Areas of natural grassland and transitional woodland scrub occur throughout the major land uses. Critical Landscape Factors of Area C are described as, essentially smooth terrain covered by low vegetation comprising moorland and bog grasses. The Appraisal determines that in landscape terms, the low vegetation has similar characteristics to the smooth terrain and that the two factors are interrelated due to soil attributes.

The Appraisal assesses that the smooth terrain, covered by grassland vegetation, is generally uniform in appearance, allowing vistas over long distances, and that the uniform appearance of the grassland vegetation cover fails to break up the long distance visibility. The Appraisal concludes that in such terrain, distances can appear shorter and development closer or larger. As a result development can have a disproportionate visual impact in such terrain, due to an inherent inability to be absorbed, physically or visually.

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In addition to descriptions of landscape character, Section 3 of the Appraisal designates areas as 'Vulnerable, Sensitive, Normal and Robust'. The policy with regard to areas designated as Vulnerable, states that "*development in the environs of these areas must not be shown to impinge in any significant way upon its character, integrity or uniformity when viewed from the surroundings. Particular attention should be given to the preservation of the character and distinctiveness as viewed from scenic routes...*".

With specific regard to the proposed site, the following designations are of relevance.

In section 3.1 (a) - **Areas Designated as Vulnerable**, a sub-division under this designation includes 'The Shorelines of Lakes, Rivers and Estuaries'. Carrowmore Lake, Owenmore River and the Munhin River under this designation. The proposed site does not directly impact on the banks or shorelines of any of these features. Owenmore River is located south of the L1206 Bangor-Geesala Road some 500m south of Area 6, the peat deposition site. Given the low-lying topography and intervening road the proposed development will have no adverse impact on the river. The Munhin River is located some 1km+ west of the site with large intervening cutover areas (4 & 7). As such the proposed development will

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have no adverse impact on the river. Carrowmore Lake is set north of and somewhat lower (8m OD) than the site (10 to 20m AOD) and north of the R313 Bangor – Belmullet Road. The lake is over 1.5km from the site with no visual connection in this low-lying bogland landscape. However, as previously noted increased traffic associated with the peat transportation from the Gas Terminal Site will be noticeable on the L1204 Bangor – Bellanaboy Road running east of the lake. The impact associated with the transportation is considered to be of a major visual significance especially from the nearer eastern shores though the impact will only be of a short duration temporary nature.

Within the sub-division 'Skylines and Ridges', the principal skylines and ridges relevant to the proposed site include Carrafull, Knocknascollop, and Knocklettercuss. At varying distance these ridges encircle the northern and eastern aspects of the site. In views from such elevated locations, the site is visible to varying extents set low and contained within its surrounds of wider cutover areas. Such areas are primarily only prominent because of their uniform brown colouring in an otherwise green – purple landscape matrix. Views from such elevated vantage points are long ranging over an unremarkable site towards the more dramatic and focusing landscapes in the background. As such any impact associated with the peat reception and deposition is temporary and negligible. In the medium and longer term the revegetated peatland will blend with the surrounding landscape, with a slightly positive and permanent impact..

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In section 3.2 (a) **Main Areas Designated as Sensitive**, a sub-division under this designation includes 'Peat Bogs'. The entire area may be considered under this designation. The policy with regard to sites that are listed as sensitive states that "*these are areas with a distinctive, homogeneous character, dominated by natural processes. Development in these areas has the potential to create impacts on the appearance and character of an extensive part of the landscape*".

Obviously the proposed site, while set within such as landscape, may be immediately considered to be at odds with such a listing - given the presence of the cutover peatland areas. However, given overall and longer term considerations such a listing would be appropriate.

In Section 3.6 the Appraisal and on the associated Scenic Views and Protected Views Figure the document lists **Roads Designated as Scenic Routes**. The N59 from Mulranny to Bangor and on to the R313 to Belmullet and the County Road west of Carrowmore Lake are indicated in the area of the site. After the temporary transportation aspect of the proposal there will be no adverse residual impact on these routes. The former route runs north to meet the R313 at Bangor from where it runs west towards Belmullet passing immediately north of proposed peat reception and deposition sites. Views from the R313 are generally over the site to more distant uplands, though the commercial peat extraction nature of the wider site setting is clearly evident through Attavally/Srahmore.

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Photo 11: View west over wider site environs from R313 west of Bangor

Principal Policy Areas

In Section 4 of the Landscape Appraisal, the County is divided into 4 Principal Policy Areas, based on the grouping of the differing character units displaying similar visual landscape elements. The proposed site is included at the eastern extent of Principal Policy Area 2 – Lowland Coastal Zone.

A set of indicative policies have been established for each Principal Area, based on the specific landscape attributes of the character unit (critical landscape factors), to determine the robustness and sensitivities of the landscape. In the proposed development on a cutover peatland , it is considered that the development will conform fully with the proposed polices.

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13.10 Impact on Other Issues

Siúlóidí Iorrais (Erris Walks)

In visual terms, the proposed development will have various impacts on walks within both the local and wider landscape.

In particular, the three local walks use part of either the R313 Bangor – Belmullet Road or the L1204 Bangor – Bellanaboy Local Road and all will be significantly and adversely impacted by increased truck traffic during the temporary peat transportation stage. For walkers the traffic will be visually and directly disruptive during this temporary stage. Similarly, though also of a temporary nature, the traffic will be visually and directly disruptive in the vicinity of the *Stratified Sheep* sculpture feature near Bellanaboy Bridge.

However, on cessation of peat transportation, the development will have no adverse landscape or visual impact on users of these walking routes. In the medium and longer term the developed site will have an overall positive effect.

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13.11 Mitigation of Landscape and Visual Impact

The selected site has a number of inherent features, which provide mitigation in terms of landscape and visual impact. The site was selected as a cutover peatland, which has a history of works, associated with peat removal over a period of 40 years. The site is largely devoid of vegetation and at a stage appropriate to the application of a rehabilitation plan. The site is saucer shaped and infilling with peat will not result in intrusive landform as new levels will remain lower than in original conditions.

Introduction of peat onto the site will initially entail cambering the surface of the deposited peat and installation and maintenance of a competent drainage system. Once the peat has stabilised on-going monitoring and evaluation will be used as a basis for determining an appropriate long-term and sustainable strategy for the site which will be consistent with its immediate surrounds.

The overall effect is to ensure no adverse landscape and/or visual impact from the proposed development after cessation of peat deposition works. After a short period, vegetative cover will integrate the site within its peatland surrounds ensuring that only a positive impact remains. No additional mitigation measures are envisaged as necessary, other than those outlined in Sections 6,7,8 and 9.

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13.12 Residual Impact

Following cessation of the temporary peat importation/reception activities the proposed development will have no adverse impact. The gradual re-vegetation of the cutover bog will have a positive impact in terms of landscape rehabilitation and visual integration. This effect will have a similar residual positive impact on the environs of the site.

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14 CLIMATIC IMPACT

14.1 Introduction

This section describes the emissions associated with the Srahmore deposition site activities that have the potential to affect or contribute to global warming (releases of 'greenhouse' gases, GHGs). In particular this relates to a) vehicular emissions and b) to a much lesser extent potential peat related emissions. No releases are anticipated that can lead to other regional or global air quality issues such as ozone depletion.

14.2 Global Warming

The main compounds considered to contribute to global warming are carbon dioxide (CO_2) and methane (CH_4). Other compounds have the potential to contribute to global warming but are generally released in much smaller quantities.

Global warming and the management of emissions with the potential to contribute to global warming are an increasingly important issue for Ireland. An international agreement was drawn up (the Kyoto Protocol) in response to rising emissions of the principal contributing compounds which has subsequently been ratified by the European Union.

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Under the burden sharing agreement within the European Union to implement the Protocol, Ireland agreed to a limit of 13% above 1990 emission levels to be achieved between 2008 and 2012. By 2001, the level of global warming releases however had risen by 31% above the 1990 levels following a period of rapid economic growth. Numerous initiatives are in place to reduce emission levels under the Government's National Climate Change Strategy and EU initiatives including the draft Directive on Emission Trading.

Global warming has numerous potential implications for Irelands' environment including:

- greater risk of seasonal flooding with an increased rainfall in winter and decrease in summer;
- changes to habitats and ecosystems including the drying of peatlands; and,
- effects on sea and river levels and influence on water resources.

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14.3 Influence of the Peat Deposition on Releases with Global Warming Potential

Carbon dioxide is released from any vehicle using fuels such as petrol or diesel. Global warming releases associated with the peat deposition site will hence occur from:

(i) vehicles used in the transfer of peat from the proposed gas terminal site to the peat deposition site; and

(ii) onsite vehicles used to deposition the peat.

Any releases from the proposed deposition site in combination with the Bellanaboy Bridge gas terminal should be viewed in the context of:

- the benefits of providing a secure and indigenous supply of natural gas. The combustion of natural gas releases lower global warming emissions in comparison to alternative fossil fuels;
- the requirement to minimise releases during the transfer and deposition of peat;
- the incorporation of peat from the Bellanaboy site on to a cutover peatland and subsequent rewetting would result in the formation of a net carbon sink.

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Releases of carbon dioxide from natural gas as a fuel compared with other fossil fuels is described in greater detail in the Terminal Volume of this EIS.

14.4 Study Methodology

This section of the Peat Deposition Site Volume aims to identify and assess the sources and describe the measures in place to minimise releases of compounds with global warming potential. Many natural and human activities generate releases that can contribute to global warming. Due to the diverse nature of sources, the effect that releases from the peat deposition site have on global warming cannot be specifically quantified in this study.

14.5 Characteristics of Proposed Development

Peat will be removed from the proposed Bellanaboy Bridge gas terminal prior to its

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construction and trucked to the proposed Srahmore deposition site.

The peatland at the Bellanaboy Bridge terminal site is probably carbon neutral given the prevailing conditions at the site (rush dominated and drainage impeded). The cutover peatland area at Srahmore was up until September 2003 a net carbon source. Incorporation of the peat from the Bellanaboy Bridge Terminal site on to the Srahmore site and revegetation by a rush-dominated sward will probably result in a carbon neutral situation.

Rewetting of the peat deposition area as described as a possible reinstatement option in Section 6 would result in the site reverting to a carbon sink. Therefore the potential impact of the development will be the formation of either a carbon neutral or carbon sink situation.

14.6 Potential Impact of the Proposed Development

Potential impacts associated with the peat deposition site mainly relate to releases from vehicles used to transfer and deposit the peat. This includes heavy goods vehicle movements to and from the peat deposition site and machinery and tractors used onsite.

A description of fluxes in natural peatlands is outlined here to illustrate the potential emissions of GHGs, during the development. Peat during its formation captures carbon in the form of biomass accumulation. As the peat bed grows methane can be emitted where low levels of oxygen are present within the peat deposit (anaerobic conditions). Microbes within the peat may also emit smaller concentrations of nitrous oxide (N_2O). Methane is a more potent global warming gas than carbon dioxide and nitrous oxide is more potent still.

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Whether peatland is a net sink or net emitter of GHGs depends primarily on the balance between carbon dioxide fixation and the release of methane. This balance can vary depending on many factors including the level of the water table. The net effect however is that usually peatland is a carbon sink and therefore removes greenhouse gases from the atmosphere rather than contribute to them.

14.7 Do Nothing Scenario

In the event the development does not proceed the Srahmore site will be rehabilitated according to the rehabilitation plan for the Oweninny Works. This will result in the Srahmore site reverting to a carbon sink situation.

14.8 Predicted Impact of the Proposed Development

14.8.1 During Transfer to the Peat Deposition site

The only predicted impacts will be associated with emissions from HGV and from onsite vehicles at the peat deposition site.

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A screening assessment methodology developed by the UK Highways Agency has been used to predict the quantity of carbon dioxide emissions from HGV's using the proposed route from the proposed gas terminal to the peat deposition site (Manual for Roads and Bridges DMRB, Vol 11 Section 3 Part 1).

Up to 800 HGV movements per day (400 round trips) are predicted to use the haulage route between the proposed Bellanaboy Bridge gas terminal and the peat deposition site. At this rate of vehicle movements per day, it would take approximately 100 days to transfer the projected quantity of peat to the deposition site. The route following the R314, LP1204 and R313 roads is also approximately 11km in length. Using these figures and the DMRB methodology, an estimated 550 tonnes of carbon dioxide will be released to atmosphere during the course of the peat transfer.

The projected release is small in comparison to the quantity of carbon stored in the transferred peat, which is estimated at roughly 24,000 tonnes of carbon (88,000 tonnes of carbon dioxide equivalent). This calculation is based on an appropriate 85-90% water content of removed peat and 50% carbon content of the remaining dry solids.

14.8.2 During Peat Deposition

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Forty machines or vehicles are expected to operate at the peat deposition site. These units will comprise of:

- 20 tractors
- 11excavators
- 7 dozers
- 2 loading shovels

A number of tractor units will be used to position the peat at the deposition site. Vehicles and machines used to transfer and position the peat will emit carbon dioxide through the combustion of fuel. The total emission will however be insignificant in comparison to the quantity of carbon locked up in the peat itself. Whilst emissions from the vehicles used onsite have not been specifically quantified, they would be expected to be of a similar order of magnitude to the HGV emissions generated in taking the peat from the proposed site of the gas terminal to the peat deposition site. This is taking into account the number of vehicles used, the lower power rating (or engine size) of many of the onsite vehicles compared with HGV's and the longer operating period over which peat will be deposited compared with haulage operations.

14.8.3 Green House Gases during Transfer and Deposition

GHG releases during peat excavation/ transfer and deposition will not be significant.

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14.9 Mitigation Measures

Vehicle emissions will be minimised through effective vehicle maintenance. Releases from HGV movements between the proposed Bellanaboy Bridge terminal site and peat deposition site will additionally be minimised through appropriate route selection to and from the peat deposition site. Route selection is described in Section 16.

14.10 Monitoring and Reporting

No direct monitoring of green house gases or methane is proposed or considered necessary. The regular servicing of vehicles will be recorded and monitored.

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15 ARCHAEOLOGY AND CULTURAL HERITAGE

15.1 Introduction

The development involves taking approximately 450,000 cubic metres of peat (excavated raw bog) from the Shell (E& P) site in Bellanaboy and spreading it on the cut-over Bord na Móna bog in Srahmore and Attavalley, Co. Mayo (See Drawing No. 1169\01\202).

This study was carried out as part of an EIA, in order to address in advance any archaeological issues that may arise in the course of the development.

15.2 Methodology

This study was carried out under the following headings:

- Field Survey
- Journal & documentary research
- Cartographic research
- Aerial photographic research
- Search of Sites and Monuments Record, Department of the Environment, Heritage and Local Government.
- Search of Topographic Files, Irish Antiquities Division, National Museum of Ireland (NMI).

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15.3 Existing Environment

The area of the development is located in Bord na Móna industrial peatland in the townland of Srahmore immediately northwest of the small town of Bangor, Co Mayo. The development area is 117 hectares in size and forms part of the Bangor Bogs which are part of the Bord na Móna group of bogs known as the Oweninny Group. The Oweninny Group supplies peat to the Bellacorick peat-fuelled power station 15km southeast of Bangor.

15.3.1 Field Survey

The site of the development was systematically fieldwalked on Wednesday the 29th October 2003 by Archaeologists Jane Whitaker, Daire Leahy and Giles Dawkes of Ads Ltd. Both of the bog areas (Area 5 & 6) were systematically fieldwalked at this time. While there had been a large amount of recent rain the weather conditions were bright and dry. Each drain was walked starting in the northwestern extent of Area 6. When the development area was extended Area 7 was walked on Friday the 5th December by Archaeologists Daire Leahy and Mark Morahan, ADS Ltd. This area was included as a flood plain should exceptional rainfall levels occur.

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The drains provide regular section faces through the bog to facilitate archaeological inspection. Fieldwalking techniques in Bord na Móna peatlands have been developed over the past twelve years since the Irish Archaeological Wetland Unit IAWU and more recently ADS Ltd were commissioned by DoE H&LG to carry out the wetland aspect of the Archaeological Survey of Ireland. During fieldwalking the drain faces and field surfaces are investigated for archaeological remains. The anaerobic conditions in wetland environments favour the preservation of organic materials such as wood, leather, textiles and even human bodies. The 2003 Peatland Survey was carried out in the Oweninny Group by ADS Ltd., in August and September of this year. The Bord na Móna bogs around both Bellacorick and Bangor were all systematically fieldwalked and no sites or finds of archaeological interest were recorded during the course of this work (Whitaker, forthcoming).

Area 6 is accessible along its southern boundary from the Geesala road. The drains run in an east-northeast / west-southwest direction in this area. While all of this bog is currently in production the northern extent is almost milled out and there are a lot of tree stumps currently exposed across this area. Towards the centre of Area 6 there were two small areas, which were completely flooded as a result of the recent rain. Nothing of archaeological importance was recorded in this Area 6.

Area 5 is accessible from the Belmullet road and the drains run in a northeast/southwest direction. This area is smaller than Area 6 and is currently in production. There is a small area along the northern extent where the underlying glacial gravels are exposed (Appendix 13, Figure 3).

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Nothing of archaeological importance was recorded in this area.
Area 7 was accessed from the rail line that runs along the western extent of Area 6. The drains run in an east – west orientation. The majority of this area was production bog with the exception of a small milled out portion at the southern extent (Appendix 13, Figure 3). Nothing of archaeological importance was recorded in this area

There is an area of reclaimed bogland to the southeast of Area 5 and to the east of Area 6 between the Geesala and Belmullet roads which will not be affected during the course of the development.

In conclusion, there was nothing of archaeological significance identified during fieldwalking of the development site. Documentary research did not reveal any recorded monuments on or in the immediate vicinity of the site, however the archaeological and historical background below shows that there are a number of recorded monuments surrounding the Bangor bogs three of which are within a 1-1.2km range of the development site.

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15.3.2 Journal & documentary research

Various published sources, including local and national journals, were consulted (Appendix 10) for reference to the townlands of Srahmore, Attavally and Bangor. In addition various archaeological artefact corpora (see Appendix 10) were also consulted.

15.3.3 Archaeological and Historical background

There are a number of archaeological sites recorded in the environs of the Bord na Móna owned Bangor Bogs as well as two stray finds. The term 'stray finds' is applied to archaeological artefacts submitted to the National Museum that have been recovered by the general public. In the absence of accurate grid references these finds are recorded by the townland that they came from. The sites are recorded around all parts of the Bangor Bogs with a particular concentration to the north of the bogs near Carrowmore Lake.

The four finds recorded from the Bangor Bog environs come from the townlands of Attavally and Bangor. The first consists of a wooden plough share or ard (1964: 68) which was recovered from the bog at a depth of approximately two meters in the townland of Attavally. The second find, also from Attavally townland, was of a chert scraper (1997: 10). The third and fourth finds were two wooden vessels from a bog at Bangor (1938:8574-5).

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The archaeological sites in the development area represent both prehistoric and historic remains with a large number of crannogs recorded particularly on Carrowmore Lake. An unclassified megalithic tomb (MA-26004) is recorded in the townland of Bangor 1km from the eastern extent of Area 6. Also in Bangor the remains of old churches (MA-26005) are recorded but no information is available about them. To the northeast of the development area, in the townland of Cloonakilta a children's burial ground (MA-18008) is recorded. It is situated on top of a hillock and consists of a low mound of earth and stones with four graves to the east, northeast and southeast of the mound. Architectural fragments (MA-18013) consisting of dressed stones are recorded in the townland of Gortmore/Attavally and may originally have formed part of the church in the townland of Dereens Island in Carrowmore Lake where ecclesiastical remains (MA-18011) are recorded. The remains consist of the ruins of an old church and the ruins of seven stone and mortar dwellings.

There are also several recorded archaeological sites in the landscape surrounding the Bord na Móna Bangor bogs. These are described in an anti-clockwise direction below.
Carrowmore Lake is the largest lake in this barony and covers 1000 hectares in area. Twenty-seven sites (MA-18014) in the lake are listed as possible crannogs in the Record of Monuments and Places (RMP). A complex of three monuments (MA-18006) is recorded to the north of the bogs, in the townland of Ratmorgan, on the east southeast slope of a steep hill. The complex consists of a holy well, a cairn and a standing stone all within close proximity of one another. In the same townland, east-northeast of the complex, a cairn is recorded, unfortunately no further information is available about this site. Also in Rathmorgan townland, to the south of the above complex, a rath or enclosure (MA-18007)

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is recorded. This site is situated on the south slope of a steep hill and consists of a raised circular area approximately 29m in diameter defined by a low irregular scarp. In the townland of Muingmore to the west of the westernmost section of the Bangor bogs an enclosure (MA-2500201 and a house (MA-2500202) are recorded. The enclosure consists of a circular area, approximately 12.4m in diameter, defined by a low earthen bank with an entrance to the east southeast. This may be a modern structure. The house is rectangular and outlined by the lower portions of drystone walls, divided internally into two rooms; this is probably a relatively modern structure. Also in the townland of Muingmore is the site of a possible crannog (MA-25003). In the townland of Tristia a burial ground (MA-2600101) and a cist (MA-2600102) are recorded. The burial ground is situated on a southwest facing slope and is ill defined on the ground. In the northeast of the burial ground is a possible cist burial consisting of large boulder split into two portions resting on smaller stones. In the townland of Kilteany a church (MA-2600301), graveyard (MA2600302) and an abbey (MA-2600303) are recorded. The church is in ruins as is the abbey and no information is available about the graveyard.

The archaeological remains around the Bangor Bogs are representative of many periods. The main concentration of sites is found to the north of the bogs in Carrowmore Lake. The nearest recorded monuments are however, located approximately 1.2km to the northwest (MA-18013), 1km to the northeast (MA-18008) and 1km to the east (MA-260004) of the development area (Appendix 13, Figure 2). The stray finds of the plough share or ard and the chert scraper are recorded in the NMI files as having come from the townland of Attavally while there are two wooden vessels recorded from Bangor. No exact find spot is recorded for these stray finds and the NMI finds from bogs database does not specify that whether they came from the Bord na Móna owned bogs or the surrounding bogland.

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15.3.4 Cartographic research

1st Edition Ordnance Survey Map, 1838, 6 Inch Scale (Fig. 15.3)

No archaeological features can be observed on the development site or in the immediate area. There are very few field boundaries in the surrounding area at this time. The site is entirely located in bogland. The stream that runs into the Munhin River and intersects Areas 5 and 6 is indicated as is a small lake or turlough within Area 6. There are no buildings on or adjacent to the development site.

2nd Edition Ordnance Survey Map, 1896, 6 Inch Scale (Fig. 15 4)

There is little or no change indicated on the second edition map. The development area remains exactly the same as illustrated on the first edition map. Northeast of the Belmullet road there are more field boundaries and dwellings than on the previous map.

3rd Edition Ordnance Survey Map, 1915/16, 6 Inch Scale (Fig.15 5)

The development site had not altered within 22 years, with the field boundaries and nearby buildings largely unchanged apart from further subdivisions and dwellings. Nothing of

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archaeological or historical significance is evident on the site or in the immediate vicinity.

15.3.5 Aerial photographic research

Aerial photographs were provided by Bord na Móna for consultation. Nothing of archaeological interest was noted on these photographs.

15.3.6 Sites & Monuments Record, Archaeological Survey, Department of the Environment, Heritage and Local Government.

The development site is located in Srahmore and Attavally townlands to the north west of Bangor Town. No known archaeological monuments are recorded on the development site in the Co. Mayo Sites & Monuments Record. However there are 23 recorded monuments in the area surrounding the Bord na Móna industrial peatlands of the Bangor Bogs (see Fig.15.2 and Appendix 11). Three of these monuments are within 1.2km of the development site (MA-1813, MA18008 & MA-260004)

15.3.7 Topographic Files, Irish Antiquities Division, National Museum of Ireland (NMI)

The Topographical files for Co. Mayo were searched for references to Srahmore, Attavally, Cloontakilla and Bangor townlands. Two finds were recorded from Attavally townland and are listed in Appendix 12 while a further two finds are recorded from Bangor townland. The plough share or ard from Attavally and the wooden vessels from Bangor are all recorded as having been recovered from bogs but none state that they were retrieved from Bord na Móna holdings.

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15.4 Characteristics of the Proposed Deveolpment

The site is currently an industrial landscape exploited to provide peat to the nearby power station at Bellacorick. With the completion of the 2003-year's peat season production is due to finish in the Oweninny Group and a programme of rehabilitation is currently underway in some areas. The development will involve a modest amount of construction work in order to facilitate the development. The construction of the access road, receiving area and new silt ponds will require the excavation of the peat to subsoil while the spreading of the peat imported from the
Shell (E&P) site is not likely to disturb any unrecorded buried archaeological features.

15.5 Potential Impact of the development

The IAWU and more recently, ADS Ltd, have been commissioned by DoE H&LG to carry out the wetland aspect of the Archaeological Survey of Ireland. To date over 3,100 archaeological finds have been recorded in the Bord na Móna raised bogs of the Midlands

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(Whitaker, 2002). These sites recorded to date have ranged in type from plank trackways to small platform structures to the more enigmatic 'worked wood in situ'. The dated sites have ranged from the Neolithic to the Late Medieval periods. Of the total number of archaeological finds from the midlands mentioned above, 65 were artefacts recovered during the course of survey work. Hundreds of artefacts have also been recovered from bogs around the country by Bord na Móna personnel and from private turbary plots.

As mentioned above the development in Srahmore and Attavally townlands, Bangor bogs, Co Mayo will involve the construction of an access roadway, reception area and new silt ponds This study has shown that there are no recorded monuments on or in the immediate vicinity of the development. The nearest recorded monuments are located within 1.2km.

Historical research has shown that the general area has seen constant human activity since at least prehistoric times in the surrounding landscape evidenced by megalithic tombs (Bangor, Rathmorgan & Tristia) and crannogs (Carrowmore Lake) and the finds of the chert scraper (Attavally) and wooden objects (Bangor and Attavally). More recent archaeological sites are evidenced by ecclesiastical remains (Attavally, Dereens Island, Rathmorgan and Kilteany) and the children's burial ground (Cloonakilta).

Although the scale of the development and the level of ground disturbance at the construction stage (access road, receiving area and new silt ponds) will be relatively minor, the presence of the archaeological sites mentioned above and the recovery of some stray finds from the surrounding area shows the potential for previously unrecorded sites and/or artefacts being revealed during groundworks.

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15.6 Do Nothing Scenario

If this development does not take place any previously unrecorded archaeological sites or artefacts are likely to remain undiscovered and undisturbed.

15.7 Mitigation Measures

Archaeological attendance will be provided for all construction groundworks associated with the development. A suitably qualified archaeologist with relevant wetland experience will be employed to carry out the archaeological monitoring of the construction of the access road, receiving area and new silt ponds.

Under the terms of the National Monuments Act (1930 & amendments) should any archaeological discoveries be made during construction, it is the responsibility of the finder to immediately report their discovery to the Duty Officer of the National Museum of Ireland. Any archaeological discoveries should also be reported to the Department of the Environment Heritage and Local Government (DoE H&LG). All recommendations herin

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are subject to discussion with, and approval of, the relevant heritage authorities, namely the DoELDG and the National Museum of Ireland.

DoE H&LG
Dun Sceine
Harcourt Lane
Dublin 2
Tel: 4117100

National Museum of Ireland
Kildare Street
Dublin 2

Tel: 6777444

.

15.8 Predicted impact of the Proposed Development

15.8.1 Predicted impact of construction

The development will involve the construction of an access road and a concrete reception area in Area 5 to facilitate the spreading of the imported peat over Area 6 as well as the construction of some new silt ponds. The site is due to be withdrawn from peat production with the completion of Bord na Móna s peat production in the Oweninny Group. Construction of the roadway, reception area and new silt ponds will involve the excavation of the peat to subsoil in these areas.

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No archaeological sites or artefacts were recorded during the fieldwalking carried out as part of the field visit to the area. Nothing of archaeological interest is recorded on the site or in its immediate vicinity. There are however, three monuments within a 1.2km distance of the development site as well as a large number of recorded sites in and around the nearby Carrowmore Lake. The retrieval of wooden artefacts from wetland contexts in the townlands of Attavally and Bangor combined with the amount of archaeological monuments in the surrounding area may suggest that there is a possibility of further archaeological material being uncovered once construction of the roadway, reception area and new silt ponds commences.

15.8.2 Predicted impact of operation

Because of the detailed and intensive nature of the fieldwalking carried out by ADS Ltd. it is predicted that the development will not have a significant archaeological impact during its operation and use. It is possible however that some stray finds may be uncovered during this work. The spreading of the imported peat over Area 6 is unlikely to impact on any un-recorded archaeological features or artefacts. The imported peat will provide extra cover for any potential archaeological material as well as guaranteeing long-term preservation in situ.

15.9 Monitoring

It is proposed that a suitably qualified archaeologist monitor the excavation of peat in the area of the roadway, reception area and new silt ponds.

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16 MATERIAL ASSETS

16.1 Introduction

Material assets are those resources available to the local community. In this section, the impact of construction and operation of the Srahmore peat deposition facility focuses on:

- waste production, treatment and disposal.
- the use of the local road network; and
- the consumption of road / surfacing construction materials and water.

This section of the Peat Deposition Site Volume has been prepared by RSK ENSR Environment Ltd and FaberMaunsell.

16.2 Waste Production, Treatment and Disposal

16.2.1 Introduction

This section considers the solid waste that will be generated during the construction and operation of the peat deposition site. The treatment and disposal of liquid effluents is discussed in Section 10.

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16.2.2 Study Methodology

The assessment of waste generation during construction and operation of the peat deposition site has been conducted as a desk top study.

The study categorises the types of waste that will be generated as Hazardous Waste or Non-Hazardous Waste. Reference was made to the Environmental Protection Agency's European Waste Catalogue, which integrates the EU Hazardous Waste List compiled under Commission Decision 2000/532/EC (as amended). Hazardous waste is defined in the Annexes to Council Directive 91/689/EEC.

The following organisations were contacted for information:

- Environmental Protection Agency (EPA Headquarters, Wexford); and
- Mayo County Council (Castlebar).

16.2.3 Receiving Environment

This section of the Peat Deposition Site Volume deals with waste stored on-site pending its removal. This could affect the soil, geology and hydrology at the peat deposition site. Section 8 (Soils and Geology) and Section 10 (Effluent) herein include descriptions of the

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relevant aspects of the receiving environment that could be affected by the on-site storage of waste.

16.2.4 Characteristics of the Proposed Development

This section summarises the characteristics of the proposed peat deposition project that are relevant to the consideration of waste management.

Non-Hazardous Wastes generated during the construction and operation of the peat deposition site are likely to be limited to general domestic waste and chemical toilet waste.

Hazardous wastes are likely to consist of used oil spill clean-up kits and oily sludge from the on-site interceptors.

16.2.5 Potential Impact of the Proposed Development

There is the potential for impacts to arise from non-hazardous waste if there is no management in place. Examples of this would be poor housekeeping, or loss of containment. The impacts in any event are unlikely to be significant.

By contrast, loss of containment of hazardous waste presents a more significant impact. Because the materials are intrinsically hazardous, there is the possibility of soil and or ground water contamination. Due to the small quantities and types of hazardous waste generated at the site, however, the risk of loss of containment is considered to be small.

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16.2.6 Do Nothing Scenario

If the development did not proceed, there would be neither waste generation nor disposal.

It should be noted, however, that if the development did not proceed there would still be the issue of disposal of 450,000m^3 of peat from the Bellanaboy Bridge Gas Terminal footprint.

16.2.7 Mitigation Measures

Mitigation measures include waste management planning, which addresses the impacts associated with waste production, treatment and disposal and ensures compliance with the relevant legislation.

The relevant waste management legislation comprises certain European Union Directives and Regulations, and the Irish legislation that implements them.

European Union Legislation

Council Directive (75/442/EEC) on Waste

The framework directive on waste establishes general rules for waste management and

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introduces the 'polluter pays' principle. The directive recognises that the recovery and reuse of waste should be encouraged. It provides that EU Member States must take all the necessary measures to ensure that waste is recovered or disposed of without endangering human health and in a manner which does not harm the environment.

Council Regulation (EEC) No.259/93
This concerns the supervision and shipment of waste within, into, and out of the European Union. It requires consignment notes to control the shipment of hazardous waste, and defines waste categories.

Council Directive (1991/689/EEC)
The hazardous waste directive sets out requirements for records of the type, quantity and disposal destination of hazardous waste that must be maintained.

Irish Legislation
The Waste Management Act, 1996 to 2003 provides for:

- a comprehensive and modern regulatory framework for the effective organisation of the management of waste in Ireland;
- the assignment of functions to public authorities in relation to waste management, e.g. the EPA and local authorities; and
- measures - mainly regulatory powers - designed to improve national performance in relation to the prevention, minimisation and recovery or recycling of wastes.

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Compliance with the Waste Management (Licensing) Regulations, 2000 is required by the EPA for licencing landfill and other waste disposal activities.

The Waste Management (Permits) Regulations, 1998 are operated by local authorities with permits required for certain waste activities.

The Waste Management (Hazardous Waste) Regulations, 1998 inter alia deals with the management of hazardous waste such as batteries, asbestos, PCBs, waste oil etc.

The Waste Management (Transfrontier Shipments of Waste) Regulations 1998, and the Waste Management (Movement of Hazardous Waste) Regulations 1998 require consignment notes for waste movements and give effect to the provisions of Council Regulation (EEC) 259/93 on the supervision and control of shipments of waste within, into and out of the European Community.

Waste Management
Consignments of waste leaving the site will be recorded on consignment notes through to the final destination in accordance with the relevant legislation. The recycling or ultimate disposal of waste will be certified by the parties receiving, or processing, each consignment.

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Non-Hazardous Waste Disposal

The generation of non-hazardous waste will be minimised where practicable, by maximising recycling and re-use and minimising packaging.

A licensed waste contractor will dispose of residual waste at an appropriate facility.

The site will be supplied with portable chemical toilets. A licensed contractor will empty these on a regular basis, and the waste will be disposed of in accordance with the relevant legislation.

Hazardous Waste Disposal

Hazardous wastes will be segregated and disposed of via a licensed waste contractor.

The licensed waste contractor will transport any hazardous waste generated during the construction and operational phases of the project by road to a licensed hazardous waste transfer facility. Depending on the nature of the waste, it may then have to be exported to continental Europe for disposal at an appropriately licensed facility.

If it is necessary to export the waste, it will be shipped to appropriate facilities operating dedicated handling and treatment processes. These facilities will be selected to ensure they have full abatement and monitoring capabilities and conform to stringent standards for emissions to air, water and land.

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The proposed mitigation measures will minimise the potential impact of hazardous waste as far as reasonably practicable.

16.2.8 Predicted Impact of the Proposed Development

Where waste is generated it will be stored securely, transported and ultimately disposed of in strict accordance with EU and Irish legislation. Particular care will be exercised with hazardous waste. On-site waste management will ensure that these materials cannot be released into the environment at the peat deposition site.

16.2.9 Monitoring

All waste removed from the peat deposition site will be checked to ensure it is properly classified as either non-hazardous or hazardous waste. Where there is any doubt, the material will be treated as hazardous waste.

Consignment notes will be retained to provide a documentary record of wastes taken off site.

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16.3 Traffic Impact Assessment

16.3.1 Introduction

This section examines the traffic impact of the peat deposition area (associated with the construction of the proposed gas terminal at Bellanaboy Bridge Co Mayo) on the local road network.

The proposed peat deposition site lies at Srahmore south of the R313 and west of Bangor. The location of the peat deposition area and the associated haul route from the gas terminal site has been identified in Figure 16.1.

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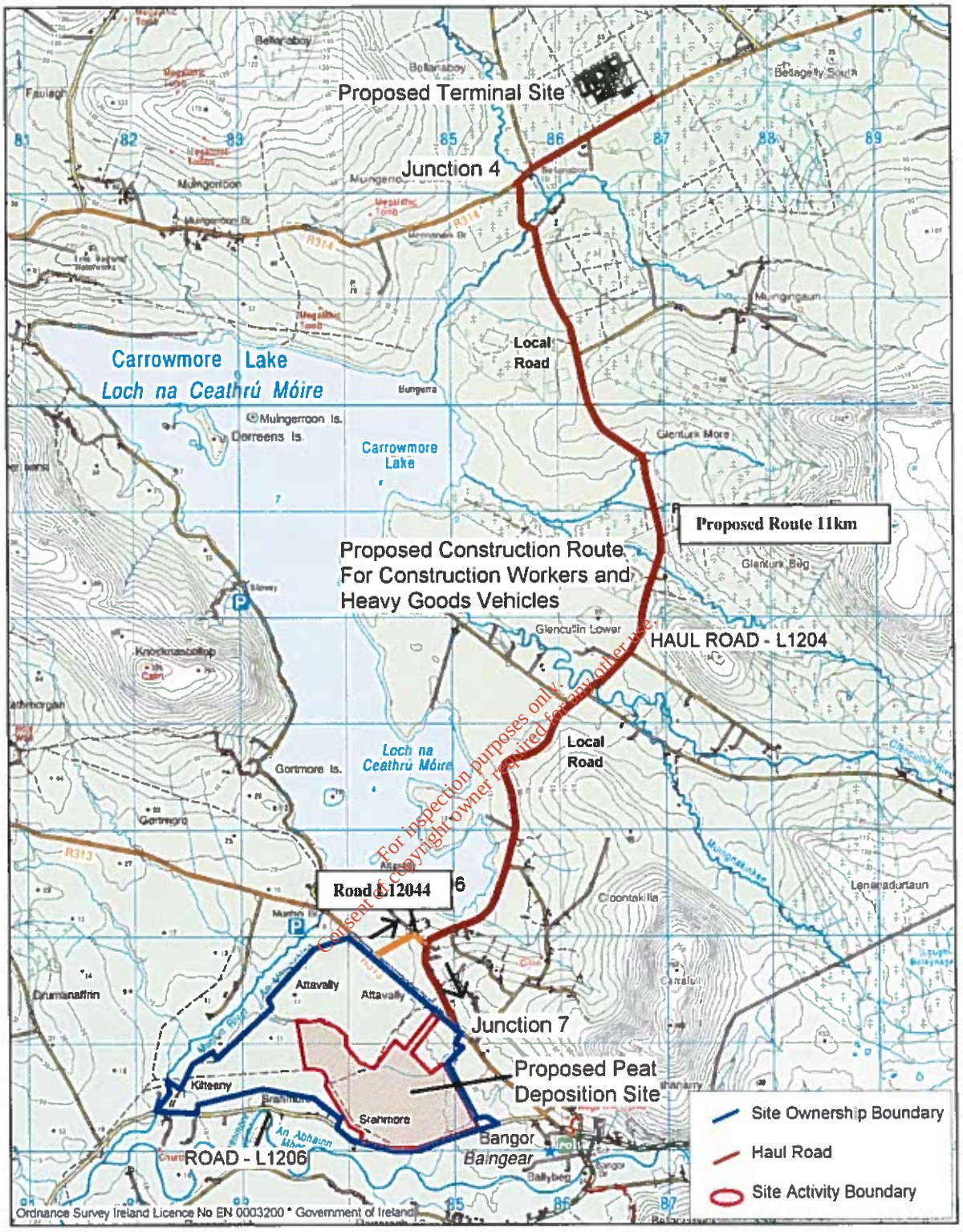

Fig 16.1 Proposed Peat Removal Route

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16.3.2 Methodology

This section considers the following issues:

- Examination of the geometry and pavement condition of the existing road network;
- Suitability of the surrounding road network to cater for the additional traffic generated by the proposed peat deposition area;
- Mitigation measures required to allow the development to be constructed in a safe manner; and,
- Proposed traffic management plan to minimise the impact of the peat transport on the environment within the study area.

16.3.3 Structure of Section

Following this introduction this section is divided into three further sections as follows:

- Existing road and traffic conditions;
- Assessment of proposed development traffic; and
- Mitigation measures.

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16.4 Existing Road and Traffic Conditions

16.4.1 Introduction

A series of surveys were carried out to determine the existing road and traffic conditions across the study area road network. These surveys consisted of junction turning counts and a detailed road inventory.

Based on these surveys the options for transporting the peat from the terminal site to the deposition area were examined before a preferred route was chosen. This was subsequently subjected to more detailed surveys and analyses.

16.4.2 Study Methodology

Junction turning count surveys have been undertaken at 8 locations across the study area between January 2002 and October 2003. It should be noted, however, that no surveys have been conducted during the summer months within this period. The location of the traffic surveys undertaken are presented in Figure 16.2.

The traffic survey information gathered was cross-referenced against the yearly profile to ensure the most onerous base flows were used in the traffic analysis.

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From examining National Roads Authority (NRA) traffic data for typical roads in the general area of the proposed development the consultants noted that traffic volumes on the routes increase significantly during the peak tourist season (between June and September). It was found that the peak month with regard to traffic flows is August.

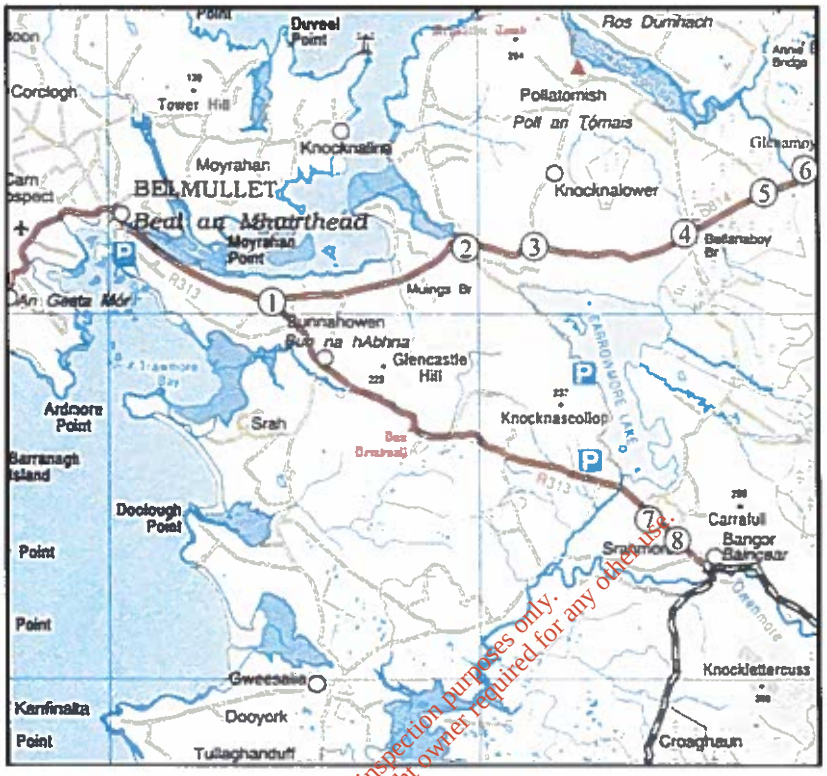

Figure 16.2 Location of Traffic Surveys

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The Maam Cross N59 – 13 and Mulrany N59-06 NRA automatic traffic counter (ATC) stations give a monthly profile of traffic experienced on the road network in the vicinity of the proposed development.

Traffic data for the above ATC stations were examined for the year 2002. The most pertinent results are tabulated in Table 16.3 for clarity.

Table 16.3 Traffic Count Data

NRA Station	October	August
Maam Cross	2756	4518
Mulrany	2336	4019

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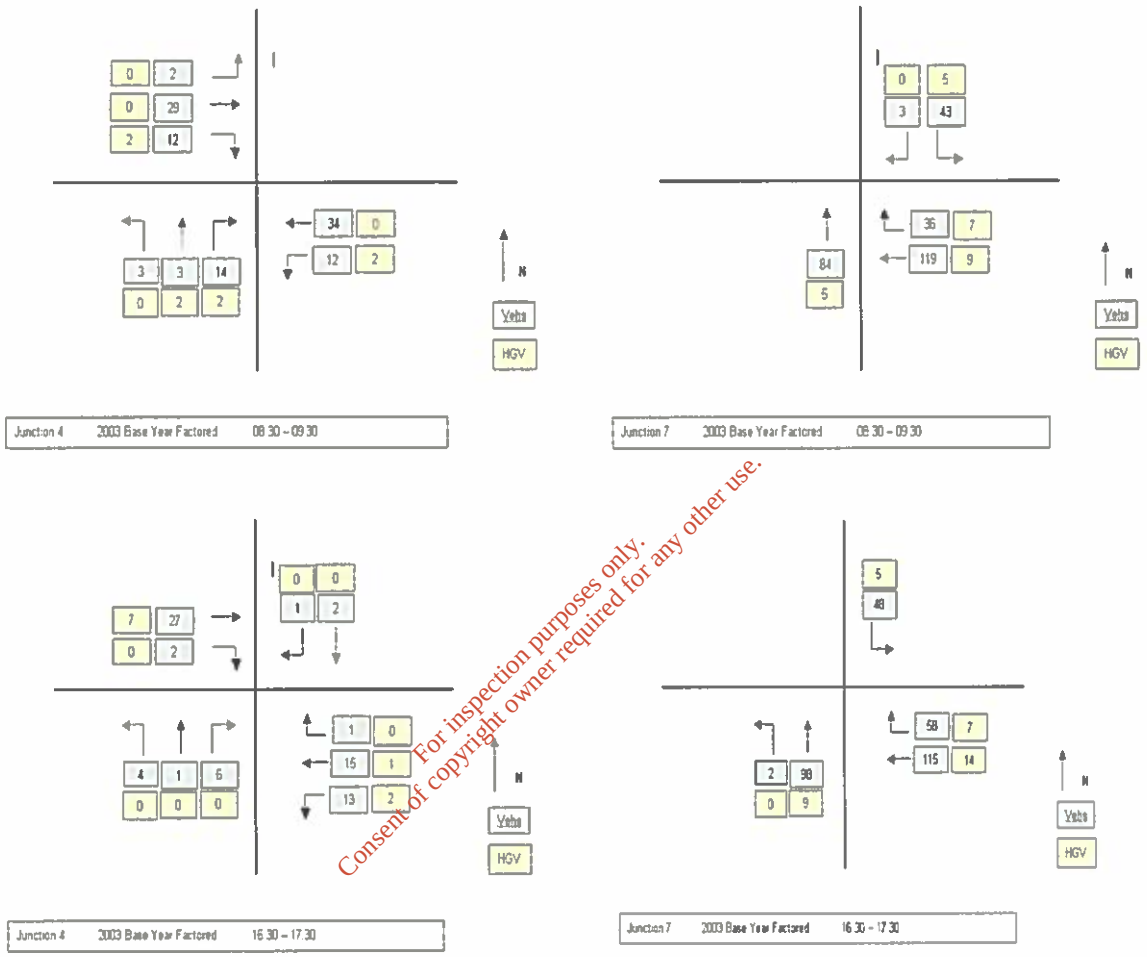
From the above results a factor of 1.72 was used in order to "factor up" the October data to reflect the summer period tourist peak. The following traffic flows were used as the basis for the traffic analysis carried out at Junctions 4 and 7:



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16.4.3 Receiving Environment

Road Network Inventory

A detailed network inventory was undertaken for all roads in the vicinity of the proposed peat deposition site. As well as examining the pavement condition and carriageway design of all links, the geometry of each individual junction was also recorded to determine any remedial measures, which might be required. In this section the characteristics of each link will be described.

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R313 Bangor / Bunnahowen – This route is a Regional Road of varying width from 6.5m to 4.5m at it narrowest location. The pavement is generally of reasonable condition and it was observed that both buses and heavy vehicles traverse the route frequently. A new river crossing approximately 3.5km west of Bangor, at the junction of the Carrowmore Drive and the R313 has been constructed. At this location the road widens to approximately 6.5m.

A quarry is located between Bangor and Bunnahowen, which generates a number of heavy vehicle movements, however, generally there are no other significant generators of traffic along the route. It is understood that the annual production capacity at the quarry is significant.

Immediately north of the quarry there is a narrow, skew bridge, which may cause some restriction to traffic flows, however, it was observed that the construction of a new wider crossing had commenced.

R314 Bunnahowen / Bellanaboy Bridge – This route known as the Coast Road is a very scenic route connecting Ballina to Belmullet via the coast through such towns as Killala, an important fishing port, and Ballycastle. The carriageway design on this route varies significantly, with road widths averaging between 5m and 6m.

The route is extensively used as a tourist route and there is an important viewing point located at Minnaun. The horizontal and vertical alignments at the road may vary considerably, however, the route does appear to cater for heavy vehicle movements, particularly for vehicles used for tree felling and peat extraction operations.

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County Roads - A number of county roads were assessed in the same context as the previous routes. Generally these routes run between the R314 and the R313. The most suitable of these was the route immediately to the east of Carrowmore Lake, L1204. This route has an average width of 5.5m and its surface is in a good condition. Several sections of the route have been recently upgraded and a new (improved) river crossing has been recently constructed. Journey time surveys undertaken along this route show that with an average speed of 40 mph this link can be traversed in less than 9 minutes.

Observations made on this route show that it is used by a number of heavy vehicles for tree felling operations at the Bellanaboy Bridge end of the link. There are only two notable "pockets" of housing on this route, indicating that a small number of residents would be affected by any increase in traffic volumes on this route.

Another county road located to the west of Carrowmore Lake, L5284, known as Carrowmore Drive, was also examined. It was found that while the route was used at present for heavy vehicle movements, it would not be suitable as the route is protected in the County Development Plan due to the Scenic Views of high importance. In addition, the average road width is less than 5m and it is unprotected from the lake in a number of

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locations. The carriageway is generally in a poor condition and its horizontal geometry would make it unsuitable for use by significant numbers of HGVs.

Two other county roads linking the R313 to the R314 were examined to the northwest of Carrowmore Drive; however, neither of these routes is worthy of further examination as they have been found to be less favourable for any additional traffic as the route would be some 20km longer on roads of equal quality as those of the proposed route.

Recommended Route Between Bellanaboy Gas Terminal and Srahmore Peat Deposition site.
The above routes were examined on the basis of their geometry, gradients, traffic volumes and the number of residential units affected. On the basis of the above examination of the study area road network, FaberMaunsell recommend the following route be used to transport peat from the gas terminal site to the peat deposition site.

R313 to County Road L1204; County Road L1204 to R313; and thence to site access road.

The recommended route is presented in Figure 16.1.

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16.4.4 Characteristics of the Proposed Development

In this section of the report the consultants will examine the number of trips generated during the operation of peat removal.

The estimated number of trips generated (both HGV and employee) in the peat removal phase of the project is based on information provided by Arup Consulting Engineers from their estimates of the volume of peat to be removed from the Bellanaboy gas terminal site.

Before carrying out the assessment the following assumptions have been made in relation to traffic generation:

- Background traffic will not grow significantly as a result of other adjacent development during the period of construction; and
- All significant site operative trips to/from the site will occur before 08:00 each morning and after 18:00 each evening.

Construction of Peat Deposition Site.
It is estimated that up to 18,000 m^3 of construction materials (mainly granular material such as gravel) will be required to construct the proposed deposition facilty. The majority of importation of this construction material will take place before any peat is moved from the terminal site. It is anticipated that this material will be imported from a local quarry. This quantity of material has been included in the analysis of the movement of peat to ensure the worst-case scenario is modelled.

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The peat removal phase will involve the removal of circa 450,000m^3 of peat from the gas terminal development site and relocation of same to the peat deposition site. It is envisaged that the peat removal process will take place over a 6 month period. The process however is weather dependant and may need to take place over two seasons. In order to perform a robust analysis the consultants have assumed the following conservative assumptions:

- Volume of peat to be moved is 450,000 m^3. It is planned to use a fleet of trucks 40 to 45 in number to carry out 400 return journeys per day, assuming a 45 - 55 minute turn around.
- The type of vehicle proposed is a conventional rigid 4 axle tipper truck with a payload of up to 18 tonnes. In general each vehicle will carry approximately 11tonnes of peat and the use of roll over covers may be deployed if required.
- The expected time frame approximately 6 months subject to weather windows.
- Peat will generally be moved from 07.00hrs to 19.00hrs Monday to Friday and 07.00hrs to 16.00hrs on Saturdays (in periods of good weather increased operations may be considered to reduce the haulage operation duration).
- Road maintenance may be carried out on weekends as and when required.
- Assuming a 12-hour total working period per day and distributing the total number return truck journeys throughout the day. It is expected that a maximum of c 42 truck movements per hour will take place.
- Staff involved in moving peat off site will be approx. 60 in transport, 40 on site at Bellanaboy and 50 at the deposition site.

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The haul route for peat removal is shown in Figure 16.1.

Key junctions that were analysed by the consultants are also identified.

The consultants have examined the two most important junctions on the access route to the site, namely:

- Junction 4 – Junction of R314/L1204 and the proposed site access road.
- Junction 7- Junction of L1204 and R313.

It should be noted that the analysis to determine if the junctions have sufficient capacity to accommodate the traffic volumes has been carried out assuming the two-way movement of trucks at Junction 4. In the examination of the road geometry of the junction of the L1204 and R313 it has been concluded that a one-way system will operate at the junction (as shown in Figure 16.1) in order to improve safety. From a traffic capacity point of view this will be less onerous than the two-way system analysed.
The assessments have been carried out using the Transport Research Laboratory computer junction simulation package, VPICADY, for determining the junction volume/capacity ratios. This package is particular to priority-controlled junctions and also provides

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information regarding the queue lengths and delays experienced at the junctions. It should be noted that an RFC (Ratio of Flow to Capacity) greater than 0.85 is considered over-capacity for practical reasons. Thus an RFC less than 0.85 is deemed to operated within capacity and any queues or delays which may be experienced are minimal.

The results for the analysis are outlined in Table 16.4 below.

Table 16.4 Traffic Analysis Results for Peat Removal Phase

Table 16.4	Junction4	Junction 7
Max. RFC	0.162	0.313
Queue	0.2	0.4

16.4.5 Potential Impact of the Proposed Development

It has been demonstrated that the study area road network can adequately cater for the traffic volumes generated by the proposed development.

The main traffic impact will be in relation to the pavement maintenance. This is discussed in further detail in the following paragraphs.

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16.4.6 Do Nothing Scenario

If the development does not proceed, additional construction traffic would not be generated.

16.4.7 Mitigation Measures

This haul road will be strengthened to mitigate against the damaging effects of the HGV's on the road pavement and structures along the route. The extent of strengthening works has been agreed as part of the pre-planning discussions with Mayo County Council. Where necessary the haul route will be widened to ensure that vehicles can pass safely and again the extent of the road widening has been agreed with Mayo County Council.

A traffic / transportation plan has been prepared to assess and control the movement of vehicles during the construction phase. This plan has been discussed and broadly agreed with both Mayo County Council and the Gardai.

Whilst it is clear from the above assessment that the road network and proposed construction routes can cater for the overall traffic generated by the scheme, it is important to minimise the overall affect on the residents and general environment within the study area. With this in mind, a Traffic Management Strategy has been developed to actively control the number and types of vehicles arriving/departing from the development sites.

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This strategy has been discussed with Mayo County Council as part of the pre planning discussions and has been broadly agreed. The principles of this strategy are outlined in Section 16 of the Terminal Volume.

16.4.8 Predicted Impacts

The main impact of the heavy construction vehicles will be in the context of possible damage to the pavement due to the amount of traffic using the route during the peat deposition phase.

A joint survey has been carried out by Tobin Consulting Engineers and Mayo County Council of the proposed haul route. This survey identifies areas where road realignment is required to ensure a minimum road width to allow vehicles to pass in a safe manner. This geometrical survey is supported by a road pavement design analysis and pavement strengthening proposals. As part of the pre planning discussions the extent of culvert strengthening work has also been agreed with Mayo County Council.

In summary, the development at Srahmore will not have any significant traffic effects when the peat deposition is complete. During the construction phase the volumes of traffic can be catered for on the road network as demonstrated in the junction analysis results and a specific haul route (L1204) has been identified.

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16.4.9 Monitoring

Bord na Móna and Shell will ensure that their main contractors and all sub-contracting firms involved in the project adhere to the Traffic Management Plan. Bord na Móna and Shell also propose to monitor the route used by heavy vehicles as well as the load they are carrying. To minimise the effects of heavy vehicles on the wearing course of the roadway, Bord na Móna and Shell are committed to ensuring that the maximum legal load of each vehicle will not be exceeded. This will be strictly monitored on-site by the provision of a weighbridge.

16.4.10 Reinstatement and Residual Effects

The gas terminal developers (Shell) are committed to reinstating the pavement as required after construction is completed.

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16.5 Consumption of Road / Surfacing Construction Materials

16.5.1 Introduction

This section considers the use of road / surfacing materials during the construction of the Srahmore peat deposition site.

16.5.2 Study Methodology

The assessment of road / surfacing construction material use has been conducted as a desk top study.

16.5.3 Characteristics of the Proposed Development

Section 3 describes the construction of the peat deposition site at Srahmore. In summary the following construction activities will require road / surfacing materials:

- Construction of entrance and access road to peat reception area.
- Construction of site accommodation area.
- Construction of peat reception area.
- Construction of internal site roads.

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The access road and accommodation area will be constructed from granular material (e.g. gravel) and surfaced with blacktop. The peat reception area will be constructed from granular material and surfaced with concrete. In addition, a precast concrete wall will be constructed around the peat reception area of approximately 1.5m in height. The internal site roads will be constructed from just granular material. Estimated amounts of material required for these construction activities are shown in Table 16.5. The construction materials will be obtained from local quarries.

Table 16.5: Requirements for Road / Surfacing Construction Materials

Use	Amount granular material (m^3)	Amount of blacktop (m^3)	Amount of concrete (m^3)
Access road	2500	344	
Peat reception area	4080		1200
Accommodation area	970	143	
Internal site roads	8317		
Total	**15,867**	**487**	**1200**

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16.5.4 Potential Impact of the Proposed Development

The potential impacts of the use of road / surfacing construction materials are:

- The reduction in the availability of formation material, sub-base material, concrete and blacktop for other users.
- Possible effects on ground water quality as a result of a different chemistry compared to that of the local geology.
- Possible effects on local habitats as a result of related changes to soil chemistry.

16.5.5 Mitigation Measures

Mitigating measures may consist of:

- Minimising the number of internal site roads required.
- Reuse of the construction material following operation of the site. Following removal of the internal site roads in Area 6, the aggregate will in order of preference:
    1. be used as construction material at the proposed wind farm development at Bord na Móna's Oweninny site,
    2. be used as construction material at an alternative site, or
    3. be disposed of at an appropriate landfill site.

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16.5.6 Predicted Impact of the Proposed Development

The mitigation measures described above address the ways in which the impacts associated with use of road / surfacing construction materials can be reduced. On this basis, the environmental impacts associated with the use of road / surfacing construction materials are judged to be insignificant.

16.6 Consumption of potable water

Service and potable water for the peat deposition site will be provided by connecting to the mains supply running along the R313. No significant environmental impact is anticipated from this activity.

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17 IMPACT INTERACTIONS AND CUMULATIVE IMPACTS

17.1 Introduction

Potential impacts of each aspect considered under the scope of the EIA, which culminated in this Volume of the EIS, have been outlined individually in this report. Mitigation measures have been identified and outlined. However, in any development with the potential for environmental impact there is also potential for interaction between impacts of each environmental aspect. The results of these interactions may either exacerbate the magnitude of the impact or may in fact ameliorate it. As part of the requirements of an Environmental Impact Statement the interaction of the impacts on the surrounding environment needs to be addressed.

Below the anticipated principal interactions, together with mitigation measures, have been summarized:

17.2 Possible cumulative impacts

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17.2.1 Human Beings and Socio-Economic

Overall it can be concluded that the proposed development will have a positive temporary impact on the socio economy of this area. This will take the form of direct and indirect job creation during the peat deposition activity.

17.2.2 Human Beings, Aquatic Ecology and Drainage

Potential negative impacts of elevated suspended solids and /or pollution incidents have been outlined in Section 7. The potential effect would be to reduce the fish catch in the Muinhin/Owenmore/Tullaghan Fisheries. This could in turn affect tourism and local enjoyment of the watercourses. The mitigation measures employed to prevent this happening are detailed in Section 7 of this Volume and take account of the detailed consultations with the NWRFB, the EPA and the NPW (formally Dúchas). There will be no impact on the overall salmonid productivity within the Owenmore catchment.

The potential impact of the development will be significantly lessened by the fact that activities within the site will only be undertaken during the traditionally low rainfall season. The activity will not be conducted during adverse weather conditions. The potential cumulative impact is considered to be of low to negligible impact.

17.2.3 Human Beings and Terrestrial Ecology

The site under consideration for the peat reception and deposition is currently covered by an IPC Licence 505 and by the rehabilitation plan prepared by Bord na Móna for that licence.

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Should the proposed development go ahead the site would be removed from the IPC licence and would be regulated under a new licence issued in accordance with the Waste Management Act. Peat deposition and the rehabilitation of the site would then take place as described in Section 6. There are no potential negative impacts on terrestrial ecology and the overall cumulative impact on flora and fauna will be positive.

17.2.4 Human Beings, Visual Impact, Traffic and Noise

There will be a temporary negative impact during the construction and operation phase. Noise, traffic levels and visual impact caused by the haulage trucks will affect people locally. However it is anticipated that the development will occur over a 6-month time frame, so the duration of the activity will be limited. Section 16 outlines the detailed mitigation measures to be put in place to limit the impact on local people and visitors caused by traffic, and so it is not expected that there will be any significant negative cumulative impacts.

In addition there will be minimum negative impact due to the peat deposition on site due to the distance of the site from houses. Local people are familiar with activity on the Bord na Móna production areas and so the perception of an impact will be limited.

The overall effect is to ensure no adverse landscape and visual impact from the proposed development after cessation of peat importation works. After a short period vegetative cover will result in the activity area blending with the surrounding landscape.

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17.2.5 Human Beings and Climate

Ireland, under the Kyoto protocol, has agreed to limit the increase in its net greenhouse gas emissions to 13% above 1990 levels by 2012. The proposed development will occur to facilitate the construction of the Bellanaboy Bridge Gas Terminal and the subsequent use of an indigenous gas supply. This will replace alternative fuels, which would generate higher releases of global warming gases. Therefore, the potential impact of this development on the global climate must be considered a positive impact in reducing Irelands' GHG emissions and thereby assisting the effort to reach the targets set out by the Kyoto Protocol. The transfer of peat to the cutover peatland site at Srahmore retains the carbon stored in the Bellanaboy peat. If the peat deposition site is rewetted following the predicted revegetation period the peat would form part of a replacement peat forming ecosystem. Thereby creating a carbon sink.

17.2.6 Interactions with other developments

In addition to the above development a number of other developments have been identified as likely to be in operation at the same time including the Bellanaboy Bridge Gas Terminal.

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1) The construction of a small (approximately 68 MW) gas-fired power station at Bellacorick, which has planning consent. The power plant will burn natural gas from the Mayo-Galway pipeline.
2) The proposed demolition of the ESB peat-fired power station at Bellacorick which is due to close at the end of 2004.
3) The possible development of a wind farm on cutover peatlands at Bellacorick, if planning consent is upheld. The application, which is the subject of an appeal to An Bord Pleanála, is for the installation of a maximum of 192 turbines and would be developed over a 10-year period. Construction would begin in 2005.
4) The cumulative impacts that the construction and operation of the proposed peat deposition site and the proposed terminal may cause through interaction with the other elements of the Corrib natural gas field development are described in the Terminal Volume of this EIS.

17.3 Conclusion

While there is potential for the above impacts to interact and result in a cumulative impact, it is unlikely as a result of the various mitigation measures proposed in the body of this Volume that any of these cumulative impacts will result in significant environmental degradation. It is likely that the overall cumulative impact of the development will be positive.

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17.4 Do Nothing Scenario

If the proposed development did not proceed, there would be no cumulative impacts with other developments.

17.5 Mitigation Measures

The project team will work closely with the managers of other concurrent development projects to pre-empt and resolve any conflicts in terms of use of materials, waste disposal, traffic management etc. An environmental monitoring group will be established to monitor developments on the site to review progress, impacts and other issues arising during the construction, operation and stabilisation phases.

17.6 Monitoring

It is not proposed that any monitoring will be undertaken specifically for cumulative impacts. However, monitoring will be undertaken, where required, for the individual phases of the Srahmore site project.

17.7 Reinstatement and Residual Impacts

There will be no reinstatement undertaken specifically for cumulative impacts. Reinstatement measures will be implemented where required.

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18 SUSTAINABLE DEVELOPMENT

18.1 Introduction

The Local Government (Planning and Development) Act, 2000 restricts a Planning Authority, when making a decision in relation to a planning application, to consideration of the proper planning and sustainable development of the area. The compliance of the proposed development of the Bellanaboy Bridge terminal and the associated peat deposition site with the principles of sustainable development is reviewed in this section. As sustainable development is measured at a project wide level, this section considers the development of the terminal and the associated peat deposition site as a whole, rather than discuss the sustainability of the peat deposition site in isolation.

Sustainable development is a very broad concept that has become widely used in recent years, particularly following the Earth Summit in Rio de Janeiro in 1992. It was defined in 1987 by the Brundtland Commission report as:

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'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.'

Ireland's National Sustainable Development Strategy, published in 1997, aims "to ensure that the economy and society in Ireland can develop to their full potential within a well protected environment, without compromising the quality of that environment and with responsibility towards present and future generations and the wider international community". The Strategy discusses the meaning of sustainable development, which it states is increasingly recognised as the key to managing economic and environmental interdependence. It is neither a fixed concept nor a narrowly defined process, but an approach in which:

- the exploitation of resources;
- the direction of investments;
- the orientation of technological development; and
- institutional changes are made consistent with future as well as present needs.

Various strategic actions have been identified. Those actions that are relevant to industry include:

- promotion of energy efficiency in industry;
- 14% of energy supply from renewables by 2010;
- total national greenhouse gas emissions limited to 13% above 1990 levels by 2010

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– measures introduced to reduce greenhouse gas emissions;

- NOx and SOx emissions limited;
  - IPPC introduced;
  - increased focus on waste prevention and minimisation;
  - producer responsibility to encourage reuse and recycling of wastes; and
  - development of a materials and energy balance for industry to determine the full extent of industry's environmental/natural resource impacts and advise on targets for greater eco-efficiency.

Other relevant National strategic priorities include:

- development of a competitive energy supply industry;
- security of indigenous energy supply; and
- balanced regional development.

18.2 Sustainable Development Policy

As well as complying with national goals through the planning process, Shell aims to contribute to sustainable development in their activities in Ireland in full compliance with the requirements of the Shell Group Sustainable Development Principles (July 1999):

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- respect and safeguard people;
- engage and work with stakeholders;
- deliver value to customers;
- minimise impact on the environment;
- use resources effectively;
- maximise profitability; and
- maximise benefits to the community.

Bord na Móna's environmental policy (below) supports several principles which align with Shell's sustainability principles.

Bord na Móna bases its operations on a set of principles in accordance with which it

a) seeks to carry out all its activities in the most environmentally responsible fashion;
b) does not produce peat on any peatland considered to be of conservation interest; and assists the State in preserving substantial areas of bogs of ecological or scientific interest;
c) will not acquire any new bogs and will produce only from bogs where drainage development has already taken place;
d) is committed to planning for the environmentally sustainable after-use of

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cutaway peatlands; carries out research to this end; and implements its plans as areas of cutaway become available;

e) acts responsibly in relation to remains of archaeological value on its land;
f) researches the effects of peatland exploitation and afteruse on the greenhouse gas balance;
g) participates in international co-operation on environmental issues.

In order to apply these principles to the Corrib project, a sustainability appraisal has been carried out using a sustainability checklist that has been developed by the Building Research Establishment (BRE) in the UK (in the absence of an equivalent framework having been developed in Ireland) Table 19.1.

18.3 Contribution to National Sustainable Development Priorities

A further assessment of the extent to which the project complies with Ireland's National Sustainable Development Objectives has been carried out as follows.

Promotion of Energy Efficiency in Industry
The availability of an alternative gas supply may encourage the development of combined cycle electrical generation plants and combined heat and power plants which are more energy efficient than conventional power plants and steam generation plants.

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The terminal equipment installations have been chosen to optimise power generation and minimise power and fuel consumption. Energy management will be incorporated into the environmental management system for the terminal.

Total national greenhouse gas emissions limited to 13% above 1990 levels by 2010 – measures introduced to reduce in greenhouse gas emissions

The project supports Ireland's proposed National strategic fuel switch from solid fuel and oil to natural gas and renewables and so contributes to Irelands target to limit national greenhouse gas emissions while ensuring security of energy supply.

Minimisation of NOx and SOx Emissions
SOx and NOx emissions from the terminal will be mitigated as described in Section 11. As the terminal will serve to encourage a national fuel switch from oil and coal towards gas, this is likely to result in lower NOx and SOx levels nationally.

Increased Focus on Waste Prevention and Minimisation
A waste management plan has been developed for construction and operation phases.

During terminal operations, biological sewage treatment will be carried out using a

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sustainable "puraflo" system.

The gas from Corrib provides the opportunity to displace the combustion of other fossil fuels, which produce solid residues requiring disposal.

Producer Responsibility to Encourage Reuse and Recycling of Wastes
The project will take excavated peat to a cutover peatland, where it will be stabilised and integrated into a replacement peatland habitat, thereby retaining carbon formed in the Bellanaboy peat (no net loss of carbon). Rewetting of the deposition site at Srahmore would restore peat forming conditions and result in the formation of a carbon sink.

The material which will be removed during decommissioning will go to one or other of the following in order of preference:

1. To be used as construction material at the proposed wind farm development at Bord na Móna's Oweninny site.
2. To be used as construction material at an alternative site
3. To be disposed of at an appropriate landfill site

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18.4 Impact on Other National Priorities Related to Economic and Social Development

Development of Competitive Energy Supply Industry
The project will increase competitiveness in the domestic energy market.

Security of Endemic Energy Supply
The project will help ensure security of gas supply for Ireland throughout the life of the field, as the project will provide an alternative supply of gas should the interconnector supply from the UK be interrupted.

By increasing competitiveness in the domestic energy market, this may serve to displace gas imports, further securing long term energy supply.

Balanced Regional Development
The project will serve to promote the development of the Northwest of Ireland, thus promoting more balanced regional development, as follows:

- by proving employment during construction and operation;
- by providing a demand for local and regional services during construction and when in operation; and
- by providing the opportunity for Bord Gáis to supply gas to local towns, thus making the region more attractive to inward investment and giving local industries the

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opportunity to become more competitive.

Table 19.1:BRE weightings against sustainability issues (issues with highest weightings shaded)

Theme	Sub-Theme	Issue	Weighting %	Shell SD Principle
1. Environment	1.1 Global Issues	Climate change	8.4	Minimise impact on the Environment.
		Acid deposition	1.1	
		Ozone depletion	1.8	
		Toxic air pollution	1.4	
		Fossil fuel depletion	2.0	Use resources effectively.
		Marine water pollution	1.2	Minimise impact on the Environment.
		Habitats and eco-systems	3.9	
	1.2 Local and Site Issues	Local air pollution	2.6	
		Water pollution	1.7	
		Contaminated land	1.2	
		Noise pollution	1.2	
		Dust pollution	0.2	
		Minerals extraction	0.8	Use resources effectively.
		Fossil fuel extraction	0.7	
		Water extraction	1.2	
		Waste disposal	1.4	Minimise impact on the Environment.
		Waste recycling	1.8	
		Transport pollution and congestion	3.5	
		Habitats and eco-systems	2.7	
		Forestry	0.6	Use resources effectively.
		Farming	0.4	Maximise benefits to the community.

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Theme	Sub-Theme	Issue		Weighting %	Shell SD Principle
	1.3 Internal Environment	Health		2.6	Respect and safeguard people.
		Comfort		1.2	
2. Economy	2.1 Construction	Profitability		2.3	Maximise profitability
		Employment		3.3	Maximise benefits to the community.
		Productivity		1.4	Maximise profitability/ Deliver value to customers.
		New build		1.2	N/a
		Refurbishment		2.5	
		Maintenance and repair		2.1	
		Overseas competitiveness		0.8	Maximise profitability
	2.2 Construction materials	Profitability		2.2	Maximise profitability
		Employment		2.6	Maximise benefits to the community.
		Productivity		1.4	Maximise profitability / Deliver value to customers.
		Product Value		2.0	Deliver value to customers.
		Overseas competitiveness		1.2	Maximise profitability
	2.3 Infrastructure	Energy and water		2.7	Maximise benefits to the community.
		Telecommunications		1.7	N/a
	2.4 Building Stock	Stock value	Housing	1.7	
			Industrial	1.4	
			Commercial	1.4	
			Other	0.3	
3. Social	3.1 Equity	Social exclusion	Affordable housing	1.6	Maximise benefits to the community.
			Healthy housing	1.6	

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Theme	Sub-Theme	Issue		Weighting %	Shell SD Principle
			Employment	5.6	
			Security	2.3	
			Education	3.2	
			Worship	0.2	
			Transport	1.0	
	3.2 Community	Urban	Identity stewardship	2.5	Maximise benefits to the community.
			Integration	1.4	
			Consultation	0.7	Engage and work with stakeholders.
		Transport	Cities	1.4	N/a
		Town and rural communications		2.7	

Source: BRE Digest 446 Assessing Environmental Impacts in Construction (2000)

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19 ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

19.1 Introduction

Bord na Móna p.l.c seeks to conduct all aspects of its business in an environmentally sensitive manner. It is committed to the compilation of information on all aspects of its impact on the environment, and making this information available to the public.

The company has established an Environmental Management System for this development, which specifically addresses the following impacts:

- Discharges to water
- Emissions to atmosphere
- Waste disposal/minimisation
- Noise, vibration, odour, dust and visual effects
- Use of natural resources
- Natural environment and ecosystem effects
- Continuous environmental improvement programmes

The environmental management system will be monitored and continually improved. A system of regular environmental audits will be established, and the company will continue to invest in research into its impact on the natural environment.

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19.2 Srahmore site operation

A draft EMS has been prepared as included in Appendix 14. This will be finalised following grant of Planning Permission and Waste Licence. Any conditions resulting from both the Planning Permission and Waste Licence will also be included. The EMS will include the following elements.

19.2.1 Incident reporting & investigation

The Srahmore site EMS will include documented procedures to control the reporting and investigation of incidents.

19.2.2 Roles and Responsibilities

Bord na Móna will define environmental roles and responsibilities for Srahmore staff and these will be documented in the EMS and in individual job descriptions. The roles and responsibilities will refer to each component of the EMS.

19.2.3 Training and Competence

Ensuring that staff are competent to operate responsibly from an environmental point of view is a critical means of control. The EMS will ensure the appointment of suitably competent staff and will cover the development and implementation of

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training programmes to ensure that environmental control requirements are understood and applied.

19.2.4 Document Control

The control of EMS documents will be the responsibility of the site supervisor assigned in accordance 19.2.2 above.

19.2.5 Records

Records provide the evidence of conformance with the requirements of the EMS and of the achievement of the objectives and targets in the Improvement Programmes. The EMS will specify those records that are to be generated for these purposes, and control their creation, storage, assessment and retention.

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- SITE OWNERSHIP BOUNDARY
- SITE ACTIVITY BOUNDARY
- HAUL ROAD

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OS Sheet No. 18 & 26 Co. Mayo

All levels relate to Ordnance Datum at Malin Head

SCALE 1 : 25000

m 0 1000m

BELLANABOY GAS TERMINAL

HAUL ROAD - L1204

SRAHMORE PEAT DEPOSITION SITE

ROAD - L12044

ROAD - L1206

Carrowmore Lake
Loch na Ceathrú Móire

Muingerroon Is.
Derreens Is.
Gortmore Is.

Slieve Fyagh 331
Sliabh Fíoch

Bellanaboy
Bellageily South
Muingerroon
Muingerroon South
Muingingaun
Glenturk More
Glenturk Beg
Glencullin Lower
Glencullin Upper
Lenanavagh
Lough Nagurgee
Barroosky
Lough Namackan
Carrowmore
Derrynamoe
Muingabhan
Grimlish
Ederglen
Glencastle Hill
Glencastle
Knockranscallop
Fintonborgan
Faulcons
Gortmore
Srahalegole South
Drumanaffrin
Attavally
Kilteany
Srahmore
Srahanarry
Bangor
Baingear
Ballybeg
Cloontakilla
Lenanadurtaun
Lough Bokaynagee
Sarratan
Gooldmore
Rosnagloragh
Ballina
Tullaghaunnashammer
Srahgraddy
Bellanumera
Briska
Largan
Graveyard
Megalithic Tomb
Megalithic Tombs
Megalithic Tombs (Possible)
Megalithic Tomb (Possible)
Standing Stone
Cairn
Church
Holy Well
Trig Point
Spot Height
Stream
River
Glencullin River
Muingerroon Br
Meenenark Br
Bangor Br
Ballybeg Br
Murrinny Br
Glencastle Br
Traw-Kirtaun
An Abhainn Mhór
Srahmore River
Glencullin River
Abhainn Mhór River
Srahgraddy River
Owenboliska River
Bunguna
Srahmore
Srahgraddy
Owenboliska
R314
R313
P
PO

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BORD NA MÓNA

Project
CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

Drawing Title
SITE LOCATION MAP

Scale 1:25000@ A1

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LEGEND

- BORD NA MONA OWNERSHIP BOUNDARY
- SITE ACTIVITY BOUNDARY
- HAUL ROAD
- HIGH FIELD
- HIGH FIELD TOE DRAIN
- ACCESS ROAD
- EXISTING RAILWAY

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BORD NA MÓNA

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SRAHMORE PEAT DEPOSITION SITE

Drawing Title

SITE PLAN

Scale 1:2500 @ A1

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BORD NA MONA OWNERSHIP BOUNDARY

SITE ACTIVITY BOUNDARY

HAUL ROAD

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CONTROLLED OVERFLOW AREA

TP11 TP10 TP12 BORROW PIT

TP13 TP8 TP9 BORROW PIT

ADMINISTRATION AREA

PEAT RECEPTION AREA

SITE ACCESS ROAD

SITE OWNERSHIP BOUNDARY

SURFACE WATER OUTFALL

TP7 HIGH FIELDHAUL ROAD

PHASE 5

2 No. SURFACE WATER LAGOONS

HAUL ROAD

BH 3A/B

TP3

HIGH FIELDHAUL ROAD

PHASE 4

BH 2A/B

PHASE 3

TP5 HIGH FIELD TOE DRAIN

TP4

TP6

SS - 2 SETTLING POND

SS - 1 SETTLING POND

BH 1A/B

SCALE 1:2,500

Legend

- TP5 — TRIAL PIT LOCATION
- BH 4 — BOREHOLE LOCATION
- PROPOSED SI LOCATIONS
- SW6 — SURFACE WATER MONITORING POINT

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BORD NA MÓNA

CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

SITE INVESTIGATION
AND MONITORING POINT
LOCATIONS

Scale VARIES AS SHOWN @ A1

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- SITE OWNERSHIP BOUNDARY
- SITE ACTIVITY BOUNDARY
- HAUL ROAD
- HIGH FIELD
- FIELD DRAIN
- HIGH FIELD TOE DRAIN
- ACCESS ROAD
- EXISTING RAILWAY

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CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

Drawing Title

SITE LAYOUT PLAN

Scale 1:2500 @ A1

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LEGEND

- SITE OWNERSHIP BOUNDARY
- SITE ACTIVITY BOUNDARY
- HAUL ROAD
- EXISTING MAJOR GROUND CONTOUR
- EXISTING MINOR GROUND CONTOUR

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SITE ACTIVITY BOUNDARY

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SRAHMORE PEAT DEPOSITION SITE

Drawing Title

EXISTING
TOPOGRAPHICAL CONTOURS (mAOD)

Scale 1:2500 @ A1

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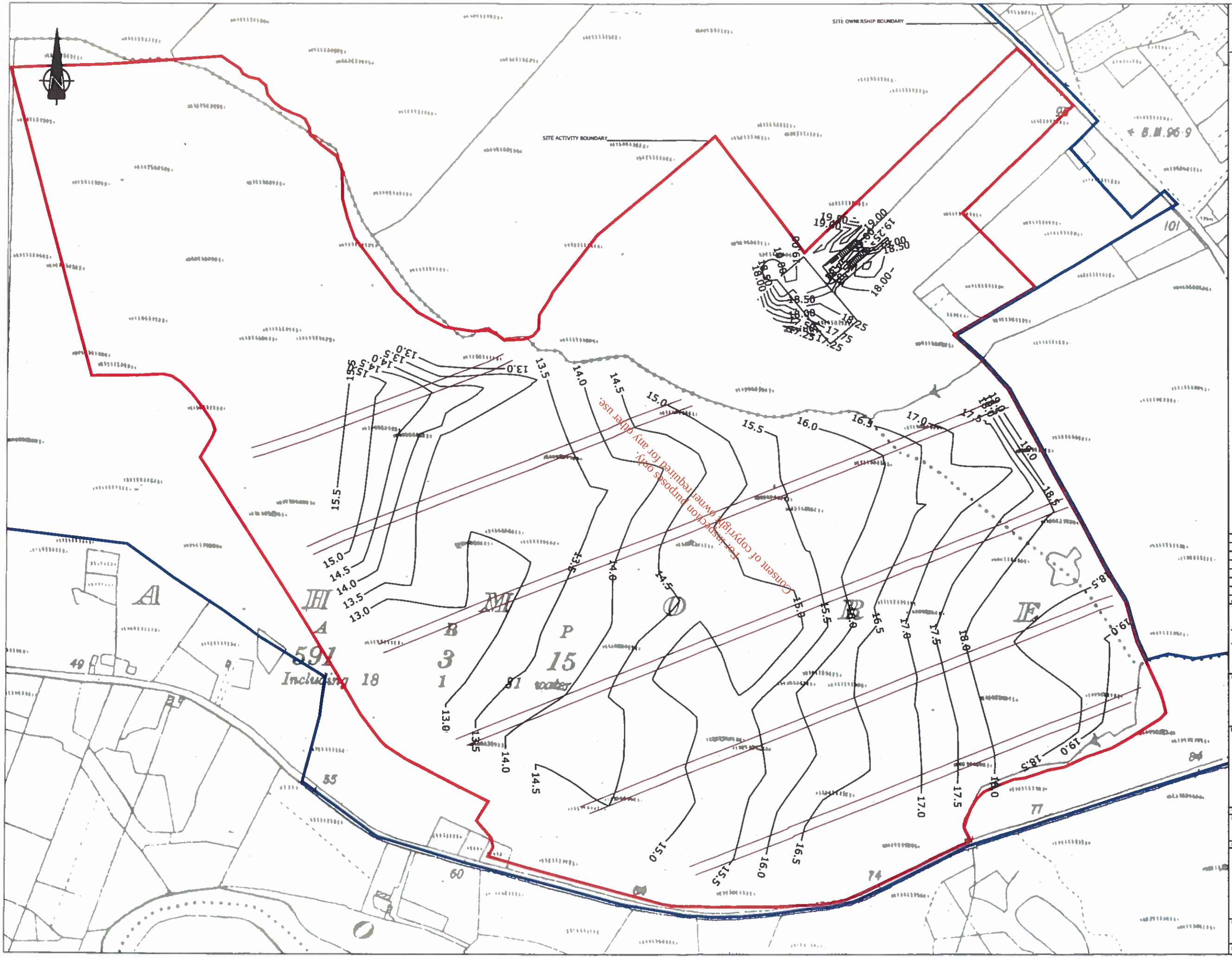

LEGEND

- SITE OWNERSHIP BOUNDARY
- SITE ACTIVITY BOUNDARY
- HAUL ROAD
- PEAT CONTOUR

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Legend

- SITE OWNERSHIP BOUNDARY
- SITE ACTIVITY BOUNDARY
- HAUL ROAD
- HIGH FIELD

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All levels relate to Ordinance Datum at Malin Head

PEAT DEPOSITION PHASING TIMEFRAME

- PHASE 1
- PHASE 2
- PHASE 3
- PHASE 4
- FILLING DIRECTION

SITE ACTIVITY BOUNDARY

ACCESS ROAD

SETTLEMENT POND

2 No. SETTLEMENT PONDS

BORD NA MONA SITE OWNERSHIP BOUNDARY

HAUL ROAD

PHASE 3

PHASE 1

PHASE 2

PHASE 4

HAUL ROAD (along top of Highfield)

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BORD NA MÓNA

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CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

Drawing Title

PEAT DEPOSITION PHASING
LAYOUT PLAN

Scale 1:2500 @ A1

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- SITE ACTIVITY BOUNDARY
- HAUL ROAD
- HIGH FIELD
- ACCESS ROAD
- EXISTING RAILWAY

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SRAHMORE PEAT DEPOSITION SITE

Drawing Title

SITE INFRASTRUCTURE PLAN

Scale 1:2500 @ A3

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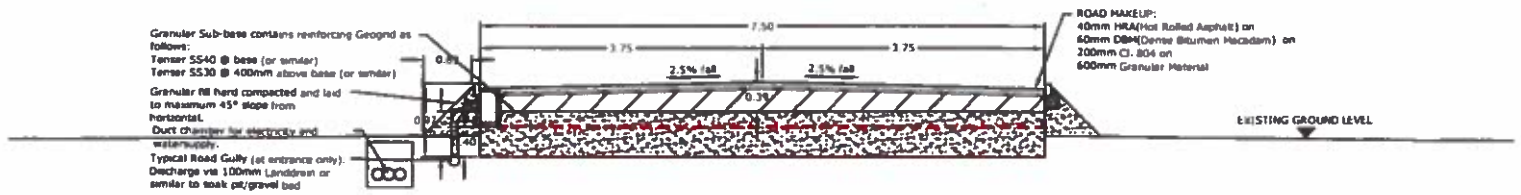
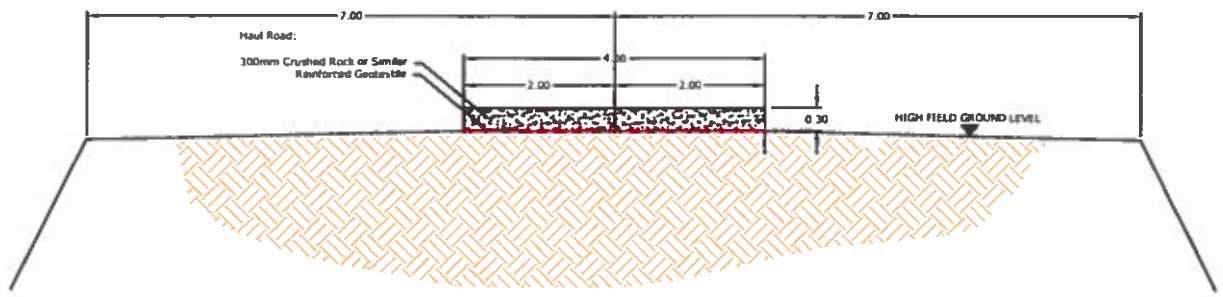
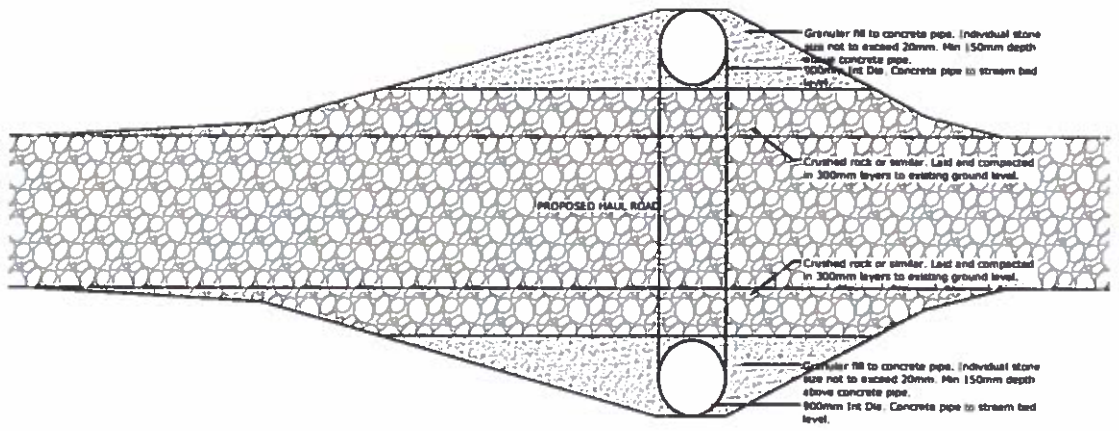


TYPICAL CROSS SECTION THROUGH ACCESS ROAD



TYPICAL CROSS SECTION THROUGH HAUL ROAD

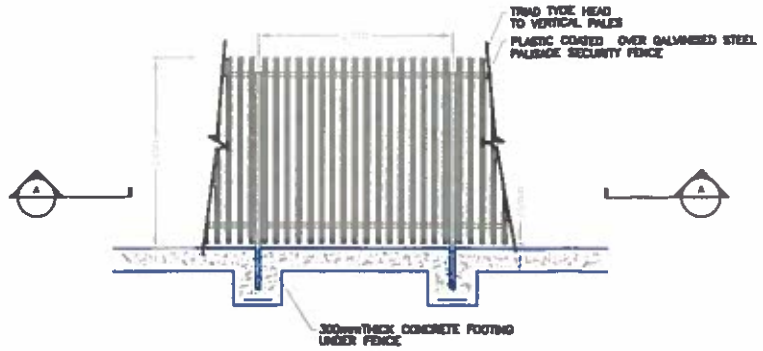
CROSS SECTION



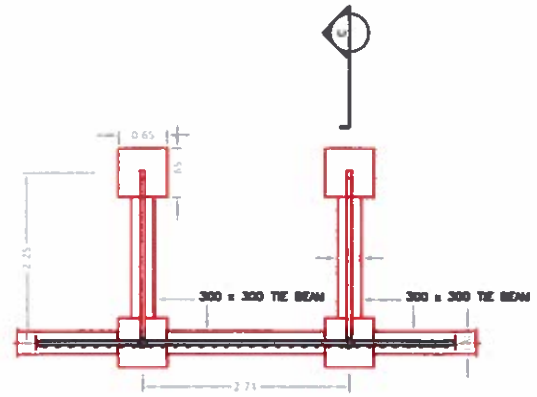
PLAN

TYPICAL STREAM CROSSING

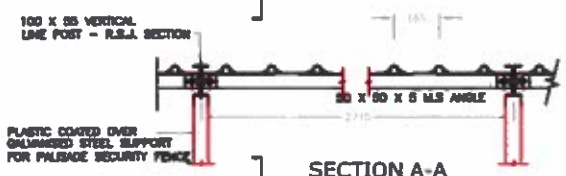
SCALE 1:100



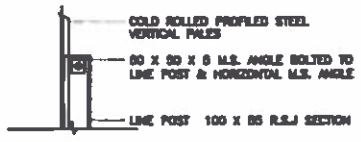
SECTIONAL ELEVATION ON PALISADE FENCING



PLAN OF PAD AND FOUNDATION DETAILS



SECTION A-A



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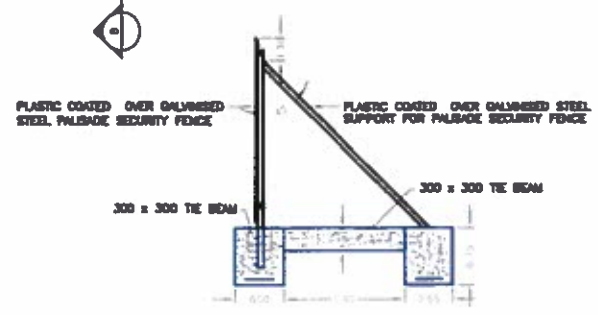

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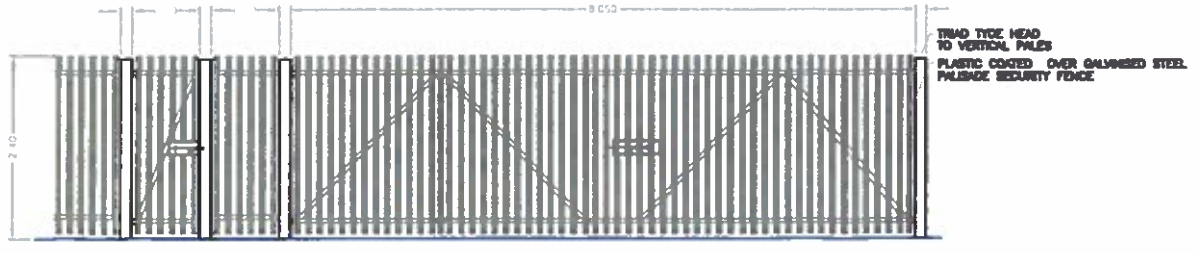

ELEVATION ON PALISADE GATE TO SITE ENTRANCE

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Legend

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No.	Revisions	Date	Init.

Client

BORD NA MÓNA

Project

CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

Drawing Title

ACCESS/HAUL ROAD SECTIONS AND FENCING DETAILS

Scale 1:50 @ A1

Drawn by	Checked by	Date
Gerard Finane	Damien Grehan	DECEMBER 2003

ENGINEER IN CHARGE SEAN FINLAY

TES CONSULTING ENGINEERS

Drawing No.

1169/01/210

Rev.

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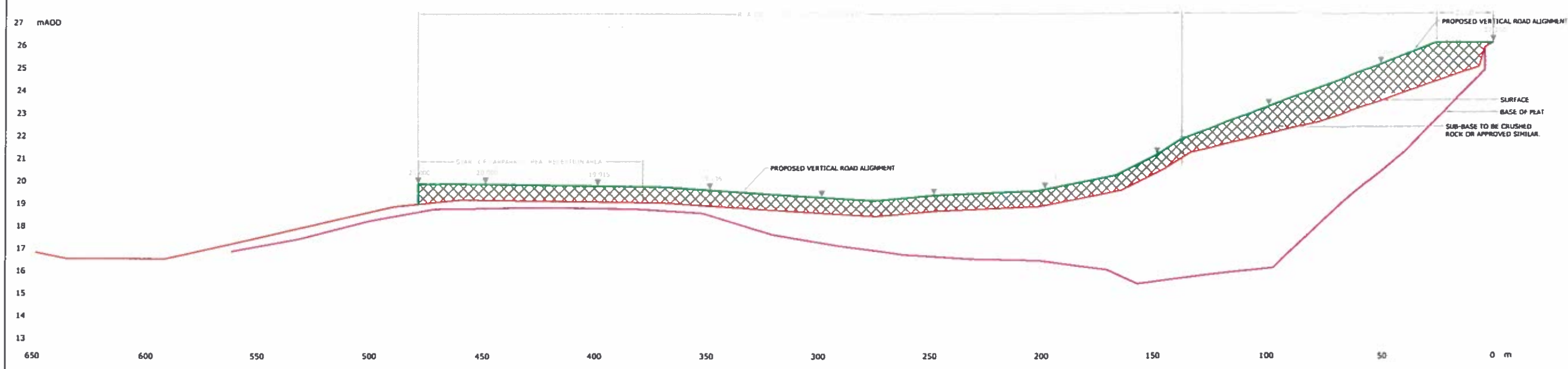
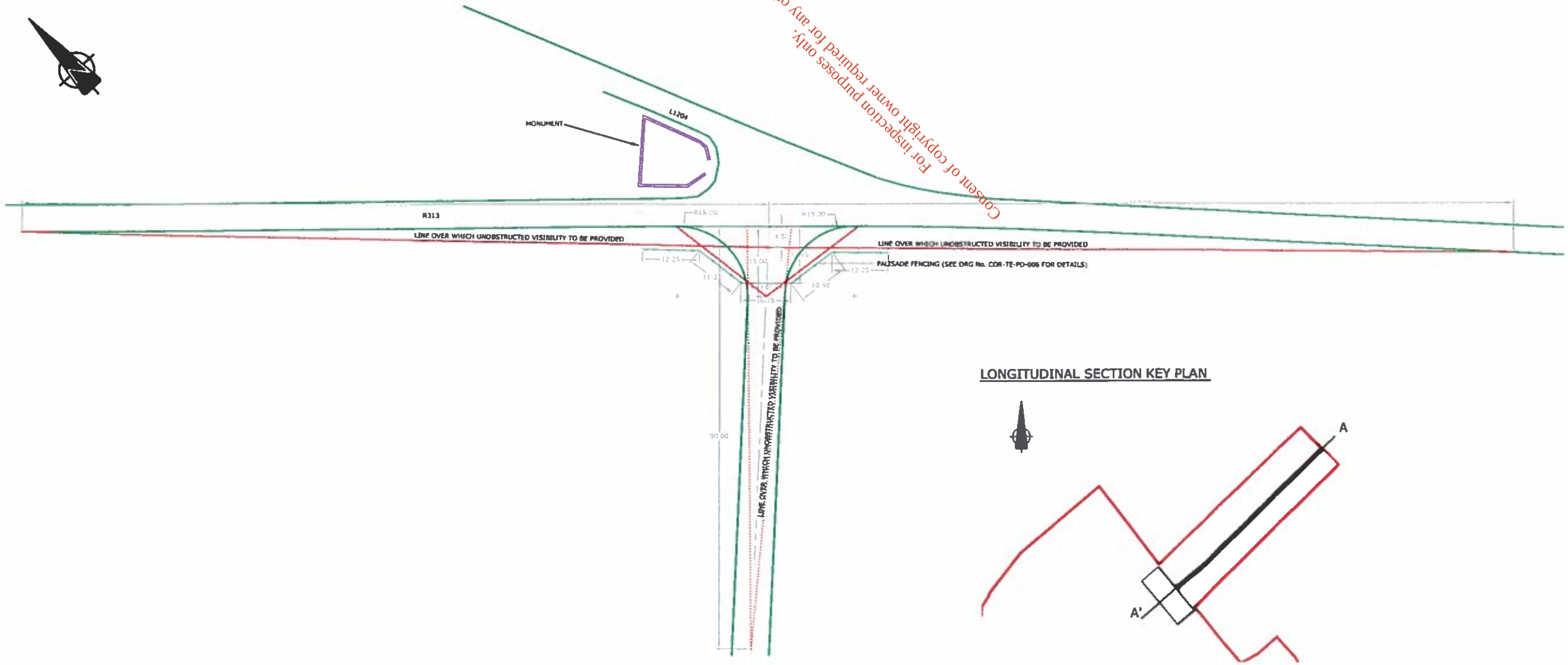


LONGITUDINAL SECTION A - A' ALONG CENTRELINE OF ACCESS ROAD

HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:500



SITE ENTRANCE DETAILS

SCALE 1:500

LONGITUDINAL SECTION KEY PLAN

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Suffix	Revisions	date	init

Client

BORD NA MÓNA

Project

CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

Drawing Title

SITE ENTRANCE DETAILS
AND LONGITUDINAL SECTION THROUGH ACCESS ROAD

Scale	VARIES @ A1	
Drawn by: Colin Peacock	Checked by: Damien Grehan	Date: DECEMBER 2013

ENGINEER IN CHARGE: SEAN FINLAY

TES
CONSULTING ENGINEERS

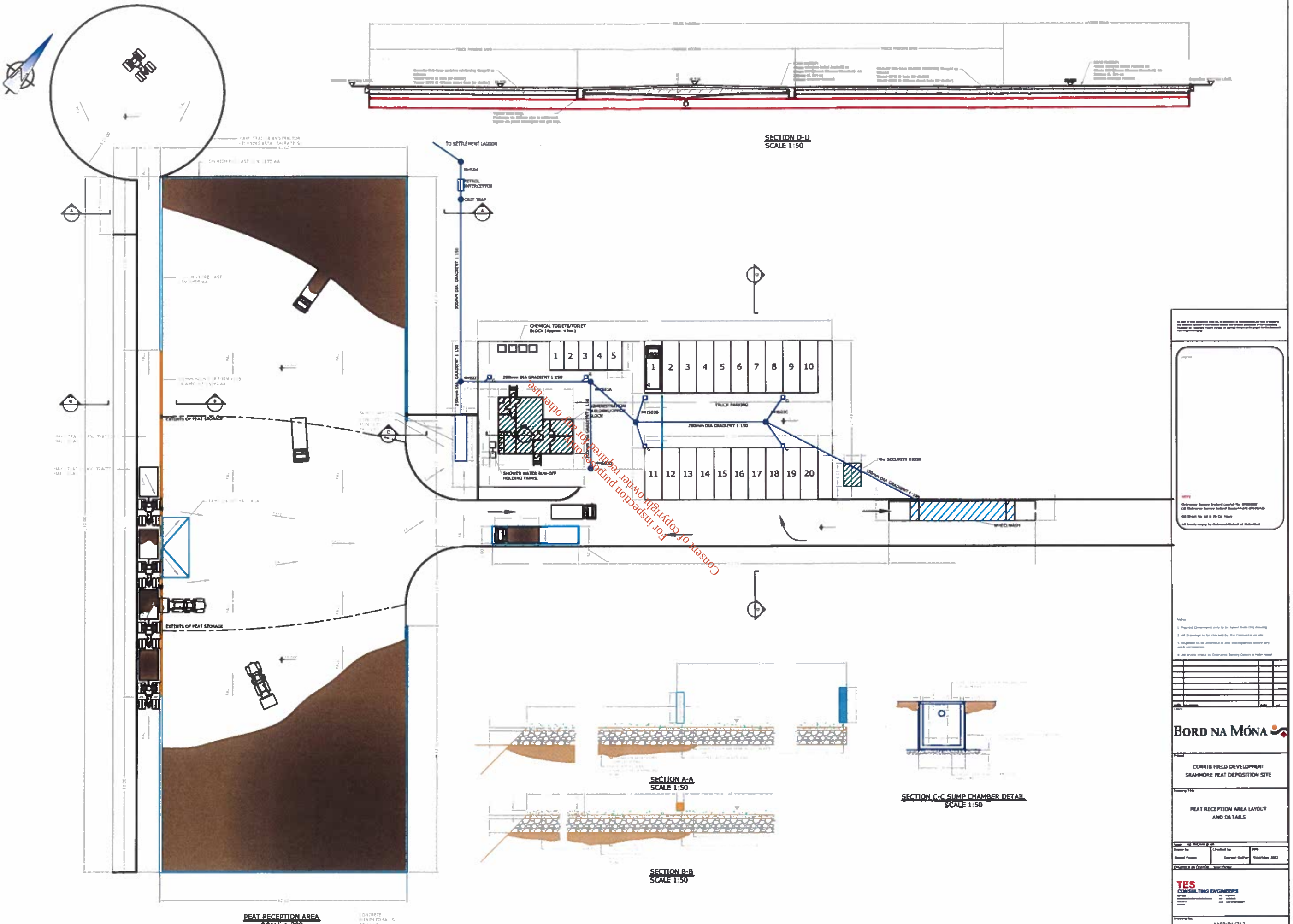
Drawing No.

1169/01/211

Rev.

EPA Export 08-07-2014:23:45:54

SECTION D-D
SCALE 1:50



SECTION A-A
SCALE 1:50

SECTION B-B
SCALE 1:50

SECTION C-C SUMP CHAMBER DETAIL
SCALE 1:50

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BORD NA MÓNA

CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

PEAT RECEPTION AREA LAYOUT AND DETAILS

TES CONSULTING ENGINEERS

1169/01/212

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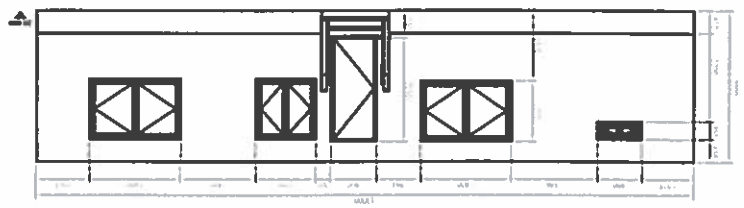
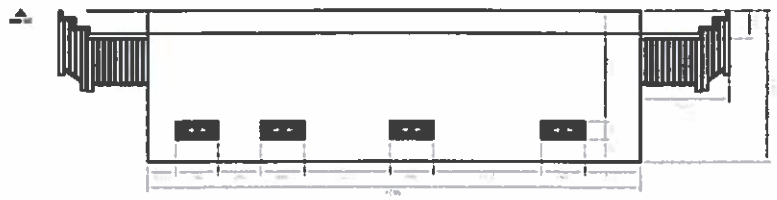
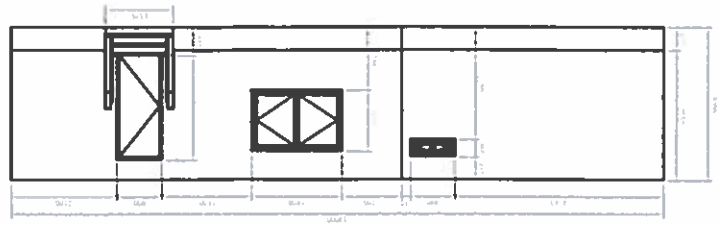
ELEVATION A



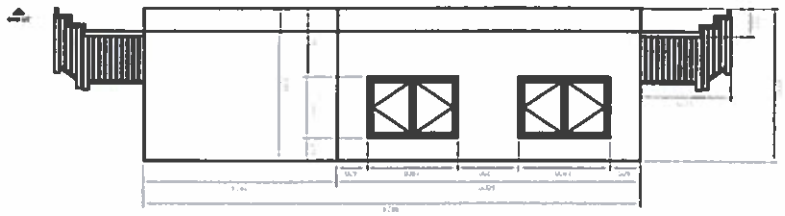
ELEVATION B



ELEVATION C

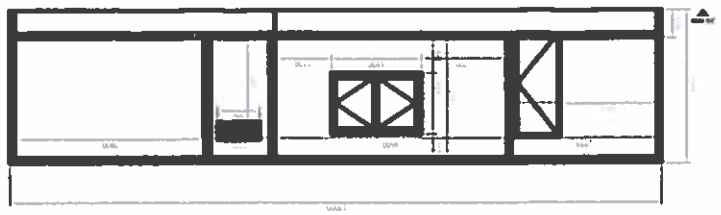


ELEVATION D

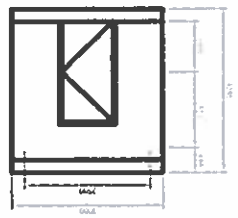


SECTION 1-1

SECTION 2-2

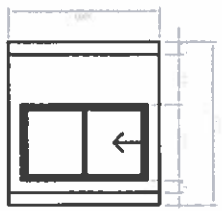


SECTION 3-3

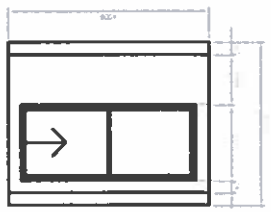


SECTION 4-4

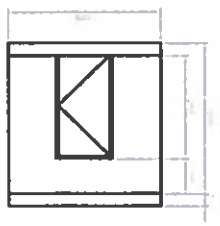
ELEVATION E



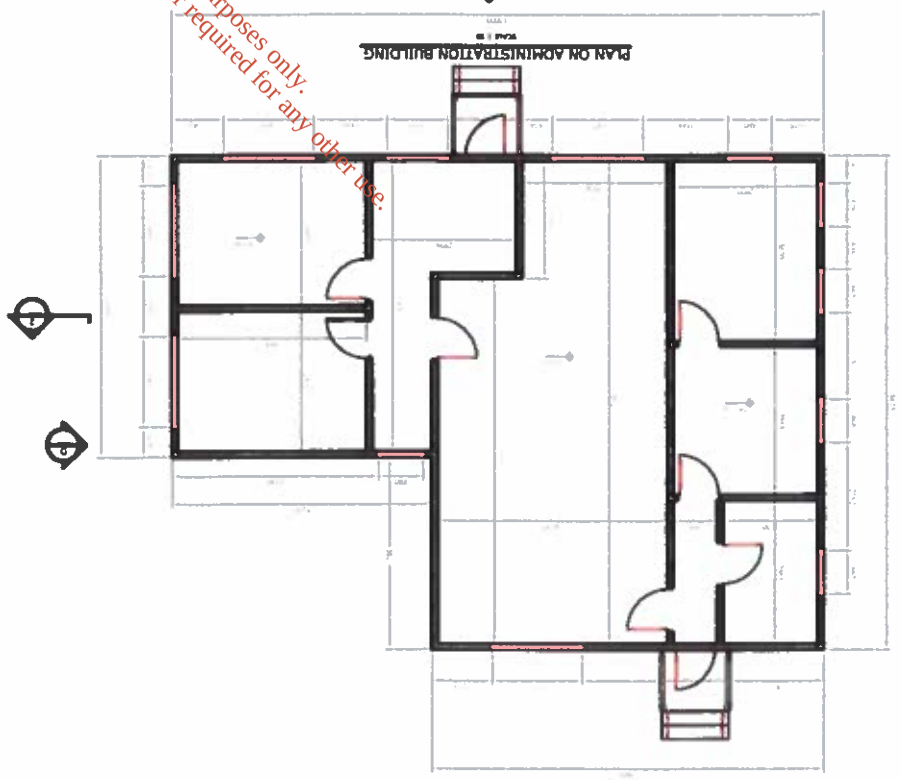
ELEVATION F



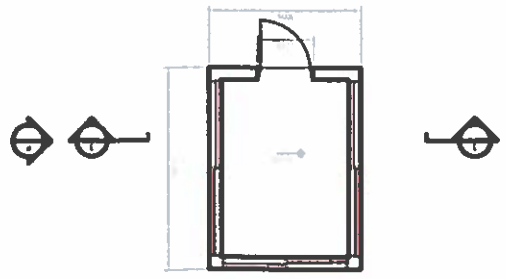
ELEVATION G



PLAN ON ADMINISTRATION BUILDING
SCALE 1:50



PLAN ON SECURITY KIOSK
SCALE 1:50



MATERIALS FOR ADMINISTRATION BUILDING AND SECURITY KIOSK
ROOF
PITCH TO BE DETERMINED TO SUIT REQUIRED SIZES
PRE-PAINTED METAL PROFILED SHEETING
Proprietary, factory produced composite corrugated roof sheeting of a structural composite panel of diamond shaped reinforced fibreglass and polyester resin bonded to an exterior panel of polyester resin reinforced fibreglass with a fully vulcanised neoprene gasket. Roof to be fixed using galvanised steel purlins, complete with flashings to give complete dry water disposal.
The finished roof shall have such roof pitch as given and fixed in accordance with the manufacturers recommendations.
Z FINISH as alternative as required.
EXTERNAL WALLS
The external walls are constructed of galvanised profiled steel sheeting to a 75mm composite polystyrene, which is then to be finished in 12.5mm plasterboard.
The cladding is finished with 12.5mm vent-a-rend plasterboard with a coating height of 1000mm as required.
FLOORS
The suspended floors shall be timber structure of steel beams and joists supporting a deck of structural board. The entire floor construction is insulated with 50mm thick insulation with a 75mm thermoset sand finishing to provide a rodent free environment and underfloor ventilation.
WINDOWS
Windows shall be 50mm UPVC fully glazing 2 mm coated double glazed units with factory finished and Tectan poly fenglaz.

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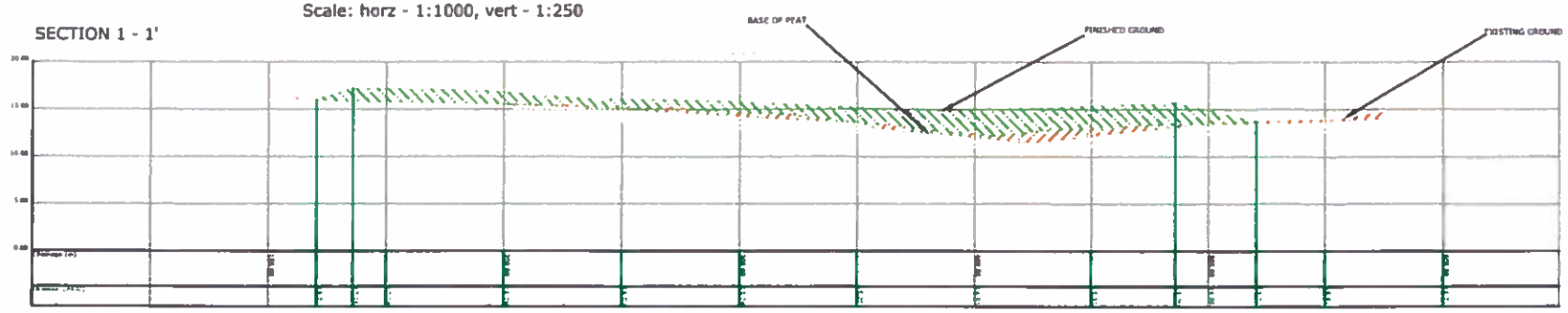
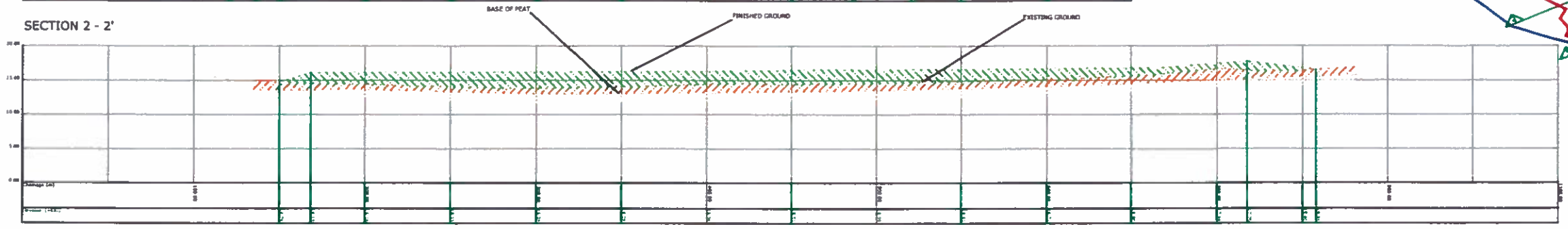
LONGITUDINAL SECTIONS
Scale: horz - 1:1000, vert - 1:250

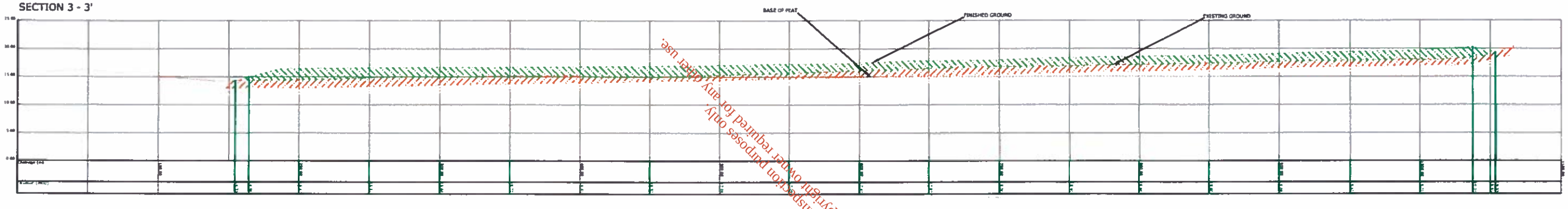
SECTION 1 - 1'



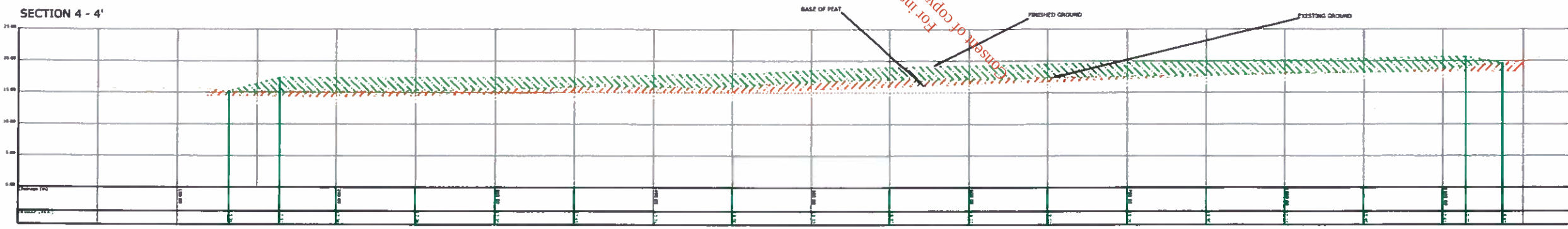
SECTION 2 - 2'



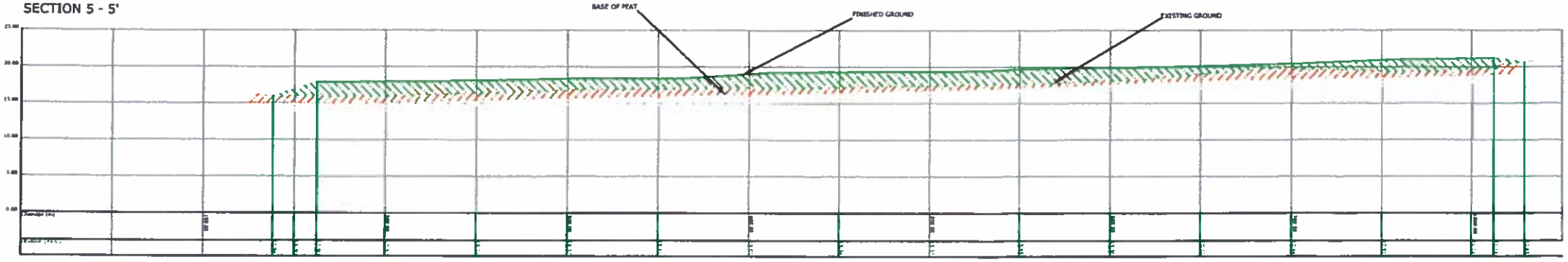
SECTION 3 - 3'



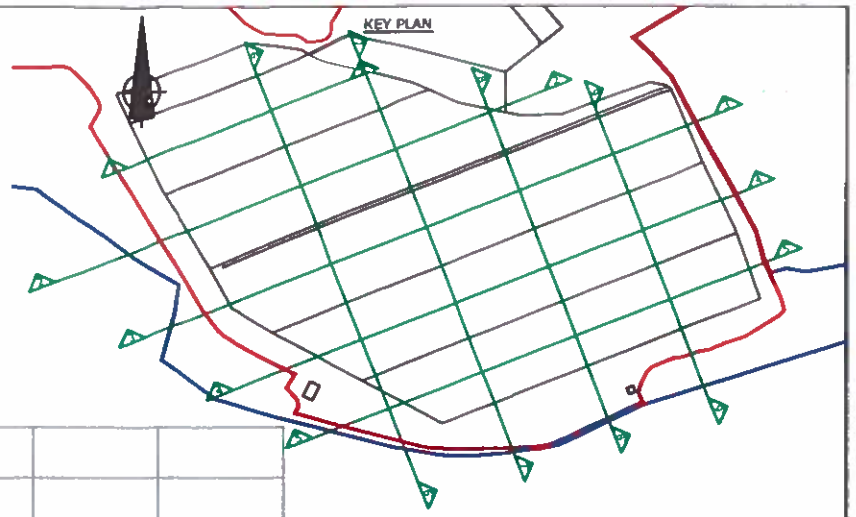
SECTION 4 - 4'



SECTION 5 - 5'



KEY PLAN



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BORD NA MÓNA

Project
Corrib Field Development
Srahmore Peat Deposition Site

Drawing Title
Longitudinal Sections 1,2,3,4, & 5
Sheet 1 of 2

Scale 1:1000 HORZ AND 1:250 VERT @ A0

Drawn by	Checked by	Date
Gerard Finane	Damien Grehan	December 2003

ENGINEER IN CHARGE: Sean Finlay

TES CONSULTING ENGINEERS

Drawing No.
1169/01/214

Rev.

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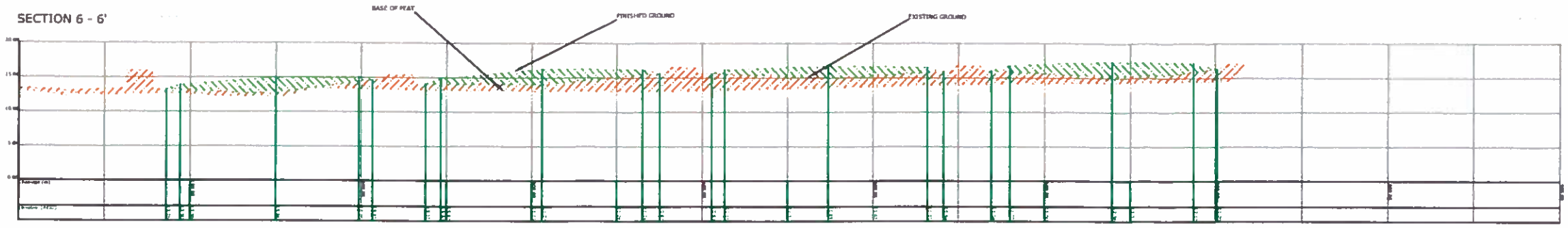
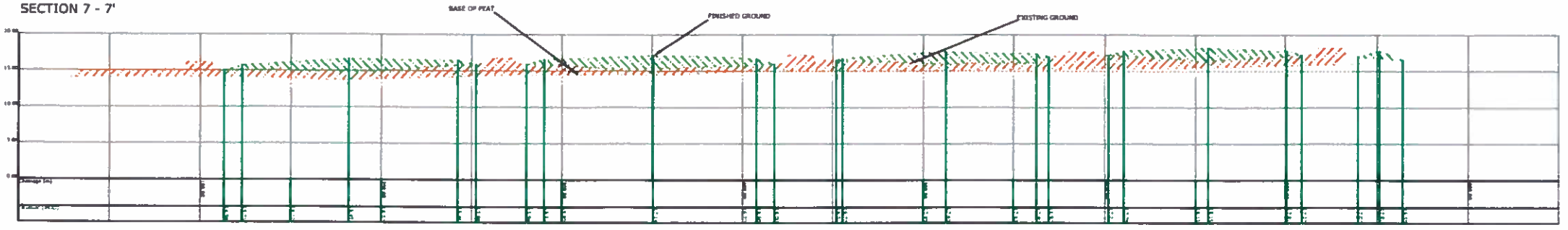
LONGITUDINAL SECTIONS
Scale: horz - 1:1000, vert - 1:250

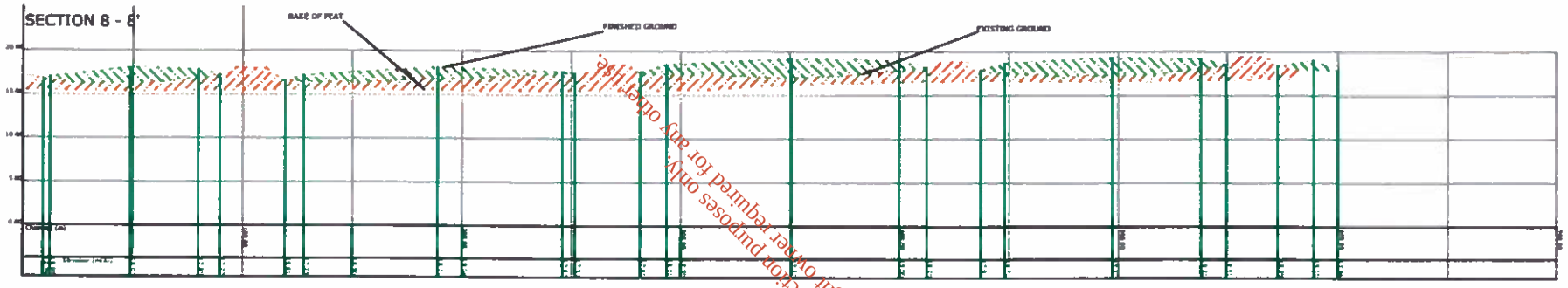
SECTION 6 - 6'



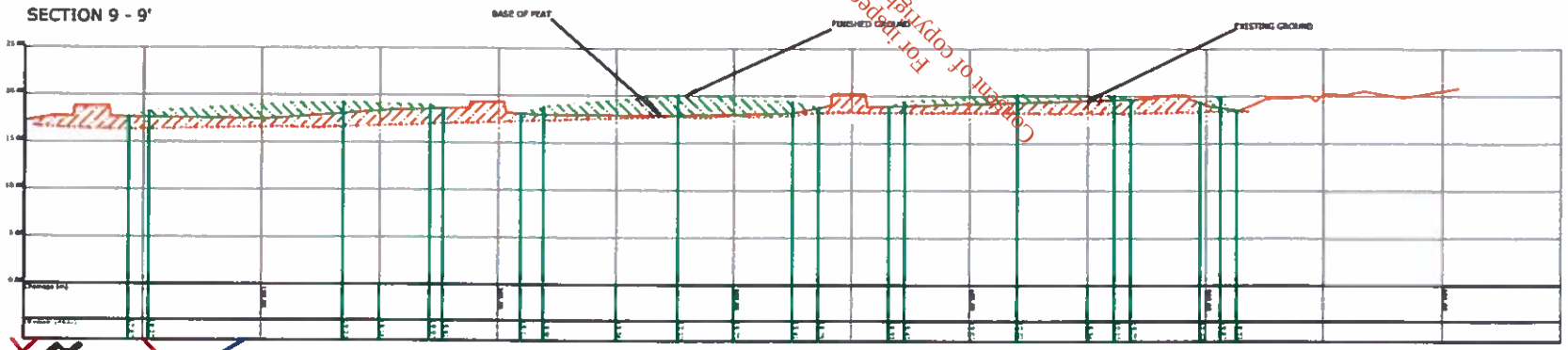
SECTION 7 - 7'



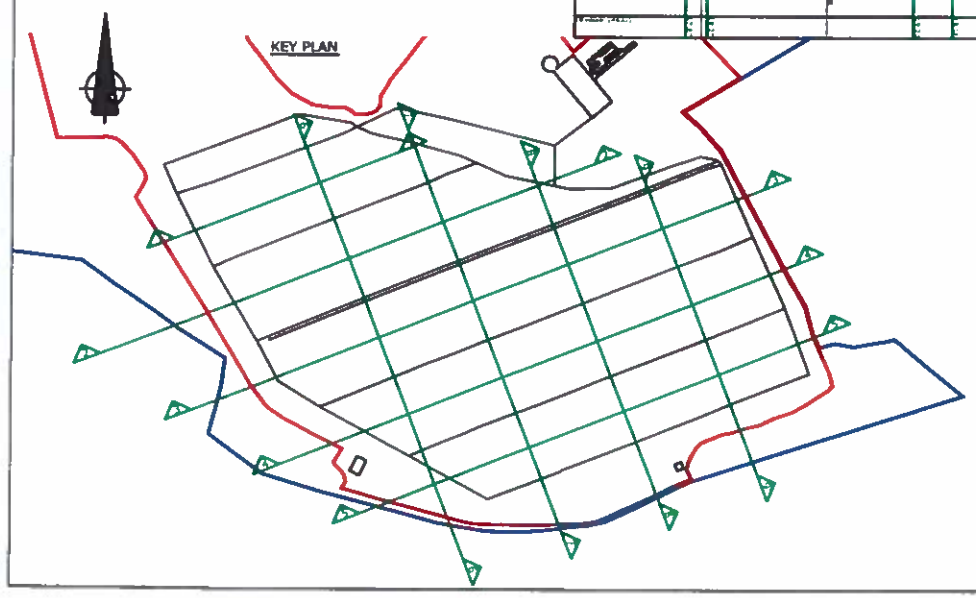
SECTION 8 - 8'



SECTION 9 - 9'



KEY PLAN



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BORD NA MÓNA

Project
Corrib Field Development
Srahmore Peat Deposition Site

Drawing Title
Cross Sections 6,7,8 & 9
Sheet 2 of 2

Scale 1:1000 HORZ AND 1:250 VERT @ A0

Drawn by	Checked by	Date
Gerard Finane	Damien Grehan	December 2003

ENGINEER IN CHARGE : Sean Finlay

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LEGEND

- SITE OWNERSHIP BOUNDARY
- SITE ACTIVITY BOUNDARY
- HAUL ROAD
- FINISHED GROUND CONTOUR

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OS Sheet No. 18 & 26 Co. Mayo

All levels relate to Ordnance Datum at Malin Head

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Issue Revisions	date	init

Client

BORD NA MÓNA

Project

CORRIB FIELD DEVELOPMENT
SRAHMORE PEATDEPOSITION SITE

Drawing Title

FINAL RESTORATION LEVELS

Scale 1:2500 @ A1

Drawn by	Checked by	Date
Gerard Finane	Damien Grehan	DECEMBER 2003

ENGINEER IN CHARGE: SEAN FINLAY

TES
CONSULTING ENGINEERS

Drawing No.

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LEGEND

- SITE OWNERSHIP BOUNDARY
- SITE ACTIVITY BOUNDARY
- HAUL ROAD
- FINISHED GROUND CONTOUR
- RE-VEGETATED PEAT

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OS Sheet No. 18 & 26 Co. Mayo

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SITE ACTIVITY BOUNDARY

SITE OWNERSHIP BOUNDARY

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4. All levels relate to Ordnance Survey Datum at Malin Head

Rev	Revisions	date	Int.

Client

BORD NA MÓNA

Project

CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

Drawing Title

FINAL REHABILITATION PLAN

Scale 1:2500 @ A1

Drawn by	Checked by	Date
Gerard Finane	Damien Grehan	DECEMBER 2003

ENGINEER IN CHARGE: SEAN FINLAY

TES
CONSULTING ENGINEERS

Drawing No.

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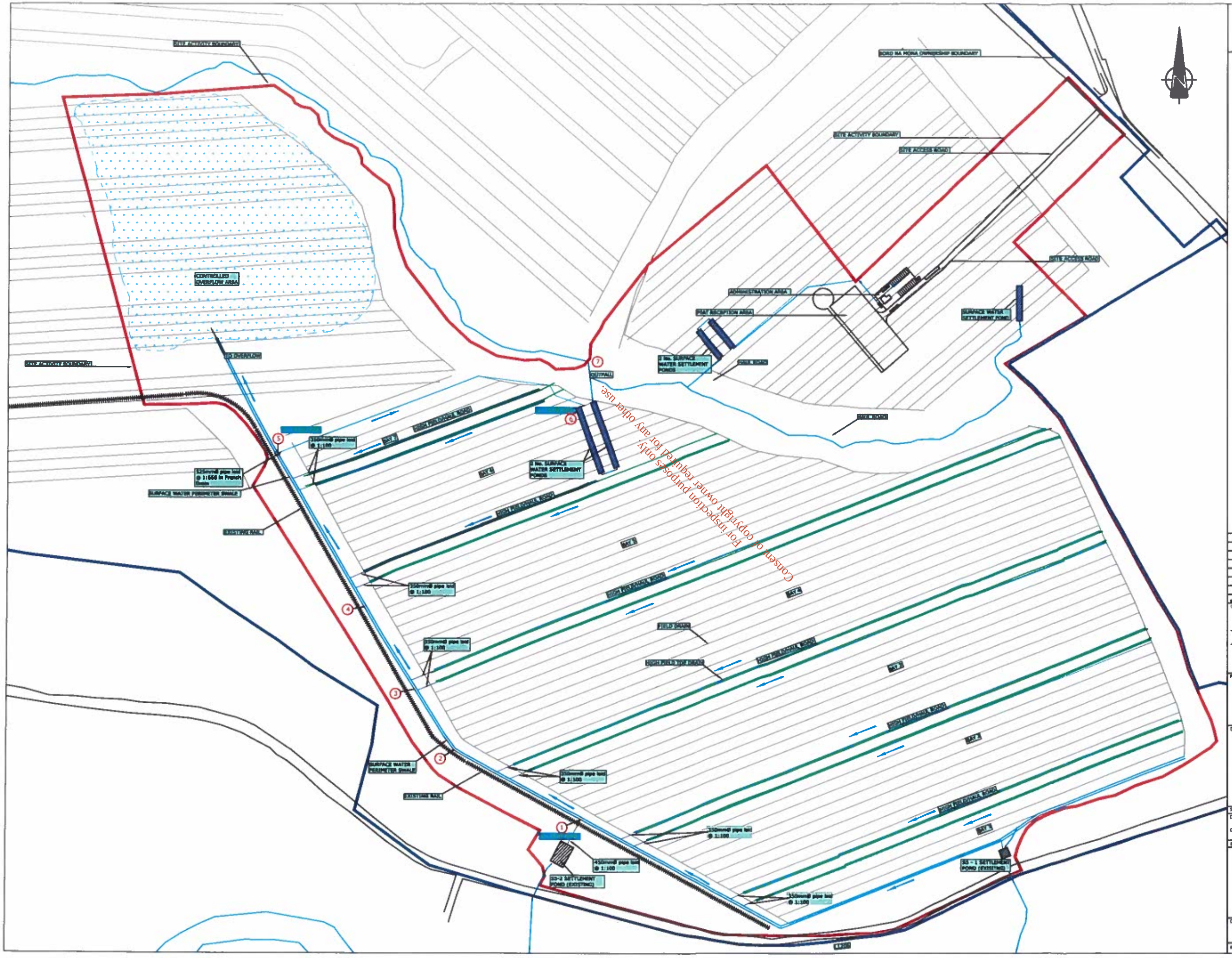

SITE OWNERSHIP BOUNDARY
SITE ACTIVITY BOUNDARY
HAUL ROAD
HIGH FIELD
FIELD DRAIN
HIGH FIELD TOE DRAIN
SURFACE WATER FLOW DIRECTION

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OS Sheet No. 18 & 26 Co. Mayo

All levels relate to Ordnance Datum at Malin Head

Notes.

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4. All levels relate to Ordnance Survey Datum at Malin Head

Suffix	Revisions	date	init

Client

BORD NA MÓNA

Project

CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSTION SITE

Drawing Title

SITE DRAINAGE LAYOUT PLAN

Scale 1:2500 @ A3

Drawn by	Checked by	Date
Gerard Finane	Damien Grehan	DECEMBER 2003

ENGINEER IN CHARGE: SEAN FINLAY

TES
CONSULTING ENGINEERS

Drawing No.

1169/01/218

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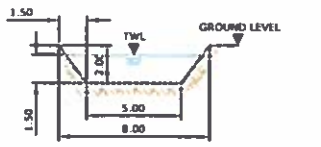
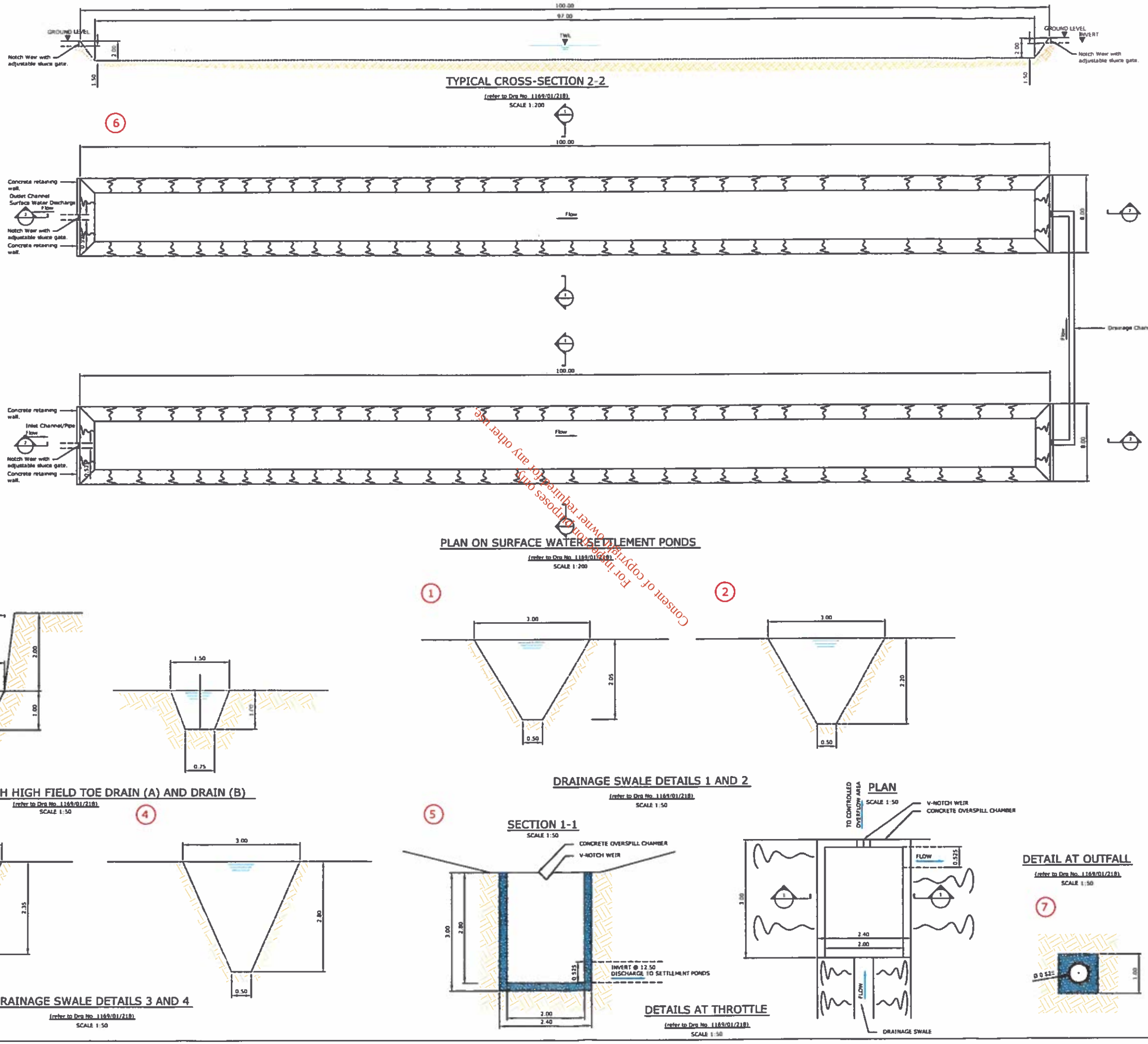


TYPICAL CROSS-SECTION 1-1

(refer to Drg No. 1169/01/218)
SCALE 1:200



TYPICAL CROSS-SECTION 2-2

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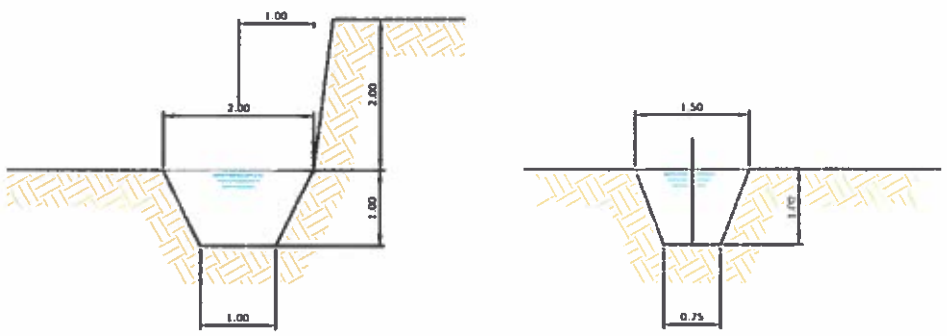

TYPICAL DETAIL THROUGH HIGH FIELD TOE DRAIN (A) AND DRAIN (B)

(refer to Drg No. 1169/01/218)
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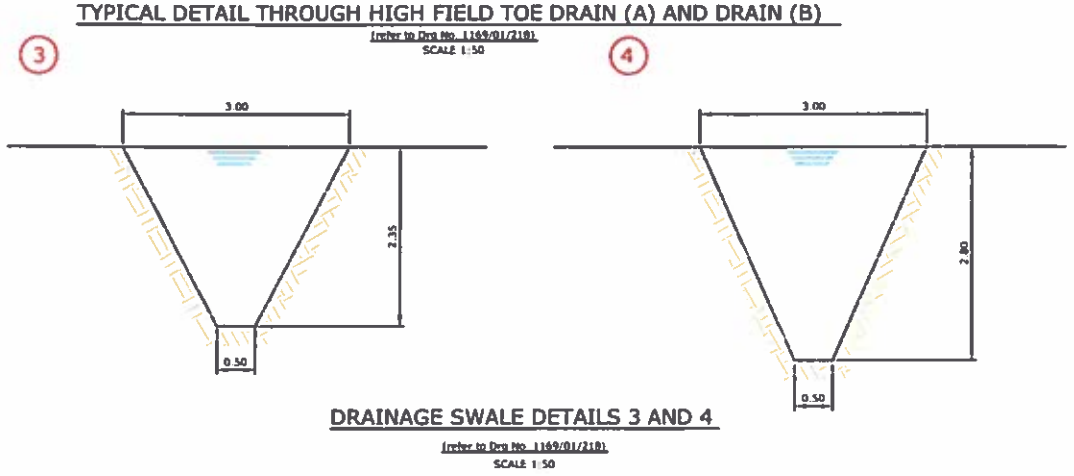
DRAINAGE SWALE DETAILS 1 AND 2

(refer to Drg No. 1169/01/218)
SCALE 1:50



DRAINAGE SWALE DETAILS 3 AND 4

(refer to Drg No. 1169/01/218)
SCALE 1:50

PLAN ON SURFACE WATER SETTLEMENT PONDS

(refer to Drg No. 1169/01/218)
SCALE 1:200

DETAILS AT THROTTLE

(refer to Drg No. 1169/01/218)
SCALE 1:50

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Legend

(1) These numbers refer to similarly identified locations on Drg. No. 1169/01/218

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Notes.

1. Figured Dimensions only to be taken from this drawing
2. All Drawings to be checked by the Contractor on site
3. Engineer to be informed of any discrepancies before any work commences
4. All levels relate to Ordinance Survey Datum at Malin Head

Suffix	Amendment	Date	Init

Client

BORD NA MÓNA

Project

CORRIB FIELD DEVELOPMENT
SRAHMORE PEAT DEPOSITION SITE

Drawing Title

SURFACE WATER SETTLEMENT PONDS AND DETAILS

Scale VARIES @ A1		
Drawn by: Colin Peacock	Checked by: Damien Grehan	Date: DECEMBER 2013

ENGINEER IN CHARGE: SEAN FINLAY

TES CONSULTING ENGINEERS

Drawing No.

1169/01/219

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Appendix 1

IPC Licence (505) Condition 10

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Appendix 1

Condition 10 Cutaway Bog Rehabilitation

10.1 Following termination of use or involvement of all or part of the site in the licensed activity, the licensee shall:

10.1.1 Decommission, render safe or remove for disposal/recovery, any soil, subsoils, buildings, plant or equipment, or any waste, materials or substances or other matter contained therein or thereon, that may result in environmental pollution.

10.1.2 Implement the agreed cutaway bog rehabilitation plan (refer Condition 10.2).

10.2 Cutaway Bog Rehabilitation Plan:

10.2.1 The licensee shall prepare, to the satisfaction of the Agency, a fully detailed and costed plan for permanent rehabilitation of the cutaway boglands within the licensed area. This plan shall be submitted to the Agency for agreement within eighteen months of the date of grant of this licence.

10.2.2 The plan shall be reviewed every two years and proposed amendments thereto notified to the Agency for agreement as part of the AER. No amendments may be implemented without the written agreement of the Agency.

10.3 The Rehabilitation Plan shall include as a minimum, the following:

10.3.1 A scope statement for the plan, to include outcome of consultations with relevant Agencies, Authorities and affected parties (to be identified by the licensee).

10.3.2 The criteria which define the successful rehabilitation of the activity or part thereof, which ensures minimum impact to the environment.

10.3.3 A programme to achieve the stated criteria.

10.3.4 Where relevant, a test programme to demonstrate the successful implementation of the rehabilitation plan.

10.3.5 A programme for aftercare and maintenance.

10.4 A final validation report to include a certificate of completion for the Rehabilitation Plan, for all or part of the site as necessary, shall be submitted to the Agency within six months of execution of the plan. The licensee shall carry out such tests, investigations or submit certification, as requested by the Agency, to confirm that there is no continuing risk to the environment.

Reason: To make provision for the proper closure of the activity ensuring protection of the environment.

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Appendix 2

Rehabilitation plan

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BORD NA MÓNA

BORD NA MÓNA ENERGY LIMITED

Cutaway Bog Rehabilitation

A document to detail the rehabilitation and aspects of decommissioning of the Oweninny Works in compliance with Condition 10 of IPC Licence Ref. No. 505, and incorporating rehabilitation following the development of the proposed Oweninny wind farm

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May 2003

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Fig.2. OAE1 (Bellacorick): Map showing production, cutaway and new development bog, bog remnants, watercourses, lakes and other predominant physical features.

Fig.3. OAE2 (Bangor): Map showing production, cutaway and new development bog, bog remnants, watercourses, lakes and other predominant physical features.

Fig. 2 & 3.The colour code for these two figures is as follows:

Red shading:	bog remnants
Yellow shading:	new development bog
Green shading:	forestry
Brown shading:	production bog
Pink shading:	cutaway bog
Blue shading:	natural lakes

The Bord na Móna boundary is highlighted in black, while the courses of the main rivers are illustrated. The production areas are highlighted and labelled, allowing for ease of reference to particular areas mentioned in the text.

Fig.14. Aerial photograph of the OAE1 (Bellacorick) site. This shows the peat production areas relative to the surrounding areas. At the Bellacorick site, cross reference with Fig. 2 shows areas of cutaway bog that are revegetating and areas where the underlying gravel hills have been revealed. Also clearly visible are bog remnants, watercourses and forestry areas.

Fig.15. Aerial photograph of the OAE2 (Bangor) site illustrating the location of the peat production areas relative to Bangor town and the main watercourse of the Owenmore River. Cross-reference with Fig. 3 will highlight the different habitat / bog conditions visible on the map. Clearly visible are the new development areas referred to on page 26.

Fig.22. New design layout for *Phase 1* of the wind farm project.

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PART 1

REHABILITATION OF THE OWENINNY BOGLANDS

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1 INTRODUCTION

Research into the after-use of cutaway industrial peatlands has been ongoing by Bord na Móna since the 1960s. Initially the main focus was on finding a commercial after-use for these areas and a number of experimental trials were established across the range of Bord na Móna peatlands to determine the success of vegetable growing, forestry, grassland and biomass crops. In latter years the focus has shifted towards allowing the post-industrial peatland areas to naturalise and revert to wetland and dry wilderness areas. A number of alternative after-uses have been explored at the Oweninny Works, including coniferous forestry, biomass, agricultural grassland, wind-energy and wetland creation. The former options have proven commercially inviable while the latter two options are deemed viable and beneficial to the area.

Bord na Móna submitted a rehabilitation plan as part of the IPC Licence for the cutaway boglands of the Oweninny Works to the EPA in January 2002. This rehabilitation plan was essentially a generic plan that outlined the criteria defining successful rehabilitation at the Oweninny Works and described a number of test programmes that incorporated the principles and methods of rehabilitation. The EPA approved the rehabilitation plan in June 2002 (Ref. No. 505). The condition that refers to cutaway bog rehabilitation within the IPC Licence is Condition 10 (Appendix 1). Both decommissioning of the site and rehabilitation of the cutaway boglands are addressed under Condition 10, encompassing the totality of the Oweninny Works.

Since the submission of the original rehabilitation plan in January 2002 a number of issues have been clarified and further developments that will impact on the rehabilitation plan have been brought to light. These are outlined as follows:

- The closure date for the Oweninny Works has been set for December 2004.

- There has been an application to Mayo County Council for planning permission to establish a large wind farm on the Bord na Móna Bellacorick Holdings. The plan is a joint venture between Bord na Móna Energy Ltd. and ESB (Electricity Supply Board).

- Subsequent to approval of the initial plan, Bord na Móna has continued to develop the specifics of the rehabilitation plan for the Oweninny Works. Formal consultation proceedings with statutory bodies and other parties with a recognisable concern for rehabilitation of the Oweninny Works were initiated in December 2002 (the original rehabilitation plan was circulated for comments).

In the light of these developments, Bord na Móna is progressively updating the rehabilitation plan, providing more detail in the event of the after-use at the Oweninny Works being (a) the development of replacement wetland habitats, and (b) the establishment of a wind farm. Following the consultation process involving those interested parties the scope of the plan will be outlined. This document therefore, represents the updated rehabilitation plan as a work in progress and the outcome of consultations to date is included.

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2 AIMS OF THE REHABILITATION PLAN

The aim of rehabilitation of the Oweninny Works is to ensure the stabilisation of the peat production area, while encouraging the area to blend with the surrounding Atlantic blanket bog landscape. The approach requires initial active rehabilitation work (blocking drains, etc.), followed by monitoring of effectiveness of this work. However, it is anticipated that natural processes of revegetation and vegetation succession will lead to the area becoming self-sustaining and stabilised, comprising a mosaic predominantly of man-made wetland habitats that will contribute to the existing natural biodiversity of the area.

The aims of this document are outlined as follows:

- To outline a detailed cutaway bog rehabilitation plan for the Oweninny Works (OAE1: Bellacorick and OAE2: Bangor), to include a breakdown of habitats on site, the range of conditions and rehabilitation work necessary to provide for the stabilisation of the site. The plan will include estimated timeframes for rehabilitation (and some decommissioning) measures to be completed.
- To outline *Phase 1* of the Oweninny Wind Farm project, detailing the impact of *Phase 1* of the wind farm development (incorporating pre-, during and post-construction phases) on the current rehabilitation plan[1].

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[1] The rehabilitation plan for the proposed wind farm has been developed in tandem with the re-design of the road and wind turbine network to mitigate any negative impacts on the initial rehabilitation plan. This general approach to the design of the wind farm taking cognisance of the criteria outlined in the original rehabilitation plan (submitted January 2002) for the site in general, provides the blueprint for development of rehabilitation plans for subsequent construction phases (*described later*).

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3 DEVELOPMENT OF A SCOPE STATEMENT FOR THE REHABILITATION PLAN *(WORK IN PROGRESS)*

The development of the rehabilitation plan has been ongoing since 1996 and the key issues of rehabilitation were identified between 1996 and 1999 through postgraduate research work (Farrell 2001) conducted through the Botany Department at University College Dublin. Formal consultation with other interested parties has been initiated, during the course of which additional issues of concern have been identified, therefore broadening the scope of the rehabilitation plan.

3.1 Consultation

Following notification from the EPA (letter dated 26/11/02), Bord na Móna forwarded a copy of the *Rehabilitation of Cutaway Bog Plan* (January 2002) to the relevant agencies, authorities and affected parties as identified by Bord na Móna and the EPA. These included:

- Dúchas, National Parks and Wildlife Service (Divisional Ecologist and Regional Conservation Officer)
- North West Regional Fisheries Board
- Mayo County Council
- Coillte
- An Taisce
- Irish Peatland Conservation Council

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3.2 Scope of the Rehabilitation Plan

The scope of the rehabilitation plan seeks to address issues of concern as identified by Bord na Móna and the consultees. The consultees have highlighted a number of issues of concern in addition to the key issues identified previously. To date, the key issues identified are:

- Categorisation of the habitats on site and proposed rehabilitation measures for each habitat type
- Stabilisation of the Oweninny boglands
- Maintenance of silt control measures *(decommissioning)*
- Remediation of water courses *(decommissioning)*
- Management of the SACs within the Bord na Móna Holdings
- The timeframe for cutaway bog rehabilitation
- The impact of the proposed Oweninny Wind Farm development on the current rehabilitation plan

This scope will be further revised and updated according to the outcome of further consultations, and will lead to the development of a scope statement for the plan.

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4 REHABILITATION OF THE CUTAWAY BOGLANDS FOLLOWING CLOSURE OF THE OWENINNY WORKS

4.1 Background Information

A comprehensive botanical study of the Oweninny Works was initiated in the mid-1990s. The main aim of this study was to identify key features in stabilisation of the Oweninny boglands following cessation of industrial activity. The work has provided an ecological understanding of the cutaway bog, and an insight into the future landscape development of the Oweninny Holdings post-industrial peat extraction (Farrell 2001).

The main criteria[2] defining successful rehabilitation of the OAE1 and OAE2 sites are:
(i) Stabilisation of the peat production areas[3]
(ii) Mitigation of silt run-off and,
(iii) Re-establishment of peat-forming communities where possible.

There are a number of issues that must be addressed to allow for stabilisation of the site in its entirety and these are addressed within this document. However, the main areas of concern are those areas that were utilised for peat extraction. The work has therefore concentrated on rehabilitation tools to (a) encourage revegetation of the peat production sites and (b) maximise the potential contribution of these post-industrial areas to local biodiversity. This will involve the development of a replacement peatland landscape that will complement the surrounding Atlantic blanket bog landscape, the greater area of which comprises a network of SACs and NHAs (Fig.1).

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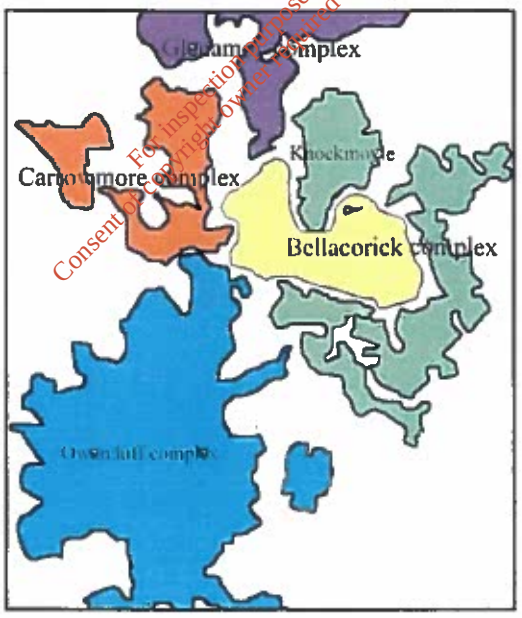

Fig.1. The location of candidate SACs in relation to the peat extraction site at Bellacorick (yellow shading) *after Farrell 2001*. The production area is central to Carrowmore, Glenamoy, Owenduff and Bellacorick bog complexes. These sites will be protected under the EU Habitats Directive. The Bangor extraction site is located south of the Carrowmore and North-west of the Owenduff complex. This site is also central to the network of NHAs and SACs in the Bangor area.

[2] These are the basic criteria as identified in the consultation process to date. They may be subject to modifications.
[3] Stabilisation of these areas infers revegetation. Once stabilised there will be no potential peat run-off from the site, which will cover the second criterion for successful rehabilitation.

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The rehabilitation work to date has focused primarily on cutaway bog areas, and this will ultimately extend to the totality of the Oweninny holdings upon cessation of peat extraction. This has involved (a) the establishment of a baseline vegetation study of the cutaway (1996-1999), (b) experimental work that focussed on determining suitable methods of encouraging vegetation establishment (1996-1999) and (c) large-scale application of the rehabilitation methods (March 2001 *to date*).

An outline of the results attained from each of these steps is described here. An estimate of work required to rehabilitate the site completely will also be presented, with an associated timeframe for completion of the work. Decommissioning of the Oweninny boglands is associated with rehabilitation and reference will be made as to how these two processes are inter-linked. Reference will also be made to the issues of concern that were identified through consultation with interested parties.

The scientific background to the rehabilitation work carried out on the cutaway bog is outlined in Farrell 2001, Farrell & Doyle 1998, and Farrell & Doyle 2003.

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4.2 Categorisation of Habitat Types

The Oweninny Works comprises a complex of habitat types, ranging from hard standings to intact bog to open water areas. Condition 10 of the IPC Licence refers to cutaway bog only. Cutaway bog is the term used to describe industrial peat production areas after the peat of commercial value has been extracted. However, in 2004 the Oweninny Holdings at Bellacorick and Bangor in their entirety will be considered as cutaway bog from the point of view that there will be no further demand for peat by the ESB and the site will be redundant of its industrial application. The term *Oweninny boglands* is therefore a more appropriate umbrella term that includes all of the component habitat types as outlined below.

A breakdown of the Oweninny boglands is outlined in Table 1. These areas are also marked on Figs 2 & 3 (Maps of the production, cutaway, new development, bog remnants, etc.)

Table 1. Breakdown of the Oweninny Holdings

	Hectares		
Bog condition	**OAE1**	**OAE2**	**Total**
Production	1303	680	1983
New development	646	628	1274
Cutaway	1946	78	2024
Forestry	682		682
Bog remnants			400-500
Other areas			<100
Total area	**5051**	**1481**	**6532**

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With reference to Table 1, production bog is that from which peat is still harvested from (peat production will cease either in September 2003 or 2004 depending on rainfall and drying conditions). Cutaway bog refers to peat fields that have been economically exhausted of their peat resource. These cutaway areas may be out of production for a period of up to 20 years. Parts of the cutaway bog, particularly at the OAE1 site have been planted, predominantly with conifers. This area is on a 60-year lease to Coillte (in operation since 1988).

New development refers to areas of Atlantic blanket bog that were ditched, but the surface vegetation was never removed. In general, these areas have begun to rewet again through the natural in-filling in of drainage channels. The bog remnants represent vestiges of the former Atlantic blanket bog complex that pre-existed industrial development at the site. As part of the rehabilitation plan, these areas are recognised as important seed sources and wildlife corridors throughout an otherwise industrial landscape. *Other areas* include watercourses, workshops, etc. and these areas generally come under the heading of decommissioning.

The areas requiring the greater amount of rehabilitation work are those that have been intensively utilised for peat extraction. Intact bog remnants and new development areas will require minimal interference.

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The Oweninny Holdings therefore, comprises a range of habitat types and/or bog conditions, including habitats that were never part of the peat production process. The following habitat types are distinguished:

(a) Shallow peat production fields (less than 1m peat depth)
(b) Cutaway bog (generally less than 0.5m peat depth)
(c) Areas of unstable peat (emerging gravel hills)
(d) Gravel hills (no peat remaining)
(e) Deep peat production fields (more than 1m peat depth)
(f) New development[4] (drained but never fully developed for peat production)
(g) Bog remnants
(h) *Other areas* – railway lines, workshops, roadways, silt ponds, watercourses, etc.

Each of these habitat types will be accounted for in the rehabilitation process, requiring specific rehabilitation measures, e.g. bare gravel hills will have different limitations to revegetation than bare peat fields or silt ponds. Also, there are different issues of concern associated with individual habitats, e.g. on-site rivers and streams may require alternative *remediation* (decommissioning) measures as identified through consultation with the NWRFB[5].

The proportion of each habitat and/or bog condition is outlined in Table 2 (also shown is the habitat type that each 'complex' is assignable to, *after Fossitt (2000)).* This highlights that up to 50% of the area will comprise cutaway bog conditions at the time of closure in 2004 (shallow production bog has the same physico-chemical characteristics of cutaway bog). This is the habitat type that has been dealt with in greatest detail. Up to a quarter can be considered as requiring minimal rehabilitation work (new development and bog remnant areas), while deep production areas will require extensive drain blocking (the least studied of the bog conditions). *Other areas* are covered under the decommissioning procedures and forested areas will remain under Coillte stewardship until further notice.

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Table 2 Percentage of habitats/bog conditions relative to the total area of the Oweninny boglands (6532ha)

Habitat/bog condition	Area (Approx.) ha	% Total area	[6]Habitat complex (Fossitt 2000)
Cutaway	1250	20%	PF2
Gravel areas (cutaway)	750	11%	ED1
Shallow production	1000	15%	PB3
Deep production	1000	15%	PB3
New development	1274	20%	PB4
Bog remnants	400-500	6-8%	PB4
Forestry	682	10%	WD4
Other areas	<100	<2%	

[4] This category can be further broken down into areas of minimal and extensive drainage impact (*see later*).
[5] NWRFB: *North West Regional Fisheries Board*
[6] The habitat types are assigned to habitat complexes as described in the classification system devised by *The Heritage Council* (Fossitt 2000). The assignment is considered justifiable on the basis of the dominant habitat represented within each complex, e.g. cutaway bog is assigned to ***PF2, Poor fen and flush***, as the dominant vegetation is poor fen although there are sporadic patches of other vegetation types occurring (*see later*).

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4.3 Rehabilitation of the Oweninny Boglands

4.3.1 Rehabilitation of cutaway bog, shallow production bog, areas of unstable peat and gravel hills (46% of total holdings)

The work carried out between 1996 and 1999 focussed largely on cutaway bog areas, the results of which are outlined here. This sub-section deals with the greater part of the Owenniny boglands that will require rehabilitation work. The habitat complex and/or bog conditions dealt with in this sub-section includes cutaway bog, shallow production bog (i.e. almost cutaway and may be exhausted of peat within the next two production seasons), areas of unstable peat on slopes and bare gravel hills.

4.3.1.1 A baseline ecological study of industrial cutaway Atlantic blanket bog (work completed 1996-1999)

A comprehensive baseline study of the cutaway bog was carried out to determine the present condition and the factors affecting revegetation of the peat fields (June 1997-August 1999, *this baseline study is described in detail in Farrell 2001 and a general overview is provided here*).

4.3.1.1.1 Physico-chemical conditions of the cutaway bog

The Bord na Móna extraction policy favours harvesting of as much peat as possible, until (a) peat is contaminated by the underlying substrate and ash levels exceed accepted ESB standards, (b) a layer of bog timber is encountered, or (c) continued drainage is no longer feasible. Industrial peat extraction at Bellacorick has therefore, resulted in a heterogeneous landscape of gravel hills and shallow peat. The cutaway fields are distributed among current production fields, with cutaway withdrawn from production on a yearly basis.

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The pH of cutaway peat fields ranges from pH 3.8 to 4.5. In peat-filled depressions, drainage water from the surrounding elevated areas provides some nutrient enrichment, with pH ranging from 5.0 to 5.5. Where isolated pockets of fen peat (usually less than $10m^2$) are exposed, peat pH ranges from 5.9 to 6.4. The cutaway peat fields have intact drainage channels, so that the fluctuating water-table remains below the peat surface for most of the year. On parts of the cutaway where peat was extracted until the underlying substrate was encountered, the underlying glacial till has been revealed. The glacial till comprises acidic gravel and sands that together are compacted and nutrient poor, with a pH of around 4.5. The cutaway bog therefore comprises an extensive area of acidic peat with isolated pockets of fen peat and gravel hills and ridges distributed throughout the sites[7].

[7] The Bellacorick bog complex has developed over a glacial landscape of eskers and kames. As the peat is extracted these glacial features are revealed. The underlying glacial geology at the Bangor site is less undulating.

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4.3.1.1.2 *Plant communities establishing on cutaway bog*

When peat fields are taken out of production they are typically devoid of vegetation, subject to fluctuations in water-table (where drainage channels are still intact) and the peat is generally compressed from the weight of machinery traversing the bog. Due to the nature of the underlying topography at Bellacorick, production and cutaway fields are interspersed amongst each other and it is therefore impossible to isolate cutaway fields hydrologically without affecting drainage of adjacent production fields (Fig. 4). The water-table of these shallow peat cutaway fields is therefore fluctuating and ideal for the spread of *Juncus effusus* (Soft Rush).

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Fig.4. *Juncus effusus* establishes in drains and then spreads across the cutaway fields. The peat field on the left is in production while the field on the right is cutaway, with *J. effusus* and *J. bulbosus* establishing. Colonisation of the cutaway generally begins within the first year of the field being taken out of production.

The classification system used here is that of the Braun-Blanquet approach, with reference to the system outlined by *The Heritage Council* (Fossitt 2000) for comparison. Under this system the cutaway bog complex habitat is assigned to the category ***PF2, Poor fen and flush*** (Fossitt 2000). This broad habitat complex is used, as poor fen is the most extensive habitat encountered within the cutaway complex with discrete patches of other habitats occurring sporadically throughout the poor fen vegetation.

In total, fourteen plant communities, including pioneer and rudimentary types, were recorded from the cutaway bog (Table 3). The most extensive plant community is a rudimentary poor fen type that is dominated by *Juncus effusus* with a bryophyte layer of *Campylopus introflexus* and *Polytrichum commune*. Poor fen vegetation is considered a precursor of ombrotrophic bog conditions and as such, is considered a replacement peatland community. The *Polytrichum* hummocks create a suitable micro-climate for hummock-forming *Sphagnum* species (Fig.5) while waterlogged pools are commonly colonised by *Sphagnum cuspidatum*.

Two cutaway plant communities that have established spontaneously where drainage has been impeded on the cutaway bog are considered as peat-forming communities (*Sphagnum*

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cuspidatum-Eriophorum angustifolium and Calluno-Sphagnion communities). Seven plant communities are considered as rudimentary forms of plant communities recorded from Atlantic blanket bog complexes. There are isolated areas of fen and grassland communities but these are restricted to areas where there are subtle differences in the nutrient content of up-welling springs and/or proximity to drainage waters.

Table 3. Plant communities (following Braun-Blanquet nomenclature, see White & Doyle 1982, with reference to Fossitt 2000) and associated habitat conditions that have established on industrial cutaway Atlantic blanket bog.

Habitat conditions	**Plant community (*after White & Doyle 1982*)**	**Plant community (*after Fossitt 2000*)**
Waterlogged peat	Pioneer *Juncus bulbosus* community Pioneer *Eriophorum angustifolium* community Litorelletea Typhetum latifoliae *Sphagnum cuspidatum-Eriophorum angustifolium* Calluno-Sphagnion	PF2 Poor fen and flush PB Bogs FL2 Acid oligotrophic lakes FS1 Reed and large sedge swamps PB Bogs PB Bogs
Frequent fluctuations in water-table	Pioneer *Juncus effusus* community Sphagneto-Juncetum Caricetum paniculatae	PF2 Poor fen and flush PF2 Poor fen and flush FS1 Reed and large sedge swamps
Dry peat	Calluno-Ericetum	HH1 Dry siliceous heath
Mineral soils/ploughed peat-mineral soil	Salicion cinereae Tussilaginetum Charetea Centaureo-Cynosuretum	WS1 Scrub ED3 Recolonising bare ground PF1 Embryonic rich fen GS1 Dry calcareous and neutral grassland

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Where peat remains on a slope (a common feature of the cutaway at Bellacorick due to the undulating sub-surface contours), there is little or no vegetation establishment. The peat is unstable and summer drying and high rainfall can lead to baring of the underlying hills. These bare gravel areas are assigned to the class ***ED1, Exposed sand, gravel or till*** (Fossitt 2000). The exposed gravel hills present a compacted, exposed and nutrient-poor habitat for colonising plants. These areas require rehabilitation measures to accelerate revegetation and stabilise any patches of remaining peat. It was noted that where the gravel had been disturbed (usually by Bord na Móna machinery) and small shelter ridges created, vegetation had established. Experimental work was carried out to examine the use of a number of measures to encourage vegetation establishment in these areas (*described later*).

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Fig.5. *Sphagnum subnitens* establishes through the ground layer of *Polytrichum* hummocks, forming epicentres of *Sphagnum* hummocks that gradually spread through the area. The *Sphagnum* patches are typically red (at the centre of the photograph) or pale green (right foreground).

4.3.1.2 Conclusions from the baseline study

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The vegetation survey of the cutaway bog provides (a) an outline of the plant communities that have established on industrial cutaway Atlantic blanket bog, and (b) the range of environmental conditions prevailing on the cutaway. The main features can be outlined as follows:

(i) Vegetation establishes relatively soon after peat fields are taken out of production (generally within one year).

(ii) The most extensive vegetation type establishing is poor fen (Sphagneto-Juncetum (PF2) dominated by *Juncus effusus*).

(iii) Where the water-table is at and/or above the cutaway surface and conditions are largely ombrotrophic, peatmosses (*Sphagnum* species) establish. In these areas, even on shallow peat, peat-forming communities occur spontaneously.

(iv) Vegetation is slow to establish on gravel areas and where peat is unstable, i.e. on sloping areas.

(v) Where small pools and ridges have been created on gravel hills or on areas of peat on slopes, vegetation (poor fen) establishes.

These observations illustrate the range of conditions on the cutaway bog and allow for the development of a set of criteria on which successful rehabilitation can be measured.

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4.3.1.3 Criteria for successful rehabilitation of the cutaway bog

Rehabilitation of the cutaway will be considered successful when the remaining peat of the cutaway fields has been stabilised, which will involve the establishment of a vegetation cover. Revegetation of the cutaway bog is therefore the primary objective (and basic criterion) of the rehabilitation programme (Farrell 2001; Farrell & Doyle 1998, 2003). While revegetation occurs with minimal active rehabilitation management on flat fields, rewetting of cutaway fields could result in more extensive development of replacement peat-forming communities (Farrell 2001; Farrell & Doyle 1998, 2003). Therefore, the secondary rehabilitation objective for the cutaway bog is to promote the establishment of peat-forming communities, where possible.

To reiterate, the criteria for successful rehabilitation of the cutaway bog are outlined as follows:

- Stabilisation of the peat production areas through revegetation and,
- *In turn* mitigation of potential peat run-off from the site.
- [8]Re-establishment of peat-forming communities where possible.

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[8] The establishment of peat-forming plant communities has been observed to occur spontaneously throughout the stands of *Juncus* as outlined.

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4.3.1.4 Developing rehabilitation measures for cutaway bog

In considering rehabilitation of the cutaway bog (cutaway, shallow production bog, unstable peat on slopes and gravel hills inclusive) at Bellacorick, a range of factors must be taken into account. It will not be possible to apply any one particular approach to the entire area, as there is such a broad range of conditions on site. While flat areas revegetate with relative ease, sloping gravel areas must also be taken into consideration.

Where peat remains on level surfaces, the primary aim will be rewetting and establishment of embryonic peatland communities. This will require blocking of the field drains at regular intervals and/or blocking main out-falls from production areas to flood areas of the cutaway.

Where peat is on a slope and/or the underlying mineral soil has been exposed, the primary aim will be to encourage revegetation that will stabilise the peat substrate. It will be impossible to restore embryonic peatland communities on the bare mineral soil substrate: the objective will be to encourage establishment of some form of pioneer vegetation that will provide shelter for further vegetation establishment and succession. *Therefore the rehabilitation objective will vary within the cutaway bog at Bellacorick depending on the substrate type and slope.*

4.3.1.4.1 Experimental rehabilitation trials

The general observations of the baseline vegetation study provided the basis for the selection of potential management strategies for each cutaway substrate type. A number of experimental trials were established to test the effectiveness of the rehabilitation measures. These are outlined below (*a more exhaustive description can be found in Farrell 2001 and Farrell & Doyle 1998, 2003*).

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Hydrological manipulations – rewetting flat areas of peat

A number of experimental rewetting sites were established on parts of the cutaway in 1997. One such site involved isolating an area of cutaway bog (approx. 0.5ha) that was relatively flat with a sparse cover of *Juncus effusus* (Fig. 6). The area was hydrologically isolated by constructing a peat ridge using a Komatsu dozer, which prevented run-off of water and maintained a high water-table (average 30cm over peat surface).

Within two years there had been extensive spread of *Sphagnum cuspidatum* and the vegetation shifted from rudimentary poor fen to an embryonic bog community (*Sphagnum cuspidatum-Eriophorum angustifolium*). The site was revisited in September 2002 and a 100% cover of *Sphagnum* was recorded (compared to approximately 30% in September 1999, Fig. 7). This demonstration area illustrates that flooding areas dominated by *Juncus effusus* or areas with patchy vegetation cover will create a habitat suitable for the establishment and rapid spread of *Sphagnum*, and therefore restoration of peat-forming conditions[9].

[9] It is generally accepted that flooding large areas is unsuitable for *Sphagnum* establishment. Previous research has shown that large water-bodies experience considerable wave-action. *Sphagnum* establishment requires focal areas from which to spread, e.g. *Juncus* tussocks and relatively shallow water. The conditions created in the experiment described above are ideal for *Sphagnum* spread. Relatively small flooded areas (site-specific) created throughout larger cutaway areas will promote the spread of *Sphagnum*.

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Fig.6. Experimental area before rewetting (August 1997). The vegetation was patchy with *Juncus effusus* and *Eriophorum angustifolium*. Total vegetation cover was approximately 40%. The peat was shallow (average 45cm), with numerous pine remains.

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Fig.7. Experimental area after rewetting (August 1999). A peat ridge was constructed around the experimental area to prevent water run-off. The vegetation cover increased to over 90%, with the greatest increase attributed to the spread of *Juncus bulbosus*. The water-table remained high and encouraged the spread of *Sphagnum cuspidatum*. The overall character of the vegetation is similar to the *Sphagnum-Eriophorum* community described from intact and cutaway bog.

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Surface sculpting - creation of pools and ridges

Manipulation of peat and gravel cutaway surfaces encourages plants to establish on areas that would otherwise be exposed. The sculpting of relatively flat surfaces creates a mosaic of pools and ridges where *Sphagnum* species may become established and also serve as core areas from which vegetation can spread across the cutaway bog.

A number of large pools (20m x 20m) were excavated from bare gravel slopes and shallow peat slopes on cutaway at Bellacorick in 1998 using a D6 dozer. Where springs were encountered these pools revegetated rapidly, predominantly developing a species-poor *Juncus bulbosus-Sphagnum* community. Pools with peat bases remain wet and provide hospitable conditions for invading plants. Where no springs are present the gravel bases dry out quickly and remain dry except during heavy rainfall. Grassland species establish in these areas. Although revegetation of these areas is particularly slow, after 5 years these areas have developed significant vegetation cover.

Ploughing on slopes

Ploughing along sloped areas using the blade of a D6 dozer has proven successful in promoting vegetation establishment on bare gravel and peat remaining along slopes. Gravel hills were ploughed so that the resulting ridges were approximately 1m apart, and depressions being half a metre deep. Ploughing created a series of ridges and furrows that provide shelter for plants, therefore increasing the vegetation cover in these areas. Initial colonisation is slow but steadily increases to cover an area within 3 to 5 years (see Appendix 2).

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4.3.1.4.2 Conclusions from experimental work

A number of conclusions can be drawn from the experimental work and two fundamental aspects have been shown to be useful for revegetation purposes at Bellacorick. These two simple tools form the basis of all the rehabilitation work that had been carried out on the cutaway bog.

Rewetting: Blocking drains and preventing water-run-off by means of peat ridges encourages the spread of the spread of *Juncus effusus* and more typical peatland species such as *Eriophorum angustifolium*, and ultimately the spread of *Sphagnum*. The outcome results in development of embryonic peat-forming communities and the experimental rewetting has proven successful in encouraging the spread of *Sphagnum cuspidatum* and the establishment of a typical peatland community within a relatively short period of time[10].

This rehabilitation tool can be applied to 50% of the Oweninny Works (approx. 1250ha of cutaway bog and up to 2000ha deep and shallow production bog). Field drains can be blocked and discrete areas flooded in up to 80% of the current production areas.

[10] It should be noted that rewetting is dependent on slopes. It is not feasible to rewet where the slope is too great, therefore, embankments will be constructed to stabilise the peat and it is likely that poor fen will establish.

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Ploughing: disturbance and ploughing of gravel and/or peat-covered slopes stabilises peat and increases vegetation establishment in areas that were otherwise slow to colonise. This rehabilitation measure will be appropriate approx. 11% of the Oweninny boglands (i.e. 750ha gravel areas).

4.3.1.5 Conclusion: rehabilitation of cutaway bog, shallow production bog, unstable peat and gravel areas

Most of the work to date has focussed on the cutaway bog, areas of unstable peat and gravel hills. The work on cutaway bog can also be translated to areas of shallow production bog. These areas in total account for 75% of the total production area and 50% of the Oweninny boglands, and have been utilised most intensively for peat production.

Based on the research conducted and general observations, Bord na Móna is confident that these areas will be stabilised within a relatively short period following cessation of peat extraction. The areas described in this sub-section will revegetate either through natural processes or through intervention in the form of the rehabilitation tools tested in the experimental work described here.

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4.3.2 Rehabilitation of deep peat production areas (15% of total holdings)

Deep peat production bog is largely concentrated in parts of the production areas that were brought into development in the last decade. The greater percentage of this bog type is concentrated in Areas 13 and 14 at the OAE1 site (Fig. 2). There are also scattered pockets in Areas S5, S4 and Area 10 (Fig. 8). At the OAE2 site, deep peat production areas are concentrated mainly south of the Owenmore River (Fig. 3).

There has been no experimental work conducted on these deep peat areas as they are regarded as most significant for peat production and are therefore essential to attaining the annual production yields.

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Fig.8. Deep peat production bog in Area 10. These areas appear in stark contrast to the patchwork nature of shallow production areas where cutaway fields are interspersed amongst production fields. The peat is relatively deep, generally more than 1m, and the drains correspondingly so. The underlying glacial features are recognisable by the rolling nature of the production bog. This habitat can be assigned to ***PB3, Cutover bog class.***

The rehabilitation aim in these areas will be to accelerate revegetation of the peat fields and stabilise these areas to reduce peat run-off. The surface peat of these production fields is generally less humified and therefore less susceptible to run-off in high rainfall periods than shallow, highly humified peat. The peat is also more fibrous and should re-colonise within a relatively short period owing to the seed bank contained in the peat. The proposed rehabilitation of deep peat production areas will involve blocking of each of the field drains at specific intervals (depending on variations in slope), in an attempt to raise the water-table relative to the peat surface and reduce large-scale fluctuations.

While there are no examples within the site to illustrate the timeframe within which this would occur, it is estimated that these areas should revegetate with relative ease. Demonstration areas to identify the rate of revegetation in deep production areas will be established as soon as possible to determine the success of potential rehabilitation measures. The vegetation is likely to develop *Molinia* and *Eriophorum* with minimal cover of *Juncus effusus*.

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4.3.3 Rehabilitation of bog remnants and new development areas

4.3.3.1 Bog remnants (up to 8% of total holdings)

There are a number of bog remnants distributed throughout the Oweninny boglands, ranging in size from 0.5-15ha. These are identifiable on Figs 2 & 3 (shaded red) surrounded by areas developed for peat production, or forming the margins of the holdings and acting as a buffer zone adjacent to rivers and roads. One of these bog remnants, the Bellacorick iron flush, has been described scientifically on a number of occasions as it is home to a number of species that are either extremely rare or have restricted distributions within Ireland and Europe in general. This bog remnant, which is a SAC, is described in greater detail later.

These bog remnants remained untouched by Bord na Móna as they were unsuitable for development under the original PECO method of peat extraction. By their nature they are typically drier than areas of extensive Atlantic blanket bog complexes, as there is generally a severe slope at some point within the remnant that inhibited the use of Bord na Móna peat harvesting methods.

The remnants are diverse in habitats and consequently floristically diverse. Almost the full range of habitats typical of Atlantic blanket bog complexes is found within these bog remnants. The typical condition comprises an area of Atlantic blanket bog vegetation (Pleurozio purpureae-Ericetum tetralicis) with a number of bog pools, some of which may be drying out at the margins of remnants and becoming colonised by *Eriophorum* and *Carex rostrata* (Fig. 9 & 10). There is generally a high point within the remnant that is dominated by either *Molinia*-grassland or dry heath. There may be occasional patches of willow scrub and rich fen vegetation. The remnants are usually bordered by a narrow fringe (up to 2m) of dry heath that indicates the margin of drying-out caused by the hydrological isolation of the remnant. A list of the habitat types recorded from the bog remnants at Bellacorick is outlined in Table 4. There are a number of plant communities recorded from these areas, all of which are assigned to the Braun-Blanquet and Heritage Council classification system. The vegetation complexes found within bog remnants can also be generally assigned to the ***PB4, Lowland blanket bog class*** (Fossitt 2000).

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The shrub species, bearberry (*Arctostaphylos uva-ursi),* more commonly found on highland areas, was found growing on one bog remnant (Farrell 2001). This is the only record of this species growing on low altitude blanket bog. These remnants provide a proximal source of local species and serve as a corridor for plant and/or animal species in an area where the local habitat range has been largely restricted. There is evidence of their use by red grouse (*Lagopus lagopus*), a species that currently has a limited and contracting distribution in Ireland.

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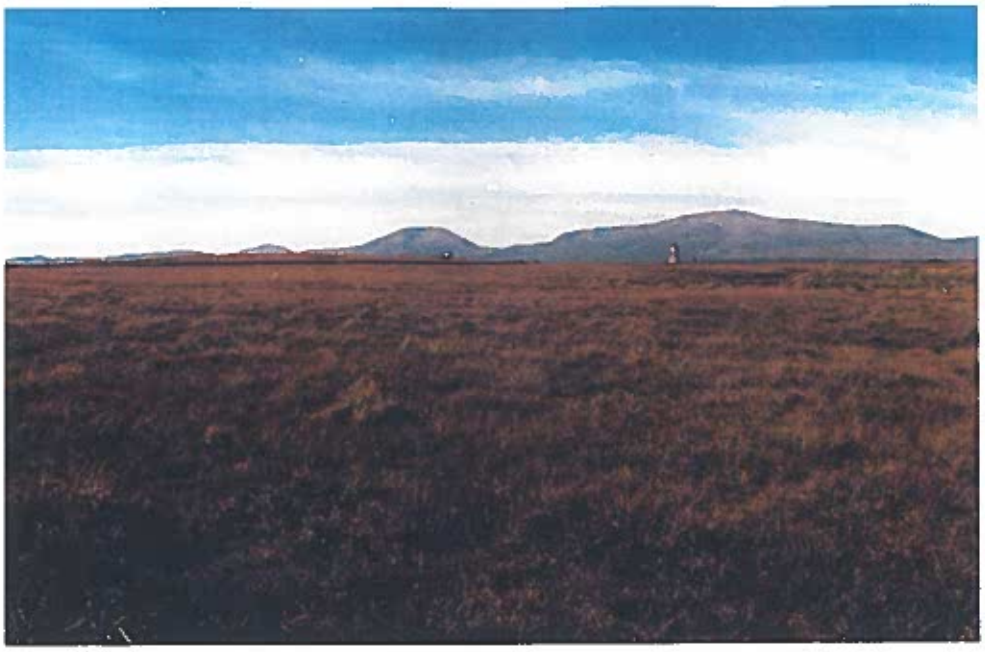

Fig.9. On large bog remnants at Bellacorick (up to 15ha), the vegetation is typical of more extensive Atlantic blanket bog complexes. A drainage channel running through this area (right-middle-ground) has been deepened to assist drying of the adjacent production fields, causing edge-drainage effects.

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Fig.10. *Sphagnum cuspidatum-Eriophorum angustifolium* community shown here established on a dried-out lake within a bog remnant. The lakebed has been almost completely covered by *Eriophorum angustifolium* with a bryophyte layer of *Sphagnum cuspidatum*.

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Some of these areas and parts of particular bog remnants are considered of botanical significance. Any disturbance or development within and/or in close proximity to these bog remnants would damage their botanical integrity.

There will be no large-scale rehabilitation required for any of the bog remnants. There may however, be scope for blocking drains that run through the remnants and /or restoring the previous water levels in bog lakes and pools. This has been conducted in one such area, Swan's Lough (*described later*).

Table 4. Plant communities (following Braun-Blanquet nomenclature, see White & Doyle 1982, with reference to Fossitt 2000) recorded from bog remnants within the Oweninny boglands.

Class	Order	Alliance	Association	Fossitt (2000)
Oxycocco-Sphagnetea	Eriophoro vaginati-Sphagnetalia papillosi	Calluno-Sphagnion papillosi	Pleurozio purpureae-Ericetum tetralicis	PB3 Lowland blanket bog
	Scheuchzerietalia palustris	Rhynchosporion albae	Sphagno tenelli-Rhynchosporetum albae	FL1 Dystrophic lakes
			Sphagnum -Eriophorum community	FL1 Dystrophic lakes
	Sphagnetalia compacti	Ericion tetralicis	Narthecio-Ericetum tetralicis	HH3 Wet heath
Calluno-Ulicetea	Vaccinio-Genistetalia	Genisto-Callunion	Calluno-Ericetum cinereae	HH1 Dry siliceous heath
Litorelletea uniflorae	Litorelletalia uniflorae			FL2 Acidic oligotrophic lakes
Scheuchzerio-Caricetea nigrae	Caricetalia nigrae	Caricion curto-nigrae	Sphagneto-Juncetum effusi	PF2 Poor fen and flush
	Caricetalia davallianae	Caricion davallianae	Campylio-Caricetum dioicae	PF1 Rich fen and flush
Phragmitetea	Magnocaricetalia	Magnocaricion	Caricetum paniculatae	FS2 Tall herb swamps
Franguletea	Salicetalia auritae	Salicion cinereae	Myricetum gale	WS1 Scrub
			Osmundo-Salicetum atrocinereae	WN7 Bog woodland
Molinio-Arrhenatheretea	Molinietalia	Junco conglomerati-Molinion	Junco acutiflori-Molinietum	GS4 Wet grassland
Nardetea	Nardetalia	Nardo-Galion saxatilis	Achilleo-Festucetum	GS3 Dry humid grassland

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4.3.3.2 Rehabilitation of new development areas (up to 20% of total holdings)

There are a number of areas of bog within the Oweninny Holdings that were ditched and drained in the 1980s and early 1990s with a view to extending the production area, both at Bangor and Bellacorick.

Peat was never harvested from these areas and they present various stages of drying-out Atlantic blanket bog with variable vegetation types. These areas are essentially stable as the vegetation was either never removed or the areas have been re-colonised. However, there is scope to block the field drains within these areas and encourage the areas both to rewet and retain *and/or restore* their Atlantic blanket bog condition. The vegetative conditions can be outlined as follows:

(i) Ditched and drained, but with a continuous vegetation cover comprising the full complement of Atlantic blanket bog species, e.g. Loughnahelly Bog (Fig. 11), the greater part of O'Boyle's Bog (Fig. 13) and Area 2 at the OAE2 site.

(ii) Ditched and drained in parts, screw-levelled to remove vegetation in marginal areas but vegetation re-colonising, e.g. parts of O'Boyle's Bog (Fig. 12).

(iii) Small, discrete areas that have experienced a greater drainage impact, e.g. adjacent Areas 13 and 14 (Fig.2).

In total, there are 1,274ha of new development bog between the Bangor and Bellacorick sites. The first two categories outlined above are hydrologically isolated from current production areas and are recognised as examples of degraded Atlantic blanket bog, but maintaining typical Atlantic blanket bog features with the potential to revert to a wetter situation if surface drains are blocked. This applies to 870ha of new development bog. The remaining areas are relatively small and scattered and there is greater evidence of drainage effects (extensive *Molinia* cover and establishment of *Calluna*).

A notable case is the Loughnahelly site that is located west of the Bangor production area and is essentially isolated from all other areas of production bog. Loughnahelly Bog comprises more than 300ha of Atlantic blanket bog that was ditched in 1982 with no further work carried out since. There is a continuous vegetation cover in this area with the full complement of Atlantic blanket bog vegetation. Blocking of drains in this area would encourage the recovery of the site and stop any potential peat run-off. Some experimental work has been established on O'Boyle's Bog to examine the effects of blocking drains in these areas[11]. However, it is generally accepted that Loughnahelly, O'Boyle's and Area 2 at the Bangor site, which are the least developed of the production areas, could revert (with drain blocking) to truer examples of Atlantic blanket bog complexes.

The general aims in rehabilitating new development bog are:

(i) To prevent further drying-out of the bog

(ii) To encourage re-establishment of typical Atlantic blanket bog vegetation

(iii) To minimise the run-off of peat into the associated silt ponds, particularly in high rainfall periods.

[11] Further work will be continued following consultation with Dúchas and restoration experts within Bord na Móna.

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Fig.11. Loughnahelly bog was drained in the early 1980s. The area still retains typical Atlantic blanket bog features and may further revert to its original condition through blocking of drains.

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Fig.12. O'Boyle's bog was drained in the mid-1990s. This photo shows a field that is drained and the surface vegetation removed. The field is re-colonising with *Eriophorum*, patches of *Schoenus* and other typical bog species.

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Fig.13. O'Boyle's Bog comprises intact bog and bog that has been drained. In the foreground can be seen intact bog. A number of pools are found in this area indicating that the area is relatively intact. Blocking drains in the ditched areas would lead to rewetting of these areas and a return to relatively intact Atlantic blanket bog.

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4.3.3.3 Conclusions: rehabilitation of bog remnants and new development areas

Both of these habitat types are considered stabilised already. These areas were never included in peat production areas and the surface has well-established vegetation. Within bog remnants, there may be minimal rehabilitation work required to restore water levels in bog lakes and pools, however it is generally accepted that a policy of no interference is the best approach to these areas.

New development areas have been drained extensively and in some places the surface vegetation damaged. These areas are however, considered stable. Rehabilitation will involve blocking of field drains to prevent further drying-out of the bog habitat and in some places the degraded Atlantic blanket bog may return to its former (pre-drained) condition. Further work will be initiated following consultation with Dúchas and Bord na Móna restoration experts.

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4.3.4 Consideration of the SACs located within the Oweninny Holdings

There are a number of SACs located within the Oweninny Holdings. These are as follows:

- Bellacorick iron flush
- L. Dahybaun
- Knockmoyle SAC complex

4.3.4.1 Bellacorick iron flush

The scientific importance of Bellacorick iron flush was first recognised by Mr. T.A. Barry of Bord na Móna in the late 1950s. Mr. Barry highlighted the uniqueness of the flush area and the site was subsequently transferred to An Taisce ownership for conservation purposes. A number of rare species and species with restricted distributions in Ireland have been recorded from the flush area, highlighting the rich habitat diversity that pre-existed the industrial development of the site (Doyle & Foss 1986; King 1958a, 1958b; Lockhart 1987, 1989a, b, 1999; Scannell 1958; Synnott 1970). The ownership of the site was transferred to An Taisce, who remain the current owners. Dúchas also own the peripheral area of the bog remnant, which comprises a buffer vegetation area around the flush proper.

The main feature of the flush is the presence of *Saxifraga hirculus* and a suite of bryophytes that are classed as boreal relics (Lockhart 1987, 1989a, b, 1999). The conservation value was first highlighted in the 1950s when four rare mosses (*Homalothecium nitens, Drepanocladus exannulatus* var. *rotae, Meesia tristicha* and *Sphagnum teres*) and the marsh saxifrage (*Saxifraga hirculus*) were recorded (King 1958a, b; Scannell 1958). The moss, *Meesia tristicha*, appears to have become extinct from the site and this may be attributed to drying of the area (Lockhart 1989b). The marsh saxifrage is protected under the Irish Flora Protection Order 1987 and listed under Annex II and IV of the EU Habitats Directive. The plant has been recorded from five sites in Ireland, one in County Antrim and four in County Mayo (Curtis & McGough 1988; Lockhart 1989b). Other rare species recorded from the site include the marsh fern (*Thelypteris palustris*) and the bog orchid (*Hammarbya paludosa*) (Synnott 1970).

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While the area has been fenced off from the surrounding Bord na Móna production bog, drainage of the surrounding peat production area and the island nature of the iron flush may be resulting in the progressive drying of the site. A survey was carried out to determine the distribution of *Saxifraga hirculus* within the flush in August 2001. More than 100 hundred flowering plants were recorded (C.A. Farrell, pers. obser.). The population may in the future however, be threatened by drying out of the flush. A study carried out in June 2001 as a follow-up to a similar study in 1982 indicates that the *Phragmites* population distribution is contracting (John Cross, pers. comm.). It is uncertain what this indicates, but it is likely that it indicates a drying out of the flush in general.

Dúchas and An Taisce have been notified of the development of the rehabilitation plan for the Oweninny boglands. Dúchas is currently developing a management plan for the site and this will be implemented following the consultation process.

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4.3.4.2 L. Dahybaun

This SAC is a large water body that is notable for the presence of *Naijas flexilis*, the slender naiad. L. Dahybaun is one of thirty recorded sites of the Slender Naiad, which is a red data species: considered rare in Ireland and in decline across Europe (Curtis & McGough 1988).

Other special botanical features within the area of the lake are the presence of two heathers of restricted distribution in Ireland and another Annex II species. These species are situated in and around L. Dahybaun, which is bounded by hand-cut turf areas to the south, commercial forestry to the east and milled peat fields to its north. The hybrid *Erica x stuartii* (*Erica mackiana x Erica tetralix*) was recorded growing close to the south edge of the lake, on a sloping area of intact bog. *Erica mackiana* was also found growing in abundance within close proximity on an area of extensive bog, south of the N59 (Van Doorslaer 1990).

There are no plans for any developments adjacent to L. Dahybaun and Bord na Móna will comply with the management guidelines set out by Dúchas for the site.

4.3.4.3 Knockmoyle SAC Complex

There is an area of Atlantic blanket bog that remains within Bord na Móna ownership that has been designated SAC. This SAC is located in the north-east corner of O'Boyle's Bog, adjacent to the Knockmoyle nature reserve but hydrologically separated from the Knockmoyle site by the Sheskin River. This SAC is an area of intact Atlantic blanket bog that is currently part of an area of new development bog. There was some drainage work carried out on O'Boyle's Bog in the mid-1990s, however the site was never fully developed for peat production except for the south-east corner (20 fields, see Fig.2 and previous description of new development areas).

A management plan for this area will be drawn up in consultation with Dúchas.

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4.3.5 Rehabilitation (Decommissioning) of *Other areas*

Both rehabilitation and decommissioning of the Oweninny boglands are dealt with in Condition 10 of the IPC licence. Decommissioning covers all areas of general hygiene within the Oweninny boglands: removal of machinery and potentially hazardous material, lifting of railway lines, silt control, remediation of watercourses, etc. The general decommissioning procedure as outlined by Bord na Móna and accepted by the EPA is outlined below and will be carried out in conjunction with the rehabilitation of the Oweninny boglands. However, they are recognised as separate procedures within the closure of the Oweninny Works. The main areas of concern can be broken down into:

- Silt control and remediation of watercourses
- General hygiene and elimination of potential pollutants

4.3.5.1 Silt control (decommissioning procedure with respect to watercourses)

Rehabilitation of the Oweninny boglands is closely linked with silt control. One of the criteria for successful rehabilitation is stabilisation of the Oweninny boglands through revegetation, which will stabilise all substrates and in turn remove the need for further silt control measures.

Drainage is an important feature of the operation of the peat production mechanism at Bellacorick and Bangor. There is an estimated 3000 km of field drains between the two sites, each of which eventually drains into a terminal silt pond that allows for settlement of suspended solids before entering the main river systems. There are currently 171[12] silt ponds in operation within the Oweninny boglands. The silt that builds up in these ponds is excavated on a regular basis by Bord na Móna to facilitate an efficient level of silt control. An extensive study was completed in 1999 to describe the different sub-catchments identifiable at the Bellacorick and Bangor sites. The location of each of these silt ponds and an outline of the catchment facilitated by each silt pond has been outlined and submitted to the EPA as part of the IPC Licence application.

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There are a number of streams and rivers draining the Oweninny boglands. The main rivers draining the Bellacorick site are the Sheskin, Ballymonnelly, Oweninny, Muing, Shanvolahan and Cloonaghmore rivers. The tributaries of these rivers include the Muingamolt, Muingaleeaun, Sruffaunamuingabatia, Fiddaunfura, Fiddaunagosty and Fiddaunmuinggeery. The courses of the majority of these tributaries have been altered through the development of the drainage network for peat production purposes. The main rivers draining the Bangor site are the Owenmore and Munhin Rivers.

The primary concern in relation to watercourses is the prevention of silt run-off into streams and rivers within and adjacent to the Oweninny Works. Other issues have been raised by the NWRFB, including (a) concerns that rehabilitation methods will alter the current discharge and flow regimes, (b) monitoring of discharges and (c) removal of silt build up in rivers and streams on- and off-site. These issues will be dealt with here, although in some areas there can be no definitive response until a comprehensive survey of the streams and rivers is conducted.

[12] 133 silt ponds at OAE1, 38 at OAE2.

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4.3.5.1.1 Silt control: developing replacement silt settlement areas

As outlined already, the main criterion of the rehabilitation plan is stabilisation of the Oweninny boglands. While this will allow the area to blend with the surrounding Atlantic blanket bog landscape, it will also mitigate against potential peat run-off from the site following cessation of peat extraction.

It is the aim of the rehabilitation plan to slow the movement of water through the peat production areas through (a) blocking of field drains, (b) creation of open water bodies in depressions and (c) developing replacement siltation areas for terminal silt ponds. Each of these aspects will work in tandem with the current flow regimes and sub-catchment areas identified on the site. At no point will Bord na Móna be altering groundwater flow regimes and as such a hydrological assessment of the site is considered un-necessary.

The rehabilitation plan for both Bellacorick and Bangor sites will involve blocking of the main out-falls and flooding areas of the cutaway – production bog complex. This serves a number of purposes. These are outlined as follows:

1. Establishment of replacement siltation areas that will with time overtake the functions of the current silt ponds
2. To facilitate raising the water-table within the cutaway – production bog complex to allow for development of replacement wetland communities.

Each of the silt ponds and associated main out-falls within the Oweninny Works will be characterised (currently underway). The location of the lowest point at which water will spill out into the watercourses off-site will be determined before any out-falls are blocked to ensure that the banks are substantial enough to withhold an increased volume of water. This is a noted concern of the NWRFB. Bord na Móna recognise that there will be some areas that this approach will not be practical and where this is the case, replacement siltation areas will be located further back from the terminal siltation area where conditions are appropriate.

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Bord na Móna is confident that the water-flow can be manipulated to filter the water sufficiently and without damage to existing river and stream-banks by this method. In the interim, Bord na Móna is undertaking to maintain the excavation of silt ponds at both the Bellacorick and Bangor sites until such time as they are no longer required (i.e. there is no further threat of silt run-off from the sites). The duration of this silt control is not known, and will be subject to EPA approval. However, as the peat production areas become revegetated and the peat on-site is stabilised there will be minimal levels of peat leaving the Oweninny boglands. This work will continue with continued consultation with the NWRFB to take full account of the issues of concern identified to date. Run-off from the site is currently monitored as a condition of the IPC Licence. Monitoring will continue at the intensity considered appropriate by the EPA.

Once silt excavation is deemed un-necessary, the silt ponds will remain undisturbed, *in situ*. When silt ponds become redundant, they quickly revegetate and naturalise. By means of vegetation establishing in the ponds, a further silt control mechanism is evoked, as water passing through these areas is filtered before entering main watercourses.

Where silt ponds are located on streams, the water will be re-diverted out of the silt pond to return either to the previous pathway of the stream and/or river or a newly excavated pathway. Where necessary, banks will be rebuilt and graded to mimic natural banks. There

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are silt ponds located on the Sruffaunamuingabatia, Muing and Ballymonnelly Rivers. These silt ponds will continue in use until such time as they are no longer required as a siltation mechanism. Following this, remediation of banks and diversion of the streams out of silt ponds will commence.

4.3.5.2 Other issues of concern with respect to watercourses

An ecological assessment of the Oweninny, Owenmore and Muing rivers will be conducted to determine whether there is a requirement for remediation measures of these rivers. This study will be completed by September 2003[13]. The results of this survey and agreed actions will be presented in a report separate to the rehabilitation plan.

Other issues such as future management of the Bellacorick Fishery will be addressed following further consultation with the NWRFB.

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[13] The survey will be conducted by Dr. J. Caffrey of the Central Fisheries Board.

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4.3.5.3 General hygiene and elimination of potential pollution (as approved by EPA)

Purpose

The purpose of this procedure is to ensure that Bord na Móna Energy Ltd. will take all the necessary steps to protect the environment from pollution, following termination of use or involvement of all or part of the site in the licensed activities. Bord na Móna Energy Ltd. shall decommission, rendering safe or remove for disposal/recovery, any soil, subsoils, buildings, plant or equipment, or any waste, materials or substances or other matter as listed in Table 5, contained therein or thereon.

Scope

The scope of this procedure covers the following locations.

- Tea-centres
- Workshops
- Transport Centres
- Out loading facilities
- Offices

[14]Decommissioning of the bog, and associated tea-centre, workshop, out-loading & offices will commence in accordance with the Decommissioning Schedule as outlined in Table 5 below. It will take place either before implementing the agreed cutaway bog rehabilitation plan or during implementation of the plan, depending on the facilities and services required to carry out the plan.

Depending on the commercial reality and conditions at the time, a Bord na Móna site may also be offered for sale.

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4.3.5.4 Conclusion: decommissioning of the 'Other areas' *within the Oweninny boglands*

While rehabilitation of the Oweninny boglands is considered a separate issue to decommissioning, there is a certain amount of overlap with respect to silt control and mitigation of peat run-off. Bord na Móna is committed to maintaining silt control measures until such time deemed appropriate by the EPA.

In the meantime, an integral feature of the rehabilitation plan involves the establishment of replacement siltation areas that will complete the functions of terminal and other silt ponds and lead to a redundancy of the silt ponds, which will in time, naturalise. There will be no alteration of flow regimes between sub-catchments or groundwater flow. Where silt ponds are located on streams and rivers, the watercourses will either be diverted around the silt ponds or the ponds will be remediated to mimic natural bank conditions. This can only be conducted when there is demonstrably no further requirement of these ponds.

[14] Depending on approval of the wind farm proposal, some of the tea-centres and workshops may be required during the construction period of the wind farm.

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Table 5. Decommissioning Schedule

Items for removal/disposal/recycling or re-use.	**Removal Period following termination of use.**	**Method of Disposal/Recovery**
Oil/Diesel/Petrol Tanks	6 months	Agreed recycling contractor or Re-use
Oil/Diesel Barrels	3 month	Agreed recycling contractor or Re-use
Waste Oil	3 month	Agreed recycling contractor
Oil Filters	3 month	Agreed recycling contractor
Oil-traps/interceptors	6 months	Agreed recycling contractor or Re-use
Grease Drums	3 month	Re-use or Disposal
Batteries	3 month	Agreed recycling contractor or Re-use
Anti-freeze	3 month	Re-use
Fluorescent Lights	3 month	Agreed recycling contractor or Re-use
Scrap Metal	6 months	Agreed recycling contractor
Scrap Machines/Parts	12 months	Agreed recycling contractor or Re-use
Rail Lines/Switches	6 months	Agreed recycling contractor or Re-use
Septic Tank & Puraflo	12 months	Removal & Disposal/re-use
Polythene	6 months	Balled and Recycled – Agreed recycling contractor
Geo-membrane	3 month	Re-use
Buildings	12 months	Demolition and Disposal
Portacabins	12 months	Re-use or Demolition
Fencing	12 months	Removal and reuse/disposal
Wooden Pallets	3 month	Disposal or Re-use
Swamp Shoes	3 month	Re-use or Disposal
Ash/Cinders	6 months	Disposal
Canteen Waste	3 month	Disposal – Waste Contractor

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4.4 Summary of Rehabilitation Methods

The main habitats and/or bog conditions and proposed rehabilitation methods have been outlined. To summarise:

- Cutaway bog, shallow production bog, unstable peat and gravel hills have been studied at the greatest level. Vegetation establishes relatively quickly on shallow peat and these areas will be dominated with poor fen vegetation (Sphagneto-Juncetum) that may with time develop into ombrotrophic peat-forming plant communities. Areas of unstable peat and gravel hills are slower to revegetate and will require more intensive rehabilitation management, such as ploughing and/or construction of embankments. These categories account for up to 75% of the total production area and therefore the most rehabilitation sensitive (50% of total holdings).
- Deep peat production areas have been least studied however, it is estimated that with blocking of the field drains, vegetation should establish with relative ease. The vegetation will be dominated by *Molinia*-grassland, with *Eriophorum* and probably reduced occurrence of *Juncus* (25% of production area, 15% of total holdings).
- Bog remnants and new development areas are considered stable entities (27% of total holdings). Bog remnants require a policy of avoidance and therefore require minimal management. New development areas will require blocking of drains to facilitate rewetting and renaturation of these areas.
- Future management of the SACs located within and adjacent the Oweninny Works will be outlined by Dúchas in the appropriate site management plans. These are currently in preparation and Bord na Móna will comply and assist where possible with their implementation
- Silt control measures will continue at both the Bellacorick and Bangor sites until such a time, as there is no further run-off from the site. This will involve the establishment of replacement siltation areas within the Oweninny boglands. As revegetation of the boglands progresses there will be minimal peat run-off and silt ponds will naturalise. Streams with silt ponds located on their course will be diverted and/or banks will be remediated.
- *Other areas* such as tea-centres and removal of wastes will be decommissioned appropriately following and during closure of the Oweninny Works.
- Conifer plantations will require no rehabilitation management and the future of these stands will depend on the owner, Coillte, to decide time of harvesting, future management, etc.
- The rehabilitation of each habitat and/or bog condition will be completed within two years of cessation of peat production at the Oweninny Works. Practical aspects of the rehabilitation plan are discussed in the next section.

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5 PRACTICAL ASPECTS – OUTLINING A REHABILITATION PLAN FOR THE OWENINNY WORKS

The baseline ecological study and the experimental trials carried out on the cutaway bog (1996-1999) and subsequent consideration of the remaining habitat and/or bog condition types, have provided the backdrop for development of a large-scale rehabilitation programme. Aspects of this programme were initiated in March 2001 and some of the work completed to date is described here. The remainder of the work and an estimated timeframe for completion of the rehabilitation tasks is also outlined.

5.1 Quantifying the Work Required on Site to Rehabilitate the Oweninny Boglands

The distribution and extent of the main habitat types are outlined in Figs. 2 and 3. These maps show production bog, cutaway bog, new development bog, bog remnants and conifer plantations as well as the main hydrological features of the site. In addition to these maps, the aerial photographs for the OAE1 and OAE2 sites clearly show the variation in conditions on the ground (Fig. 14 & 15). The aerial photographs can be related to Fig. 2 & 3, and illustrate the diversity of the Bellacorick Holdings: gravel areas, revegetating cutaway bog, new development, etc.

An attempt is made here to (a) outline the machinery and resources required for rehabilitation of the Oweninny boglands, and (b) to describe some of the work completed and the insights provided by this work to date.

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5.1.1 Rehabilitation work required for the totality of the Oweninny boglands: machinery and resources required

The rehabilitation methods have already been outlined. In order to conduct this work however, specific machinery is required for each rehabilitation measure.

Rehabilitation work has involved a range of machinery, primarily dozers (D6 and D4) and excavators. A D6 dozer was purchased by Bord na Móna in April 2002 and has been applied solely to rehabilitation at the Oweninny Works. This machine has been working primarily on rehabilitating gravel areas however, when drying conditions are good, it can be used to work on shallow bog areas to construct embankments and block drains. In general a lighter machine is required for this work such as the D4 dozer. This machine is more suitable for blocking drains as it works in a wider range of weather conditions. An excavator has been used to block drains on deep peat and new development areas. In summary, a D6 dozer is required for rehabilitation of gravel areas, a D4 dozer (or a dozer of similar size and track width) for blocking field drains and outfalls in former peat production areas and an excavator for filling in drains in deep-peat production areas. The excavator may also be used for blocking drains on bog remnants.

There are a number of excavator and D4 machines already on site that will be available for rehabilitation work once peat production ceases at Bangor and Bellacorick, and in some cases machinery may become available as production comes to a close in Bangor in September 2003. An estimate of the total time required to complete the rehabilitation work in each habitat and/or bog condition type is outlined in Table 6. The estimate is based on work completed and one machine working continuously on each habitat and/or bog

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condition type. This estimate will be taken into consideration when outlining the timeframe of rehabilitation at the Oweninny Works[15].

Table 6. An estimate of the total time required for rehabilitation of each habitat and/or bog condition type, and machinery required to complete the work.

Habitat/bog condition	Area (Approx.) ha	% Total area	Machinery required	Rehabilitation time (days)
*Cutaway	2250	35%	Dozer	300+*50*
**Gravel areas	750	11%	D6 Dozer	425+*50*
***Deep production	1000	15%	Excavator	250+*50*
***New development	1274	20%	Excavator	300+*50*
† Bog remnants	400-500	8%	Excavator	90+*50*
†† Forestry	682	10%	N/A	N/A
‡ *Other areas*	50-100	1-2%	Silt excavators	N/A
‡‡ **Total**				**1,365+200**

**Cutaway includes current cutaway bog and shallow production bog. Estimated time is based on 10ha rehabilitation work per day (blocking field drains)*
***Rehabilitation work on gravel areas will be largely completed by January 2004. This total includes up to 200 days of rehabilitation work already completed on gravel areas.*
****Based on an estimate of 5ha of bog rehabilitated per day*
† *Minimal work will be required on bog remnants*
†† *Coillte is responsible for forested areas*
‡ *Decommissioning of other areas will require a range of machinery to lift railway lines, maintain silt control, remove rubbish and other aspects outlined in Table 5.*
‡‡ *An additional period of time is incorporated into the total figures to compensate for unforeseen weather and working conditions.*

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The greater part of the rehabilitation work will be required in former production areas. Each production area comprises a range of habitats and therefore a number of rehabilitation methods may be employed in any one area. An example of how this rehabilitation will be approached is outlined in section 5.2.1.

[15] It should be noted that the estimate provided (Table 6) of days for rehabilitation is simply an outline of the man-hours required to complete the work and **not of the duration of rehabilitation work**. Some of the rehabilitation work will be dependent on the time of year, weather conditions and/or other unforeseen occurrences. The rehabilitation approach employed at the Oweninny Works will involve initial rehabilitation work followed by monitoring of the success of the rehabilitation work (sometimes over a period of up to a year, which may be shorter or longer). This may be followed by further re-enforcement of peat embankments, additional rehabilitation measures, etc., if deemed necessary. It is important to recognise that the work will also be phased. For example, diversion of streams from silt ponds is dependent on the need for the silt pond to be maintained. It is estimated that silt control measures will continue for a number of years following cessation of peat production. Therefore, certain aspects of rehabilitation and/or decommissioning will be phased over a number of years following 2004.

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5.2 Rehabilitation Work Completed to Date

Extensive areas of cutaway bog have already revegetated across the Bellacorick and Bangor holdings. More than 50% of the cutaway bog eliminated to date has a vegetation cover, while more recent cutaway or areas where glacial till has been exposed currently have no vegetation (Table 7). The greater portion of the current cutaway bog area comprises flat fields that already have extensive vegetation cover (predominantly poor fen). Most of the revegetation has occurred at the Bellacorick site and this corresponds with the greater proportion of cutaway bog. The revegetated areas can be clearly seen from the aerial photograph (Fig.14).

Table 7. Breakdown of cutaway bog[16] revegetated areas (OAE1 and OAE2 inclusive).

Cutaway	Total	Revegetated	Rehabilitated	
	ha (approx.)	%	ha	%
Gravel	750	10	500	67
Flat peat areas	1250	75	453	35
Total	**2000**	**50**	**953**	**51**

In total, rehabilitation work has been carried out to date on areas of cutaway bog (more than 453ha – 35% of 1250ha), gravel hills and areas of unstable peat on slopes (67% of 750ha). To date 50% of the current cutaway bog area has been rehabilitated and will continue to be monitored to assess success of the rehabilitation work. This represents almost 25% of the total production-cutaway bog area. Approximately 50% of the cutaway bog has already revegetated to some degree, the greater proportion being on flat areas where there is a layer of peat remaining.

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Ploughing of gravel hills is ongoing at Bellacorick. To date, gravel areas in Areas 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 4A, Rail 17A-18A, Rail A-B, C, D, F, S1C, S2A, S2B, S4 have been rehabilitated. This technique (*described previously*) has proven successful on other gravel areas to encourage vegetation establishment on otherwise bare areas.

Work is ongoing on gravel areas and will be completed by 2004, while possible work on other cutaway areas has been largely completed. It is generally impossible to carry out any rehabilitation work on cutaway bog situated within active production areas, as there may be a likelihood of preventing free-drainage of adjacent production areas. This is not considered problematic, as these areas are quick to revegetate once taken out of production. Gravel areas, however, are relatively easy to access for rehabilitation work with machinery, as high points are easily isolated from production areas and have no impact on drainage. Gravel hills are also slower to colonise and therefore, active rehabilitation management is a pre-requisite.

[16] Cutaway refers to that area considered as cutaway at the time of writing. It does not refer to the totality of the Oweninny boglands.

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5.2.1 Test areas to demonstrate the effectiveness of rehabilitation tools

5.2.1.1 Area 3 (Rail 14-18) (see Fig.2)

The existing wind-farm at Bellacorick was established in an area that encloses 90ha of cutaway bog. This area is effectively isolated from current production bog and provided an opportunity to monitor rehabilitation measures on a larger scale than previously studied. A site plan was developed for this area, providing a template for future rehabilitation of unit areas of bog. The approach has involved the following steps:

1. Mapping of habitats, vegetation types present and total vegetation cover to date within the area
2. Mapping the main outfalls and high points
3. Outlining the rehabilitation tools required in each part of the area
4. Carrying out the work required (ploughing, drain blocking)
5. Monitoring vegetation and hydrological changes

The work commenced in March 2001: gravel hills were ploughed using a D6 dozer and field drains were blocked using a D4 dozer.

Blocking of field drains has slowed down the movement of water though the area and leads to reduced drying-out of the peat fields. A peat ridge was constructed across ten production fields to further slow down the movement of water (shown as point **B** in Fig. 16). Excess water spills over into low points within the area, which are either blocked by high peat fields or are the main out-fall areas. All out-falls from this area have been blocked and this has led to the creation of four open water bodies, the largest water-body covering 2ha and reaching depths of 2m in places (shown as point **A** in Fig. 16). The level of that water-body is maintained by an out-fall that was excavated in the adjacent high field. All water from the 90ha cutaway catchment enters the most southern water-body (Fig. 17), and any peat that may be carried in the water settles in the water-body.

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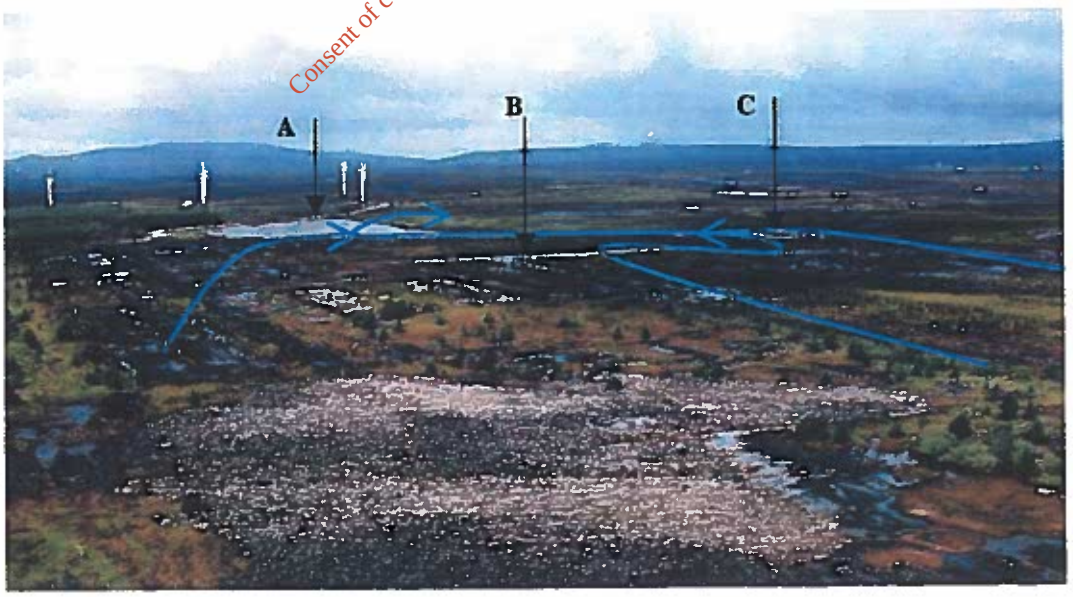

Fig.16. An aerial view of the rehabilitation work completed in the south-west part of Area 3. The gravel areas were ploughed and are starting to revegetate. The direction of water-flow in this area is highlighted with the blue lines. All of the water enters the terminal water body at the south-west corner (**A**). Water flows south-westerly through the water body marked **B**, turns in a north-westerly direction to water body **C**, into the water-body at **A** and in turn into the River Muing.

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Fig.17. The terminal water body in Area 3. All of the water in the catchment enters this artificial water-body that was formed by blocking the main out fall that flowed underneath the high field on the left of the picture. Water exits at the left middle ground of the picture into the R. Muing. Any peat carried in the water settles in the water-body before exiting the catchment. The levels of suspended solids and total solids are currently being monitored to validate this.

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The total vegetation cover in the area was 60% before rehabilitation commenced. Initial, sparse colonisation occurred within the first growing season and is expected to increase steadily within three years (based on previous studies). Fixed-point photography is used to monitor large-scale vegetation changes and the site was photographed from a number of viewpoints to keep a visual and easy reference guide to vegetative changes in the area. The results to date reflect previous observations – *Juncus bulbosus* spreads rapidly in shallow water and otherwise vegetation changes are slow, particularly where the levels of fields are variable (high fields adjacent low fields, or a difference of up to 30cm between adjacent fields).

A number of general observations were made and these are outlined briefly here:
High fields – blocking of field drains may hold enough water to keep these fields saturated in wet periods although excess water generally spills over onto adjacent lower fields. Where high fields are considerably high relative to the adjacent fields, these high fields may be used to facilitate flooding of discrete areas.
Volume of water – blocking field drains and main outfalls is effective in slowing down the movement of water through an area. As vegetation cover increases there will be an increased retention time of water within the peatland system, thereby leading to a reduction in the frequency and magnitude of spate events in streams draining the site.
Prevention of flooding - there is a constant flow of water through Area 3 and the water level is maintained relatively constant by an outfall excavated through the adjacent high field and intact bog margin. Initially, this out-fall was ineffective and led to flooding of the wind-farm road in high rainfall periods. Widening of the outfall from 1m to 2m in width

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ameliorated that situation. The width of the intact bog margin over which the water is flowing is 50m. There is no danger of this margin becoming destabilised.
Sloped fields – a number of peat fields are sloping and blocking of field drains may not hold water in situ throughout the year. In these areas ridges have been constructed perpendicular with the slope. It is hoped that these ridges will slow down the movement of water and allow for rewetting that will encourage revegetation and prevention of peat movement.

September 2002 Update

A number of additional works in Area 3 were completed between Sept 2001 and Sept 2002:

1. A gravel hill was dozed out along Rail 17 in order to flood the south-east corner. The area has flooded and there is up to 0.5m of water in some areas. It is anticipated that these flooded areas will become colonised with floating rafts of *Sphagnum* in the next few years (Fig.18).
2. Flood control – there were difficulties arising with flooding of the wind-farm road in the south-west corner. The embankment along the road was strengthened and improved at weak points using a Hitachi excavator.
3. An excavator was also used to excavate the water path between pools to reduce the potential levels of peat that would be carried in the stream.

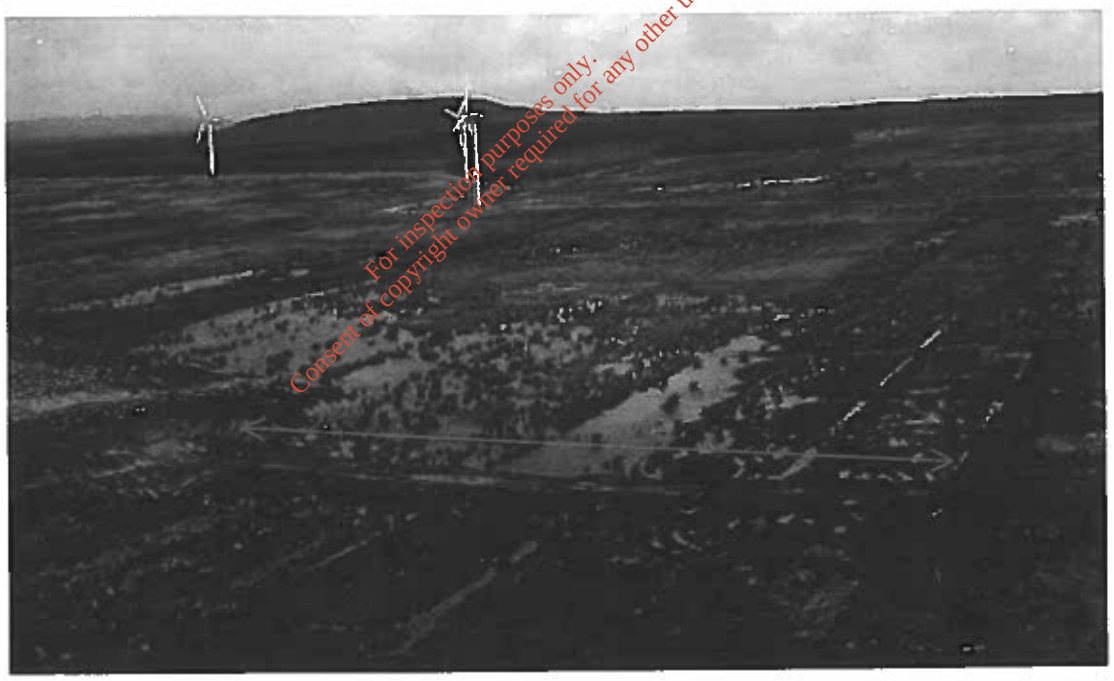

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Fig.18. A gravel hill was dozed across 5 peat fields to create an open water area shown above (indicated by the red arrow). This was created on basis of previous experimental work where flooding of *Juncus* stands resulted in the expansion of *Sphagnum cuspidatum*.

As anticipated, vegetation cover within Area 3 has increased. In general high fields remain slow to colonise, nonetheless there are sparse populations of *Eriophorum angustifolium* establishing and these will spread further in coming years. Areas with shallow water have been colonised by rafts of *Juncus bulbosus*, with fragments of *Sphagnum cuspidatum* frequently occurring in these pools. The water exiting the system at the lowest point is free of suspended solids, indicating that there is no peat leaving the system and entering

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watercourses. The banks remain stable while the water is still finding a suitable level to enter the stream.

5.2.1.2 Rail 17A-18A and Swan's Lough

This area comprises approximately 20ha and was also isolated from active production areas. The area is notable, as it lies adjacent to a bog remnant and drained lakebed (see Fig.2). This site (including production area, bog remnant and drained lake) is interesting for the following features:

- *Arctostaphylos uva-ursi* was recorded on the bog remnant – this is the first recording of the bearberry on low-level Atlantic blanket bog. It is generally a feature of upland heath.
- St. Dabeoc's Heath, *Daboecia cantabrica,* was recorded from the cutaway within Rail 17A-18A. This species is typical of heathland vegetation and was previously never recorded north of Clew Bay in Co. Mayo.
- Swan's Lough– this drained lake basin was relatively intact and was becoming colonised by rich-fen vegetation, a generally restricted habitat in this area. The lake itself is considered an ecologically significant site within the Bellacorick production area.
- *Calluna-Juncus squarrosus* heath was developing on the gravel hills within the inactive peat extraction area.

Work commenced within Rail 17A-18A in May 2001: bare gravel areas were ploughed. Field drains and main outfalls from the production area and the adjacent Swan's Lough area were blocked in July 2001. The water level in Swan's Lough has returned to the level that existed prior to peat extraction and a number of pools have been created in the adjacent peat extraction site. Once again, photographic records were taken to monitor changes in vegetation on site (Fig. 19 & 20).

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September 2002 Update

Further work was completed in the south-west corner of Rail 17A-18A. The out-fall draining into Area 3 was blocked and a small pool was created. Water exiting the area now spills over a high gravel embankment and this has created a small waterfall (Fig.21). It also serves to show that the water leaving the area is carrying no peat particles. The level of water in Swan's Lough remains relatively high with some fluctuations in drying periods. Fragments of *Sphagnum* plants were collected and spread into pools throughout the area to speed up the colonisation process. Revegetation of the area is progressing slowly.

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Fig.19. Swan's Lough prior to blocking of out-falls (July 2001). The lake bed is covered in an algal layer with some expansion of *Carex rostrata*.

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Fig.20. Swan's Lough after out-falls were blocked (photo taken from the same point in August 2001). The water level has returned to the original level in the southerly part of the lake.

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Fig.21. Water exiting the Rail 17A-18A catchment area spills out over a gravel ridge and subsequently is piped under the wind farm road into Area 3. The water from this area flows into the terminal water-body in Area 3. The water quality is currently monitored to validate that no peat is exiting the system and that the rehabilitation methods are successful in stabilising the substrates.

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5.3 Implementation of the Rehabilitation Plan

The work completed to date and an estimate of the basic work required to complete the rehabilitation plan has been outlined. An estimate of the working days required to rehabilitate the different areas has also been outlined. Peat production will continue at Oweninny up until September 2004. However, the amount of peat required for the remainder of 2004 will be minimal and therefore the current production area will not be required. It is likely that following September 2003, there will be no further peat extraction from the Bangor site. Also there will be no development within the O'Boyle's Bog and Loughnahelly Bog areas. These isolatable units are therefore available for rehabilitation work. Active production areas will not be available for rehabilitation until peat production ceases and in some areas until all peat piles have been removed to the ESB station. Based on this information a rough outline of the rehabilitation (and decommissioning) timeframe is outlined below.

5.3.1 Timeframe for rehabilitation of the Oweninny boglands

A general timeframe of activities during this phase can be outlined as follows:

March 2001 – to date	Rehabilitation of gravel areas and hydrologically isolatable areas of cutaway bog (70% gravel areas, 35% current cutaway area)
From today -Aug. 2004	Rehabilitation of gravel hills and hydrologically isolatable cutaway areas (*completed by January 2004*)
	General bog clean-up and removal of recyclable materials (*commencing April 2003*)
	Initiation of rehabilitation of O'Boyle's Bog, Loughnahelly Bogs and Bangor production areas
Sept. 2004 – Sept. 2006	Rehabilitation of Oweninny boglands: blocking all field drains, blocking main outfalls where possible to create replacement siltation areas, monitoring the effects of rehabilitation measures.
	Decommissioning of workshops, machinery, etc.
	Removal of railway networks
	Continuation of silt control measures
Sept. 2006 - ?	Continuation of silt mitigation measures
	Monitoring the effectiveness of rehabilitation work

It should be noted that this is an estimate of the length of time required to complete the rehabilitation work. It should be noted that this timeframe is dependent on weather conditions (*refer to Footnote 15*), while monitoring of the site will continue until such a time, as the Oweninny boglands are considered stabilised.

A costing of the rehabilitation programme is currently being developed.

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6 REHABILITATION OF THE OWENINNY BOGLANDS: GENERAL CONCLUSIONS

- Bord na Móna has developed a number of rehabilitation methods for the Oweninny Works. These methods have taken all habitat types and all issues of concern into consideration. In some cases there are surveys underway to assess the work required, e.g. the remediation of watercourses.
- Rehabilitation of the OAE1 and OAE2 sites will commence as soon as peat extraction ceases by Bord na Móna.
- A number of test programmes were established to demonstrate the effectiveness of the rehabilitation methods. These areas will continue to be monitored to document changes in vegetation cover. To date, rehabilitation methods have proven successful in accelerating the rate of revegetation in most areas. In some areas, revegetation will remain slow. This is a typical feature of peatland habitats.
- The criteria that define successful rehabilitation are stabilisation of bare peat and gravel areas through revegetation. Other aspects include mitigation of silt run-off, the future management of SACs and bog remnants, and potential restoration work in new development areas.
- The rehabilitation and decommissioning of the sites will be completed having taken account of issues of concern identified by the consultees. There will also be regular updates provided of the progress of rehabilitation work.
- The sites will continue to be monitored for a number of years after the rehabilitation work has been completed. The purpose will be to document the successional development of the new landscape and to remediate possible breaks in embankments, etc.
- The sites will remain in Bord na Móna ownership until the rehabilitation and decommissioning of the Oweninny boglands is completed. At that time, there may be a change of ownership depending on proposed alternative after-uses for the site and the outcome of consultation with interested parties.

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7 GUIDELINES FOR POTENTIAL CHANGES IN THE AFTER-USE OF THE OWENINNY BOGLANDS

The rehabilitation plan for the Oweninny boglands is a legal requirement and any proposed alternative developments at either the Bellacorick or Bangor production areas must take this plan into consideration. In particular, the criteria defining successful rehabilitation should be considered. To assist potential developers in designing a development for the area a number of criteria have been outlined by Bord na Móna. These criteria are essentially design guides for developers:

1. Within the development design, avoid bog remnants and areas of intact bog.
2. Minimise disturbance of bog remnant and intact bog edges. Areas proximal, particularly to bog remnants, may be required to maintain and/or enhance the ecological integrity of the habitats. Therefore, there should be no new excavations adjacent to these areas[17].
3. Any development should focus on the higher points and/or areas of shallower peat in order to minimise peat excavation and therefore potential environmental damage.
4. Lowest points in production areas, generally the location of main outfalls and terminal silt ponds should be avoided. These areas are focal points for the rehabilitation plan in developing replacement siltation areas and providing sustainable filtration mechanisms.
5. Minimise disturbance of established rehabilitated areas identified as of ongoing scientific interest, namely Area 3. This particular area has been established to provide an insight to the development of the future landscape.
6. Avoid disturbance of peat, or any activity that could destabilise peat banks, particularly on peripheral areas or steep slopes, and/or adjacent to streams and rivers.
7. A minimum distance from streams and rivers[18] should be considered where there is no margin of intact bog to isolate and/or mitigate against the potential run-off of peat into streams and rivers.
8. Where a development includes new development bog (i.e. areas not developed completely for peat production purposes), a policy of minimum impact on these areas should be adopted[19].
9. Where possible, use the existing road infrastructure as entry points to the sites.
10. The construction methods employed in any development should operate in a fashion to mitigate against potential peat run-off and siltation of streams and watercourses.

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[17] Restrict new developments within 15m (one peat production field width).
[18] A minimum distance of 50m should be considered.
[19] For example, if there is a road network passing through these areas, the road construction method should be adapted to minimise the footprint in the area. Concurrently, in advance of peat excavation for roads, the vegetative layer should be laid to one side and replaced on the excavated peat, which in turn should be deposited within 10m either side of the excavated roadway. When the drainage for the roadway is established, the peatland area between roadways should be rehabilitated (refer to *Rehabilitation Plan).*

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PART 2

REHABILITATION OF THE OWENINNY BOGLANDS INCORPORATING THE OWENINNY WIND FARM PROPOSAL

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8 THE PROPOSED OWENINNY WIND FARM

8.1 An Outline of the Proposed Wind Farm Development

Bord na Móna and the ESB have submitted a joint application for the development of a wind farm at the Bellacorick site in north-west Mayo. The wind farm design is a substantial development, with initial designs comprising the installation of up to 210 turbines inter-connected by an extensive road network (up to 87km additional track way). The initial proposal outlined the installation of turbines on a range of conditions – glacial till, cutaway bog, cut-over bog and intact bog, involving a number of construction phases – 6 in total – which would be completed within 10 years of the start-date of development.

Subsequent to the initial design submitted in October 2001, and following from the guidelines for potential after-uses outlined in **Part A** of this document and the outcome of consultations with interested parties, a number of modifications have been made to the wind farm design. There have been significant alterations to the road network design, a number of turbines in sensitive locations have been moved and the development for O'Boyle's Bog has been withdrawn from the proposal. In the light of these modifications, the rehabilitation plan for the Oweninny boglands and the wind farm proposal can proceed in tandem.

The wind farm proposal will impact on the rehabilitation plan, but this will be largely from the point of view of timeframes once the guidelines for development are adhered to[20]. The criteria defining successful rehabilitation are the same in both instances (with or without wind farm development): stabilisation of peat through revegetation, mitigation of silt run-off and establishment of wetland communities where possible.

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It is the aim here to illustrate how the rehabilitation plan and wind farm development can proceed together with minimal impact on either aspect. *Phase 1* of the Oweninny wind farm development was selected and the design guidelines set out in the rehabilitation plan were followed to develop an alternative road and turbine network. This alternative design is included here, and the rehabilitation methods also described.

There is a large degree of overlap[21] between rehabilitation plans described in **Part A** and **Part B**, highlighting the common features and concerns of Bord na Móna in relation to ensuring that the site is rehabilitated in an appropriate and sustainable way regardless what after-use is implemented. Additional aspects of rehabilitation will be consideration of pre-, during and post-construction phases.

[20] It should be noted that the Bangor site is not included in the wind farm proposal and as such, rehabilitation of the Bangor site will be completed following the methods described in Part A of this document.

[21] (a) The rehabilitation measures for each bog condition and/or habitat type, (b) the approach to SAC areas, (c) remediation of watercourses and (b) silt control measures are the same.

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8.2 Integrating the Rehabilitation Plan and the Wind Farm Development: *Phase 1*

The first step in describing the rehabilitation of that part of the Oweninny wind farm involved in *Phase 1* was to consider the original design, and based on the guidelines developed as part of the rehabilitation plan, design an alternative road and turbine network. This updated *Phase 1* of the wind farm proposal is outlined in Fig.22.

A number of features can be identified:

- The road network follows the high points and there are a number of blind roads. This minimises impact on low areas and reduces fragmentation of the bog drainage network.
- Bog remnants have been avoided.
- Turbines located in lowest points and in environmentally sensitive areas (e.g. adjacent streams) have been re-located or eliminated. Where they are located close to low points the method of construction will involve building a causeway. This will lead to the turbine being elevated from the surrounding area and allow for the establishment of replacement siltation areas in the area around the causeway.
- The design will have minimal impact on the rehabilitation plan – the main outfalls can be blocked, and the road re-alignment minimises the excavation and disturbance of peat.

This new design will have minimal impact on the rehabilitation plan, while maximising the value of the land.

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8.3 Rehabilitation of the Oweninny Boglands: modifications to the timeframe of rehabilitation as a result of the wind farm development

In order for the rehabilitation programme to be tailored to incorporate the Oweninny wind farm proposal, the plan must be broken into three distinct phases:

- Pre-construction
- During construction
- Post-construction

The criteria for successful rehabilitation remain the same, i.e. stabilisation of the remaining peat by revegetation of the substrates, mitigation of silt run-off and re-instatement of replacement wetland communities where possible.

8.3.1 Pre-construction

This phase essentially relates to the time period from present to initiation of wind farm construction and largely follows that proposed timeframe for activities set out in **Part A.** Rehabilitation of cutaway areas was initiated in March 2001, and is still underway. This has focused primarily on hydrologically isolatable areas of cutaway and exposed gravel hills. Rehabilitation of gravel areas should be completed by January 2004. Also, a general clean up and removal of recyclable materials from the bog areas will be initiated in spring 2003. Peat extraction is due to cease in September 2003, although based on recent climatic trends, production may be ongoing for a period in 2004 to make up production targets. Once peat extraction ceases further rehabilitation and decommissioning measures will be initiated, including lifting of the railway networks and continuation of silt excavation (*see previous timeframe estimates*).

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It will be impossible to carry out any large-scale bog rehabilitation, except at the Bangor site and in areas at Bellacorick that are identified as exempt from turbine installation. These areas are readily identifiable from the wind turbine map (see aerial photograph: generally the areas adjacent to the N59 and the Srahnakilly road). Depending on planning permission and processing of the application, it is not possible at this time to say when actual construction of the Oweninny Wind Farm will commence.

A general timeframe of activities during this pre-construction phase can be outlined as follows:

March 2001 – to date	Rehabilitation of gravel areas and hydrologically isolatable areas of cutaway bog (70% gravel areas, 35% current cutaway area)
From today -Aug. 2004	Rehabilitation of gravel hills and hydrologically isolatable cutaway areas (*completed by January 2004*) General bog clean-up and removal of recyclable materials (*commencing April 2003*) Initiation of rehabilitation of O'Boyle's Bog, Loughnahelly Bogs and Bangor production areas
Sept. 2004 - construction	Rehabilitation of areas unaffected by wind turbine installation (Bangor bogs, areas adjacent roads, etc.) Continuation of silt pond excavations Decommissioning of workshops, machinery, etc. Removal of railway networks

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8.3.2 During construction

At the onset of actual construction of the wind farm a number of rehabilitation and decommissioning tasks will have been completed, including removal of the railway networks, general bog clean up, etc.

The construction period will be spread over a maximum of ten years and will take place over 6 phases. Each phase will initially involve road construction to allow for transport of wind turbine components, etc. The main features of rehabilitation at this point will be (i) rehabilitation of the bog areas outside of the road and wind-turbine network and (ii) maintenance of silt mitigation measures.

Rehabilitation of bog areas outside of the road and turbine network

The main features of the proposed wind farm development are the wind turbines and associated infrastructure. During construction, discrete areas will be successively selected for development and the prescribed work conducted. In the case of *Phase 1*, the areas under development are Areas 5, 6, 7 12, Rail D, F, G and Rail 337B (identifiable from Fig. 2). In general, until the road network and associated drainage network has been installed and proven effective in each discrete area, rehabilitation work will be limited. There will be scope however, to block field drains and main outfalls particularly in the western parts of Areas 5 and 6. It is likely that blocking of some of the outfalls in Areas 12 and 7 may proceed, but the turbines are located in greater proximity to the boundary margins and it may be impossible to flood areas until construction is completed.

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Once the construction work is completed however, the rehabilitation tools will reflect those described initially in **Part A**, working around the road and network. Where there are gravel hills exposed, these areas will be ploughed to accelerate revegetation. Where there are depressions within an area, the drainage will be manipulated, to create open water bodies. Where peat remains on a slope, embankments will be constructed sequentially along the slope to slow down the movement of water and ultimately peat. Main out-falls will ultimately be blocked and replacement siltation areas created but the timing of this is dependent on road construction.

N.B. The rehabilitation programme will be staggered with the construction programme for the wind farm development. As such, the duration will be spread over a longer period that that defined in **Part A**.

Maintenance of silt mitigation measures

Existing silt ponds will be maintained and will continue to be excavated at the current rates over the course of construction of the Oweninny Wind Farm. It has been proposed by the developers to install a silt pond at each turbine, which would capture any peat disturbed during construction and/or maintenance material used in the construction phase. Silt will continue to be excavated until there is no further silt run-off from the construction and post-peat production areas.

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8.3.3 Post construction

Once the construction phase is complete, a number of tasks will remain for completion. At this stage, most of the rehabilitation work will have been characterised and largely completed. There will however, be further remediation work to be completed as the areas are monitored to ensure rehabilitation methods have been effective, i.e. peat is stabilised, there are no breaches of embankments or dams, and the area is revegetating. Silt pond excavation will continue up until such time, as there is no further build-up of silt in ponds and therefore, no run-off of peat or other material from the construction site.

The post construction rehabilitation tasks will therefore include:

- Completion of rehabilitation measures
- Continuation of monitoring of effectiveness of rehabilitation measures to date
- Continuation of silt pond excavation until such time as there is no further build-up of silt in terminal ponds and no further threat of siltation of rivers and streams (time unknown)

The timeframe for completion of these rehabilitation/remediation tasks is as yet unknown and will be highly dependent on the rate of construction, issues arising from on-site environmental conditions and the ongoing alterations in the landscape.

8.4 Other Issues

All other aspects that were described in **Part A**, such as management of SACs, relocation of silt ponds (and possible remediation of watercourses) and rehabilitation of new development areas will proceed as outlined in **Part A** of the document. These aspects are seen as somewhat independent of the wind farm development, although silt control may be inter-linked with the wind farm construction.

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8.5 The Oweninny Wind Farm Development: General Conclusions

- The re-design of the road and turbine network to comply with the guidelines outlined in Section 7 of **Part A** is seen as an essential part of the wind farm development.
- In following these guidelines, there will be minimal environmental disturbance on site and minimal impact on the rehabilitation plan for the area.
- The rehabilitation work will involve the same procedures as outlined in **Part A**, although the timeframes of rehabilitation for during construction up until completion of the total 6 phases of the development can not be defined as yet.
- Issues of concern identified by the consultees relating to the development will be taken into consideration and the updated designs for the road and turbine networks for each phase of the development will be circulated as part of the ongoing consultation process.
- Rehabilitation of the Bangor site will proceed as outlined in **Part A** of this document.

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Appendix 3

Birdwatch Ireland and RAMSAR descriptions

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Appendix 3

Site descriptions of SPAs, IBAs and Ramsar sites

Source:

Blacksod Bay Special Protection Area (SPA) (4037):

This forms part of the IBA 041, which encompasses Broadhaven, Blacksod, Tullaghan Bay and parts of the Mullet Peninsula. The entire intertidal zone of this IBA is located within SPAs. Areas not included in the SPAs but included in the IBA are those important for corncrake (*Crex crex*), swan and geese grazing, and also for ground nesting waders and terns. Areas covered under the designations are outlined below,

- 683 ha of this IBA is covered by a *Ramsar* site (see below), which is also part of the Broadhaven Bay SPA.
- 7493 ha is covered by the Blacksod/Broadhaven SPA
- 109 ha is covered by the Cross Lough Mullet SPA
- 377 ha is covered by the Termoncaragh Lake SPA

The Broadhaven/Blacksod IBA:

This IBA is very large coastal complex, approximately 10,852 ha, next to Belmullet in County Mayo. The site includes intertidal mudflats, sand flats and salt marshes of several bays as well as parts of Belmullet peninsula and mainland. Habitats present are machair, lakes, marshes and non-intensive farmland. The site is an amalgamation of three sites, which were listed as separate important bird areas in the EU previous inventory (Grimmit and Jones 1989). It is selected as an important bird area because of the presence of the following species: Great Northern Diver, Whooper Swan, Barnacle Goose, Brent Goose, Corncrake, Bar Tailed Godwit, Red Necked Phalarope and Sandwich Tern.

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Ramsar Sites

Blacksod Bay and Broadhaven Ramsar Site
11/06/96; Mayo; 683 ha; 54°03'N 010°00'W.
A composite of diverse marine and coastal habitats that includes vast dune systems and extensive areas of dune grassland with saltmarshes occurring in sheltered bays and inlets. The grasslands are of considerable botanical importance. The site also includes several brackish lakes important to various species of breeding waders, large numbers of wintering water birds of various species, and internationally important numbers of Brent geese. Ramsar site no. 844.

This site equated to the Broadhaven/Blacksod SPA prior to the site review in the 1990s and subsequent SAC designations. Sections of these sites are now incorporated into three SACs namely Mullet/Blacksod Complex, Broadhaven Bay SAC and the Glenamoy Bog Complex SAC.

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Appendix 4

Trial Pit logs

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TRIAL PIT LOG

Trial Pit No. 1

Sheet No. 1 of 1

Excavator Type:	Date:	Client:
HITACHI	23/10/03	Bord na Mona/Shell E&P
Grid Reference:	**Elevation (mOD):**	**Site:**
E084643, N324121		Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	PEAT Soft, medium light brown to medium brown, occasional fragments of bog wood, slightly moist.			Vane Test	TP1			
2.4	Yellowish brown to light yellowish brown gravelly, clayey SAND with some angular subangular cobbles of schist at base.			Disturbed Sample	TP1			
3.0	END OF TRIAL PIT							

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Logged by:	Job No.:	Remarks:
P.K.	1169	1. Shear vane test undertaken on peat, disturbed soil sample obtained for Particle Size Distribution testing.
Scale: 1:25	Rev.:	2. No significant groundwater inflow recorded during excavation. 3. Excavation terminated at 3m due to obstruction/compaction of subsoil.

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TRIAL PIT LOG

Trial Pit No. 2

Sheet No. 1 of 1

Excavator Type:	Date:	Client:
	23/10/03	Bord na Mona/Shell E&P

Grid Reference:	Elevation (mOD):	Site:
E084646, N323870		Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	PEAT Soft, medium dark brown to dark brown, occasional fragments of bog wood.			Vane Test	TP2			
0.65								
	Medium light grey to light greenish grey, gravelly, clayey slightly micaceous SAND. The Gravels are platey, angular to subangular Quartzites.			Disturbed Sample	TP2			
3.0								
	END OF TRIAL PIT							

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Logged by:	Job No.:	Remarks:
P.K.	1169	1. Shear vane test undertaken on peat, disturbed soil sample obtained for Particle Size Distribution testing. 2. No significant groundwater inflow recorded during excavation.
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 3

Sheet No. 1 of 1

Excavator Type:	Date: 23/10/03	Client: Bord na Mona/Shell E&P
Grid Reference: E084890, N323700	Elevation (mOD):	Site: Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	PEAT Soft, medium brown to light brown, fragments of bog wood and rootlets, slightly moist.			Vane Test	TP3			
1.8	Greenish grey to light greenish grey to light grey SAND, with some angular to subangular gravels and cobbles of schist.			Disturbed Sample	TP3			
3.45	END OF TRIAL PIT							

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Logged by: P.K.	Job No.: 1169	Remarks:
Scale: 1:25	Rev.:	1. Shear vane test undertaken on peat, disturbed soil sample obtained for Particle Size Distribution testing. 2. Slight to moderate groundwater inflow recorded at 2.5m during excavation. 3. Excavation terminated due to obstruction/compaction of subsoil at 3.45m.

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TRIAL PIT LOG

Trial Pit No. 4

Sheet No. 1 of 1

Excavator Type:	Date:	Client:
	23/10/03	Bord na Mona/Shell E&P

Grid Reference:	Elevation (mOD):	Site:
E084164, N323332		Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	PEAT Soft to very soft, medium brown to medium dark brown, with fragments of bog wood and roolets, moist.			Vane Test	TP4			
1.1								
	Medium greenish grey to grey, clayey, fine grained SAND with occasional subrounded to rounded gravel and cobbles.			Disturbed Sample	TP4			
1.4								
	Medium grey to light brownish grey GRAVEL with some sub–rounded to subangular cobbles.							
1.65								
	END OF TRIAL PIT							

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Logged by:	Job No.:	Remarks:
P.K.	1169	1. Shear vane test undertaken on peat, disturbed soil sample obtained for Particle Size Distribution testing. 2. Excavations terminated at 1.65m bgl due to unstable ground and pit wall collpase caused by water inflow.
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 5

Sheet No. 1 of 1

Excavator Type:	Date:	Client:
	23/10/03	Bord na Mona/Shell E&P
Grid Reference:	**Elevation (mOD):**	**Site:**
E084474, N323382		Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	PEAT Soft, medium dark brown fragments of bog wood and rootlets, moist.			Vane Test	TP5			
0.9								
	Yellowish brown to greyish brown, gravelly, cobbley SILT/ SAND. The gravels are subangular to subrounded.			Disturbed Sample	TP5			
3.0	END OF TRIAL PIT							

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Logged by:	Job No.:	Remarks:
P.K.	1169	1. Shear vane test undertaken on peat, disturbed soil sample obtained for Particle Size Distribution testing.
Scale:	Rev.:	2. Slight to moderate groundwater inflow at 2.5m bgl.
1:25		

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TRIAL PIT LOG

Trial Pit No. 6

Sheet No. 1 of 1

Excavator Type:	Date: 23/10/03	Client: Bord na Mona/Shell E&P
Grid Reference: E084852, N323176	Elevation (mOD):	Site: Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	PEAT Soft, dark brown to brownish black, fragments of bog wood, moist.			Vane Test	TP6			
0.95								
	Light yellowish brown clayey, fine grained SAND with occasional gravels that are subrounded to rounded							
1.9								
	Medium brown to dark brown subangular to subrounded GRAVELS, with some Cobbles.			Disturbed Sample	TP6			
2.5								
	END OF TRIAL PIT							

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Logged by: P.K.	Job No.: 1169	Remarks: 1. Shear vane test undertaken on peat, disturbed soil sample obtained for Particle Size Distribution testing. 2. No significant groundwater inflows noted during excavation.
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 7

Sheet No. 1 of 1

Excavator Type:	Date: 23/10/03	Client: Bord na Mona/Shell E&P
Grid Reference: E084001, N323713	Elevation (mOD):	Site: Srahmore, Bangor-Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	PEAT Soft, dark brown to brownish black, fragments of bog wood, moist. Occurance of more recent plant material and heather.							
0.85				Vane Test	TP7			
	Light yellowish brown to light yellowish grey clayey SAND with occasional gravels that are subrounded to rounded. Gravel content increases with depth and becomes angular at base.							
				Disturbed Sample	TP7			
2.5	END OF TRIAL PIT							

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Logged by: P.K.	Job No.: 1169	Remarks: 1. Shear vane test undertaken on peat, disturbed soil sample obtained for Particle Size Distribution testing. 2. No significant groundwater inflows noted during excavation.
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 8

Sheet No. 1 of 1

Excavator Type:	Date:	Client:
	23/10/03	Bord na Mona/Shell E&P

Grid Reference:	Elevation (mOD):	Site:
E084402, N323988		Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
0.2	Medium dark, soft PEAT							
	Medium light grey to greenish grey, gravelly, cobbley SILT/ SAND. The gravels are subangular to subrounded and occasionally well rounded Quartzites, with occasional Red Sandstones and Slate.							
2.6	END OF TRIAL PIT							

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Logged by:	Job No.:	Remarks:
P.K.	1169	
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 9

Sheet No. 1 of 1

Excavator Type:	Date:	Client:
	23/10/03	Bord na Mona/Shell E&P

Grid Reference:	Elevation (mOD):	Site:
E084402, N323988		Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	Medium dark, soft PEAT							
0.4								
	Medium light grey to greenish grey, gravelly, cobbley SILT/ SAND. The gravels are subangular subrounded and occasionally well rounded Quartites, with occasional Red Sandstone and Slate.							
2.5	END OF TRIAL PIT							

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Logged by:	Job No.:	Remarks:
P.K.	1169	
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 10

Sheet No. 1 of 1

Excavator Type:	Date:	Client:
	18/11/03	Bord na Mona/Shell E&P

Grid Reference:	Elevation (mOD):	Site:
E083780, N323797		Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
0.1	Dark brown, peaty GRAVEL, with many cobbles and boulders. Gravels subangular to subrounded Quartzite, Schist, Slate and Red Sandstone							
0.7	Medium brown, clayey, gravelly, fine grained SAND. Gravels are subangular to subrounded							
1.45	Medium grey to greenish grey to light brownish grey, clayey, gravelly, fine to medium grained SAND, with occasional subangular to subrounded cobbles.			Bulk Sample	TP10			
3.2	Medium light grey, sandy, slightly clayey, subangular GRAVEL, with occasional angular, subangular and subrounded cobbles and boulders of Quartzite, Schist and Red Sandstone.							
	END OF TRIAL PIT							

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Logged by:	Job No.:	Remarks:
P.K.	1169	1. Surface water running into pit excavation because of heavy rain
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 11

Sheet No. 1 of 1

Excavator Type:	Date:	Client:
	18/11/03	Bord na Mona/Shell E&P

Grid Reference:	Elevation (mOD):	Site:
E083837, N323823		Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
0.2	Medium brown, sandy, slightly clayey, peaty GRAVEL, with some cobbles. Gravel is subangular to angular Quartzite, with occasional Schist and Sandstone							
	Light brown to yellowish grey, slightly clayey, gravelly, fine SAND. Subangular gravels of Quartzite and occasional angular boulders of banded Gneiss			Bulk Sample	TP11			
3.0	END OF TRIAL PIT							

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Logged by:	Job No.:	Remarks:
P.K.	1169	1. No water inflows to pit, dry.
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 12

Sheet No. 1 of 1

Excavator Type:	Date:	Client:
	18/11/03	Bord na Mona/Shell E&P

Grid Reference:	Elevation (mOD):	Site:
E083925, N323806		Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
0.3	Medium brown, slightly clayey fine grained SAND, with thin layers of peat on top							
	Medium light grey, gravelly, slightly clayey, slightly micaceous SAND with some subangular cobbles and occasional subangular boulders. Gravels are subangular to subrounded Quartzite.							
				Bulk Sample	TP12A			
	Medium grey to medium light grey gravelly, fine grained SAND with some cobbles and some blocky boulders of Gneiss. Gravels are subrounded and occasionally well rounded							
				Bulk Sample	TP12B			
3.0	END OF TRIAL PIT							

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Logged by:	Job No.:	Remarks:
P.K.	1169	1. Increase in moisture content at 3m bgl.
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 13

Sheet No. 1 of 1

Excavator Type:	Date:	Client:
	18/11/03	Bord na Mona/Shell E&P
Grid Reference:	**Elevation (mOD):**	**Site:**
E084417, N324002		Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
0.25	Medium dark brown to brownish black, soft PEAT, with angular and subrounded gravels and boulders of Quartzite and Schist							
0.75	Medium dark brown to medium brown, Firm CLAY							
	Light grey to medium light grey and light greyish brown, gravelly, silty, fine grained SAND with occasional subangular to subrounded blocky boulders of Gneiss. Gravels are subangular to subrounded, occasionally well rounded, composed of Quartzite Schist, Red Sandstone and Slate.			Bulk Sample	TP13A			
				Bulk Sample	TP13B			
3.2	END OF TRIAL PIT							

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Logged by:	Job No.:	Remarks:
P.K.	1169	
Scale:	Rev.:	
1:25		

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TRIAL PIT LOG

Trial Pit No. 14

Sheet No. 1 of 1

Excavator Type:	Date:	Client:
	18/11/03	Bord na Mona/Shell E&P

Grid Reference:	Elevation (mOD):	Site:
E084647, N324207		Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
0.75	Medium brown, gravelly, slightly clayey, fine grained SAND, with some angular cobbles and boulders of Quartzite. Gravels are subangular to angular.							
2.0	Light grey to light yellowish grey, gravelly, cobbley, slightly clayey SAND with some angular boulders of Gneiss. Gravels are subangular to subrounded Quartzite and Red Sandstone.			Bulk Sample	TP14A			
3.5	Medium grey, gravelly, slightly clayey, slightly micaceouas SAND with some subangular to subrounded cobbles of Quartzite. Gravels are subangular to subrounded Quartzite.			Bulk Sample	TP14B			
	END OF TRIAL PIT							

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Logged by:	Job No.:	Remarks:
P.K.	1169	1. Increase in moisture content at 1.5m bgl.
Scale: 1:25	Rev.:	

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Appendix 5

PSD Curves

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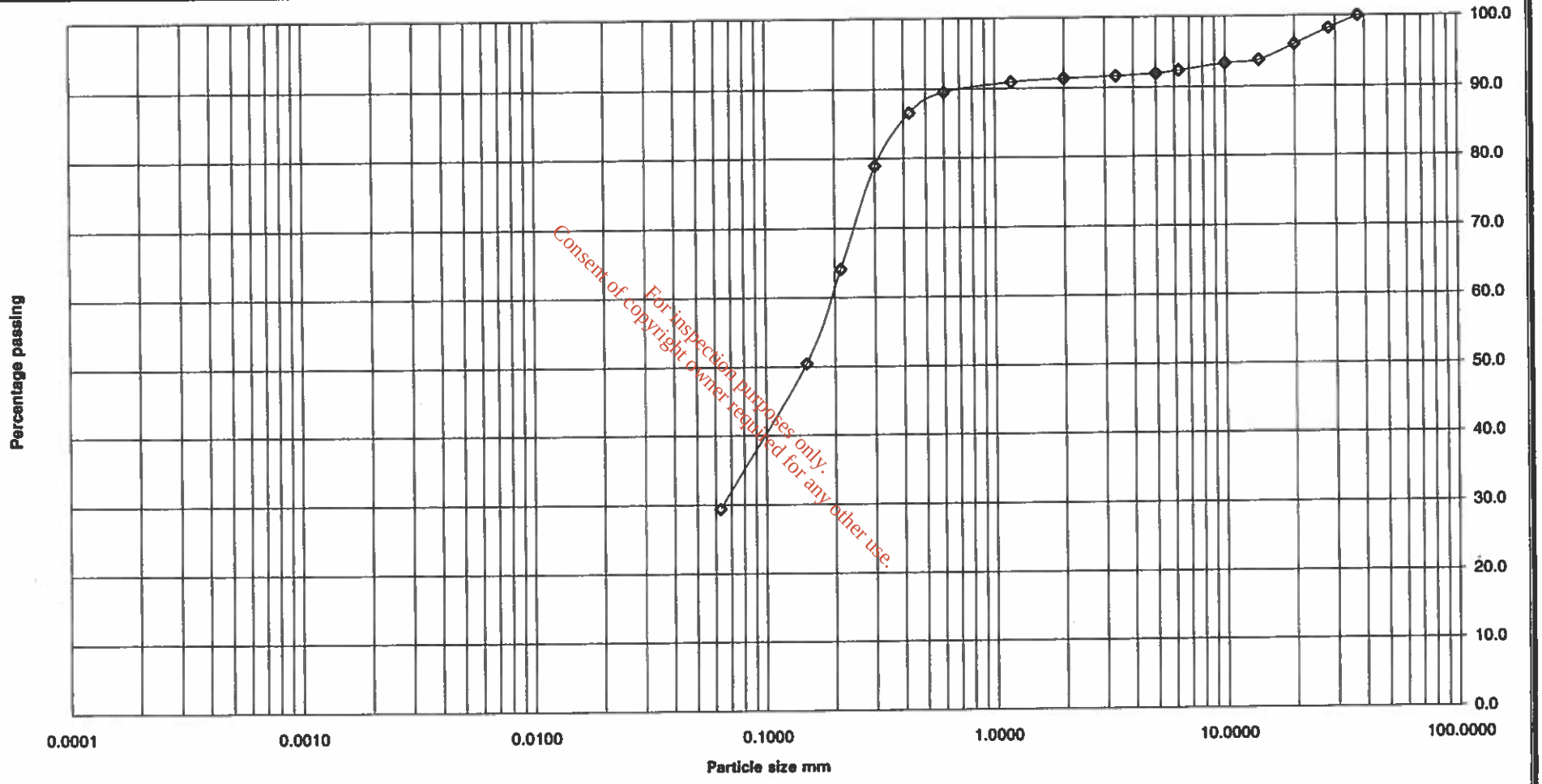
PROJECT:	Bangor Erris	Project No: 1169	**PARTICLE SIZE DISTRIBUTION**
CLIENT:	Irish Drilling	Reference: 0415	

Borehole No. TP1 Sample No. Depth 3.00 m



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CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLES
	SILT			SAND			GRAVEL			

Visual Description: Pale grey silty SAND with little gravel

K4 SOILS LABORATORY

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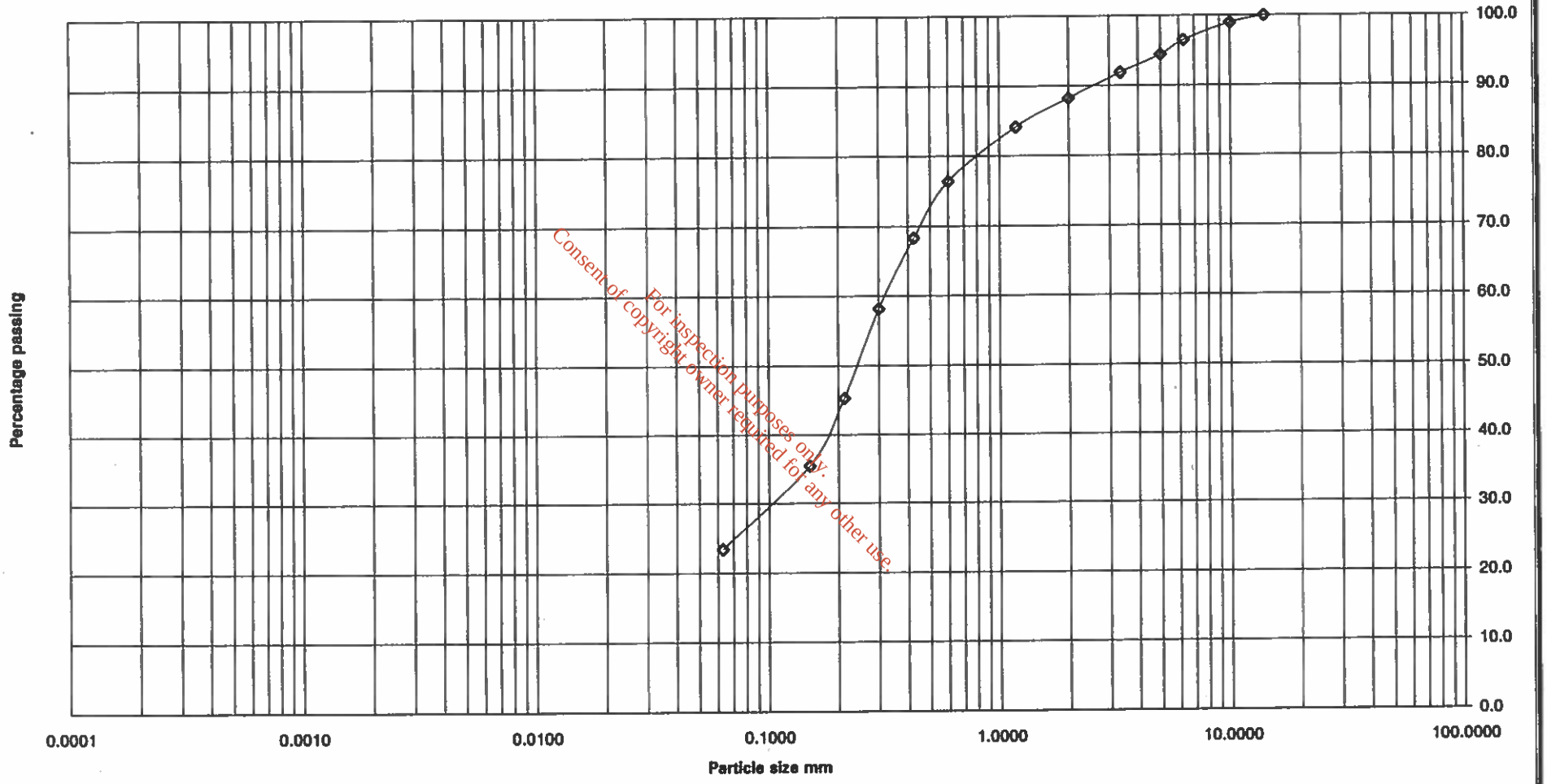
PROJECT:	Bangor Erris	Project No: 1169	**PARTICLE SIZE DISTRIBUTION**
CLIENT:	Irish Drilling	Reference: 0415	

Borehole No. TP2 Sample No. Depth 2.50 m



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CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLES
	SILT			SAND			GRAVEL			

Visual Description: Grey silty SAND with a little gravel

K4 SOILS LABORATORY

E.P.A. Export 08-07-2014:23:45:57

PROJECT: Bangor Erris

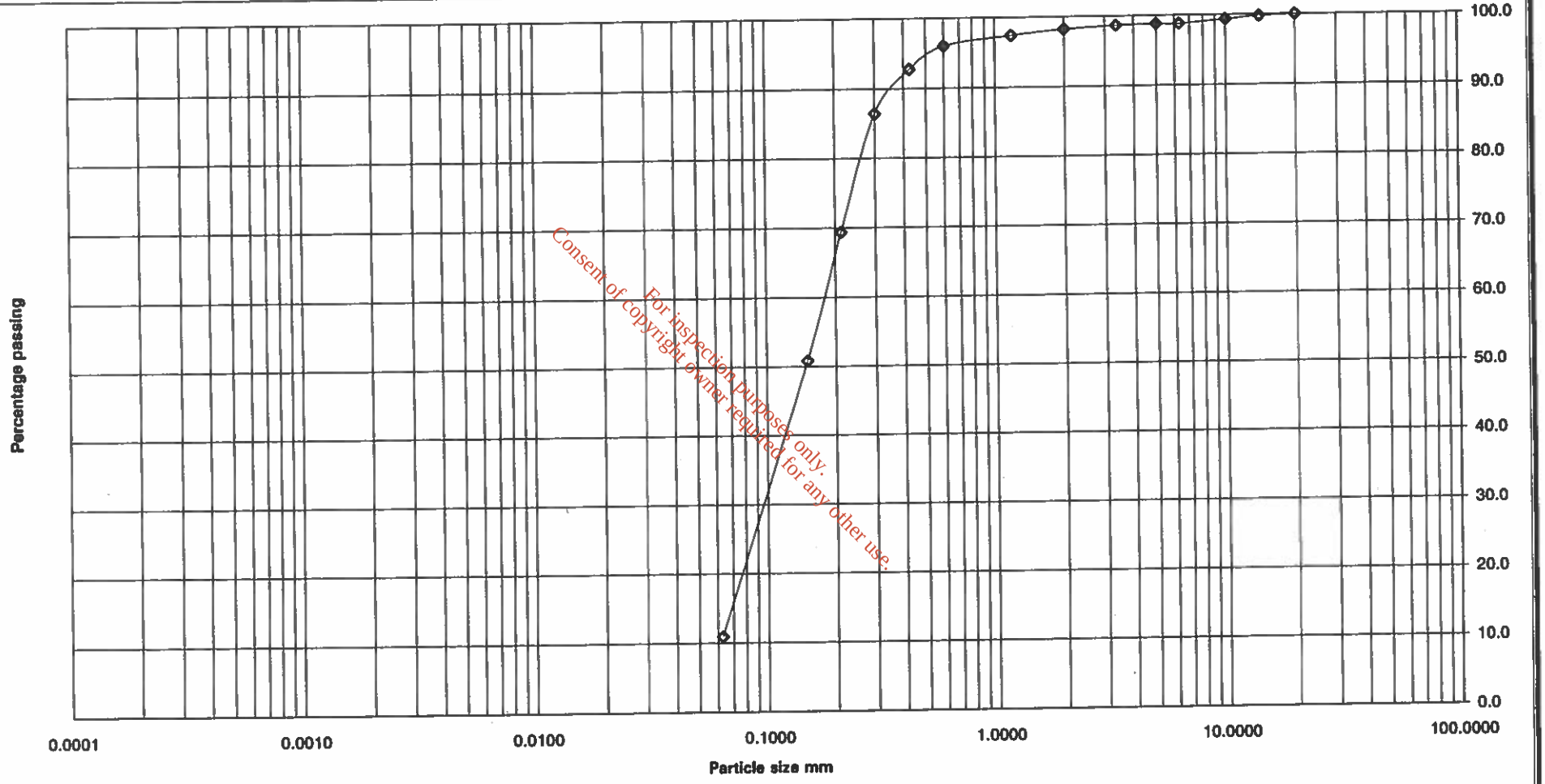
CLIENT: Irish Drilling

Project No: 1169

Reference: 0415

PARTICLE SIZE DISTRIBUTION

Borehole No. TP3 Sample No. Depth 2.50 m



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CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLES
	SILT			SAND			GRAVEL			

Visual Description: Pale grey SAND with a trace of gravel

K4 SOILS LABORATORY

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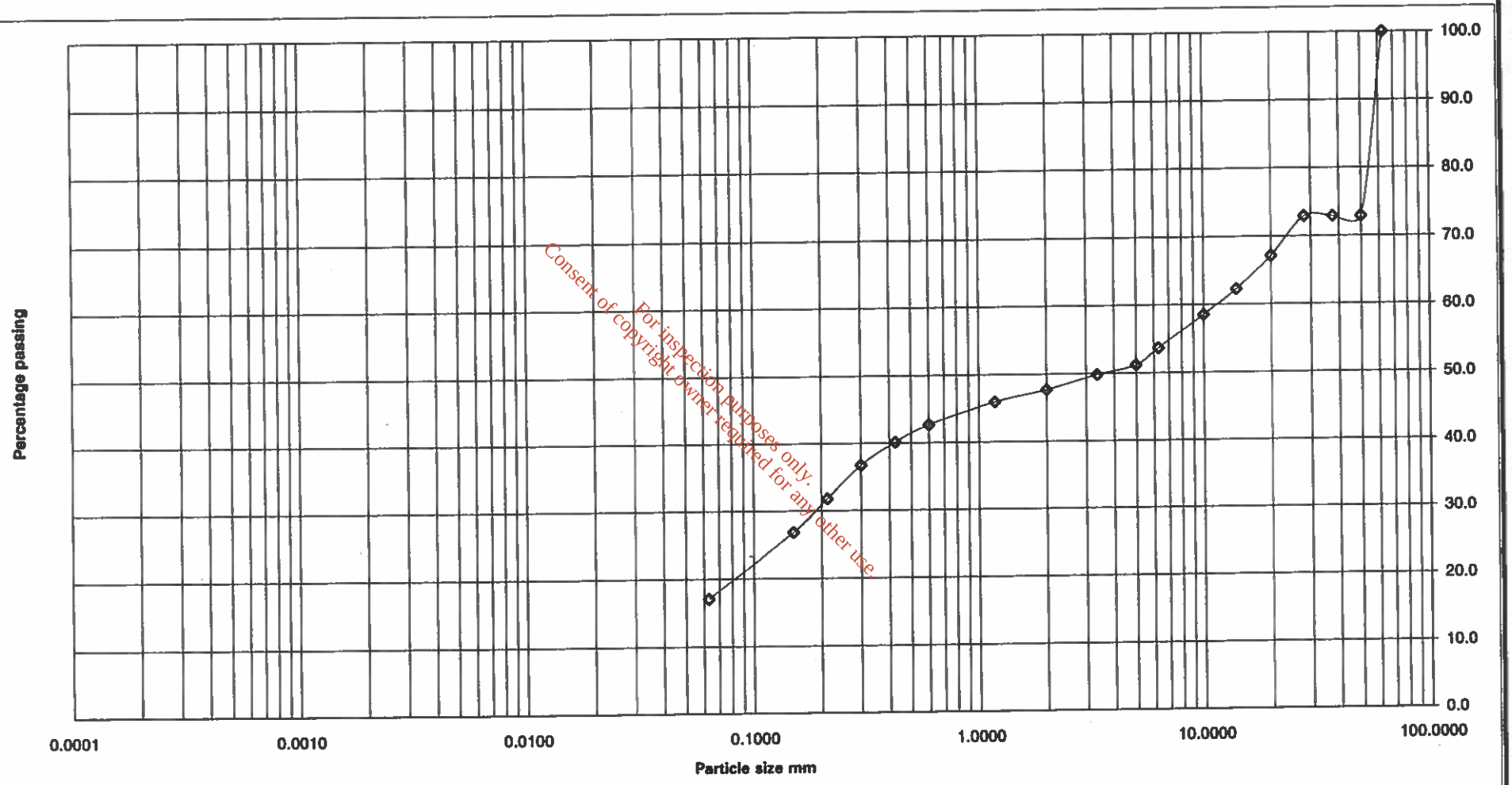
PROJECT:	Bangor Erris	Project No:	1169
CLIENT:	Irish Drilling	Reference:	0415

PARTICLE SIZE DISTRIBUTION

Borehole No. TP4 Sample No. Depth 1.00 m



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CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLES
	SILT			SAND			GRAVEL			

Visual Description: Grey silty SAND and GRAVEL

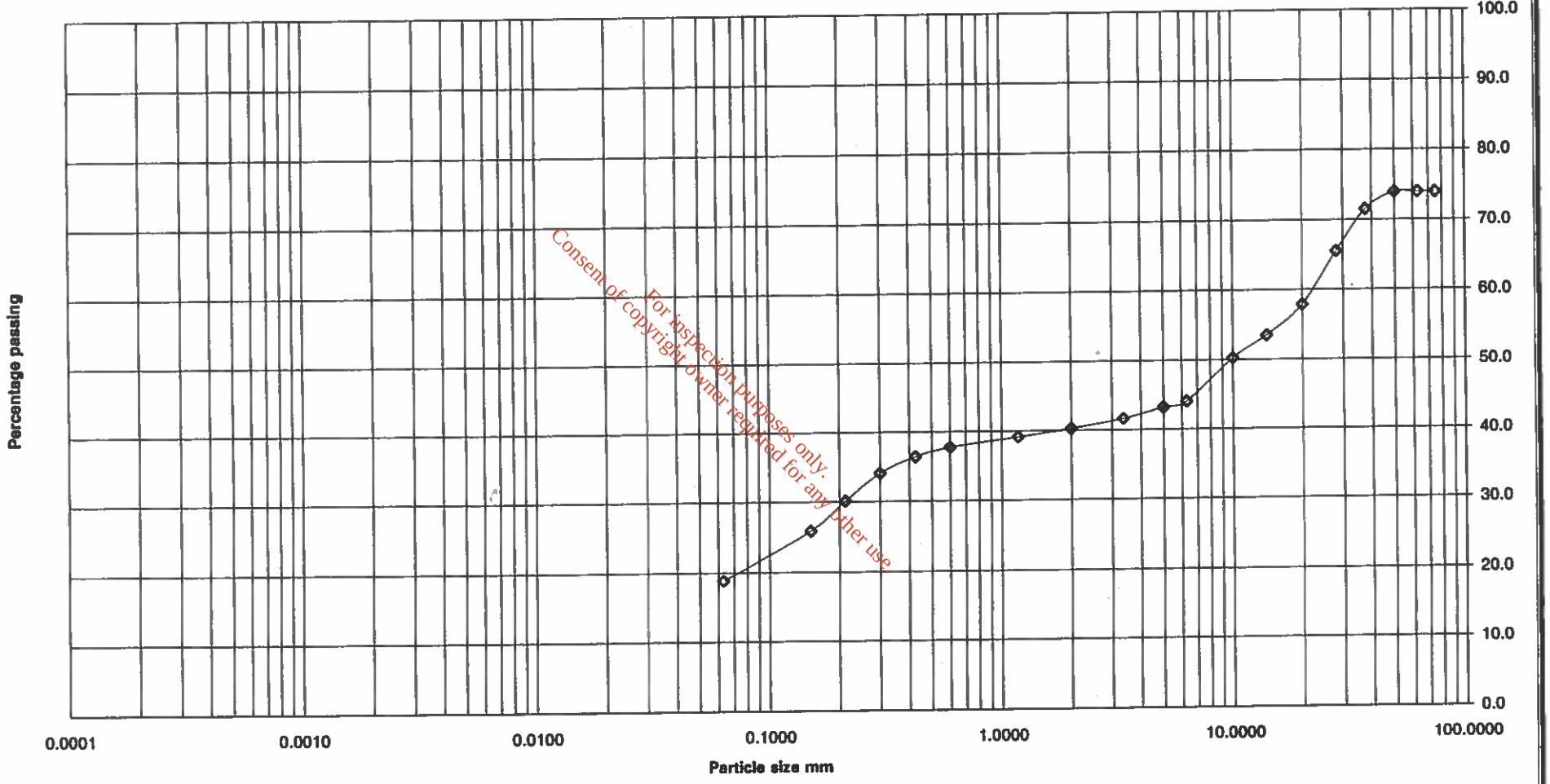
K4 SOILS LABORATORY

E.P.A. Export 08-07-2014:23:45:58

PROJECT:	Bangor Erris	Project No:	1169
CLIENT:	Irish Drilling	Reference:	0415

PARTICLE SIZE DISTRIBUTION

Borehole No. TP5 Sample No. Depth 1.50 m



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CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLES
	SILT			SAND			GRAVEL			

Visual Description: Grey silty sandy GRAVEL with occasional cobbles

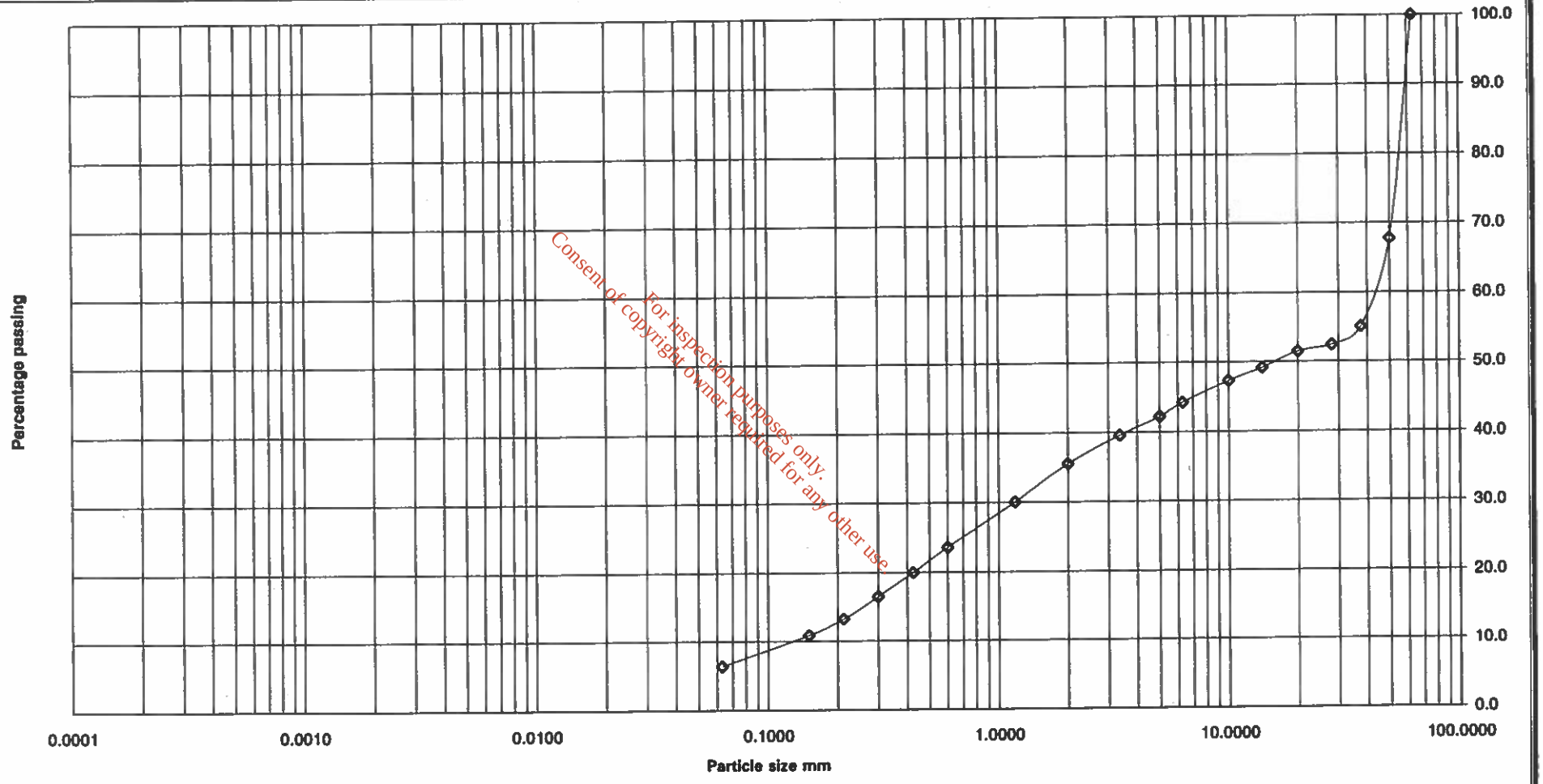
K4 SOILS LABORATORY

E.P.A. Export 09-07-2014:23:45:58

PROJECT:	Bangor Erris	Project No:	1169
CLIENT:	Irish Drilling	Reference:	0415

PARTICLE SIZE DISTRIBUTION

Borehole No. TP6 Sample No. Depth 2.50 m



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CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLES
	SILT			SAND			GRAVEL			

Visual Description: Grey sandy GRAVEL

K4 SOILS LABORATORY

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Appendix 6

Borehole logs

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BOREHOLE LOG

Borehole BH1A

Sheet No. 1 of 1

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor-Erris, Co. Mayo.	1169	1:50

Grid Reference			
Easting: E084463 Northing: N323049	Elevation (mOD): 17.56m Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm Borehole Depth (m): 13.5m	Date Started: 22/10/03 Date Completed: 22/10/03	Drill Contractor: Irish Drilling Ltd. Drill Method: Coring Logged by: P.K.

Depth m	Description of Strata	Legend	OD Level m	Static Water Level 4/11/03	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
GL									
0.55	PEAT							50MM uPVC CASING	CEMENT
			15.09	▼					BENT ONITE
	Fine grained SAND, with clay/silt matrix, medium light grey to greenish grey.							50MM uPVC SCREEN	3-7mm Pea Gravel
12.5								END OF CASING	
13.5	SAND with fragments of Schist and Quartzite. Light grey to light greenish grey.								
18	END OF BOREHOLE								

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BOREHOLE LOG

Borehole BH1B

Sheet No. 1 of 2

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor–Erris, County Mayo.	1169	1:50

Grid Reference	Elevation (mOD): 17.524	Date Started: 23/10/03	Drill Contractor: Irish Drilling Ltd.
Easting: 084463	Borehole Diameter (Subsoil): 65mm	Date Completed: 24/10/03	Drill Method: Coring
Northing: 323049	Borehole Diameter (Rock): 65mm		Logged by: PK
	Borehole Depth (m): 23.7m		

Depth m	Description of Strata	Legend	OD Level m	Static Water Level 4/11/03	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
GL									
0.65	PEAT								
	Fine grained SAND with clay/silt matrix. Medium light grey to greenish grey.		15.09m ▼					50mm uPVC CASING	BENTONITE
12.7									
13.7	SAND with fregments of Schist and Quartzite. Light grey to light greenish grey.								
18	Moderately weak to moderately strong narrowly banded, schistose (dipping 75 degrees), greenish brown, coarsely to medium grained and frequently flaky, extremely micaceous, haematitic, PSAMMITE, moderately weathered. Large (2mm) flaky, specular micas, exhibiting pronounced schistosity–parallel preferred orientation. Discontinuities: Closely spaced, mainly schistosity paralle, sub–planar to undulose, rough surfaced, tight to moderately open.								

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Remarks:

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BOREHOLE LOG

Borehole BH1B

Sheet No. 2 of 2

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor-Erris, County Mayo.	1169	1:50

Grid Reference	Elevation (mOD): 17.254	Date Started: 23/10/03	Drill Contractor: Irish Drilling Ltd.
Easting: 084463	Borehole Diameter (Subsoil): 65mm	Date Completed: 24/10/03	Drill Method: Coring
Northing: 323049	Borehole Diameter (Rock): 65mm		Logged by: PK
	Borehole Depth (m): 23.7m		

Depth m	Description of Strata	Legend	OD Level m	Water Inflows	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
18m / 18.5	As above						Packet Test Ref.: BH1B Test section: 15.5–23.7m bgl	50mm uPVC Screen	3–7mm Pea Gravel
	Strong to very strong, faintly narrowly banded, (dipping 60 degrees), white to very pale grey, fine to medium grained, micaceous QUARTZITE, fresh to slightly weathered. Mica occurs as strong orientated flakes, producing previously described narrow banding. Discontinuities: Closely to medium spaced, generally banding parallel (but also steeply dipping in at least 2 other orientations), generally planar, slightly rough surfaced, tight and clean.								
23.7	END OF BOREHOLE								

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BOREHOLE LOG

Borehole BH2A

Sheet No. 1 of 1

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor-Erris, Co. Mayo.	1169	1:50

Grid Reference			
Easting: E083092 Northing: N323519	Elevation (mOD): 17.20m Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm Borehole Depth (m): 6.1m	Date Started: 28/10/03 Date Completed: 28/10/03	Drill Contractor: Irish Drilling Ltd. Drill Method: Coring Logged by: P.K.

Depth m	Description of Strata	Legend	OD Level m	Static Water Level 4/11/03	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
GL									
0.55	PEAT							50MM uPVC CASING	CEMENT
	Fine grained SAND, with clay/silt matrix, medium light grey to greenish grey.		14.10	▼					BENTONITE
12.3								50MM uPVC SCREEN	3-7mm Pea Gravel
14.0	SAND with fragments of eroded Quartzite, Sandstone and Schist. grey.								
18	END OF BOREHOLE								

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Blanchardstown
Dublin 15
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BOREHOLE LOG

Borehole BH2B

Sheet No. 1 of 2

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor-Erris, County Mayo.	1169	1:50

Grid Reference			
Easting: 083092 Northing: 323519	Elevation (mOD): 17.17m Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm Borehole Depth (m): 23.5m	Date Started: 27/10/03 Date Completed: 27/10/03	Drill Contractor: Irish Drilling Ltd. Drill Method: Coring Logged by: PK

Depth m	Description of Strata	Legend	OD Level m	Static Water Level 4/11/03	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
GL									
0.55	PEAT								
	Fine grained SAND with clay/silt matrix. Medium light grey to greenish grey.		14.09	▼				50mm uPVC CASING	BENTONITE
12.0									
	SAND with fragments/cobbles of eroded Quartzite, Sandstone and Schist.								
14.3									
	Moderately weak to moderately strong thinly bedded/schistose (dipping 30-45 degrees), greenish grey (changing to brown below 21.4m), fine to medium grained micaceous PSAMMITE, moderately weathered. Occasional very thin (<20mm) highly weathered zones. Discontinuities: Very closely spaced, schistosity parallel, generally planar smooth to slightly rough , thick to moderately open, strongly discoloured and clay/rock material filled.								
18									

Remarks: moderately open.

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BOREHOLE LOG

Borehole BH2B

Sheet No. 2 of 2

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor-Erris, County Mayo.	1169	1:50

Grid Reference	Elevation (mOD): 17.17m	Date Started: 27/10/03	Drill Contractor: Irish Drilling Ltd.
Easting: 083092	Borehole Diameter (Subsoil): 65mm	Date Completed: 27/10/03	Drill Method: Coring
Northing: 323519	Borehole Diameter (Rock): 65mm		Logged by: PK
	Borehole Depth (m): 23.5		

Depth m	Description of Strata	Legend	OD Level m	Water Inflows	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
18m	As above						Packet Test Ref.: BH2B Test section: 15.75–23.5m	50mm uPVC Screen	3–7mm Pea Gravel
23.5	END OF BOREHOLE								

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BOREHOLE LOG

Borehole BH3B

Sheet No. 1 of 2

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor–Erris, County Mayo.	1169	1:50

Grid Reference			
Easting: 084908 Northing: 323745	Elevation (mOD): 20.26m Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm Borehole Depth (m): 16m	Date Started: 29/10/03 Date Completed: 29/10/03	Drill Contractor: Irish Drilling Ltd. Drill Method: Coring Logged by: PK

Depth m	Description of Strata	Legend	OD Level m	Static Water Level 4/11/03	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
GL									
1.55	PEAT							50mm uPVC CASING	BENTONITE
6.0	Fine grained SAND with clay/silt matrix. Medium light grey to greenish grey.		18.02	▼					
16	Strong to very strong, massive but locally narrowly banded (dipping 35 degrees), grey to yellowish grey, fine grained micaceous QUARTZITE, fresh to slightly weathered. Mica locally occurring as close to very closely spaced bands/laminae dipping circa 35 degrees. Discontinuities: Between non-intact zones, fractures are closely to very closely spaced, bedding parallel, (dipping about 35 degrees), generally sub-planar, smooth to slightly rough, generally clean.						Packet Test Ref.: BH3B Test section: 11.75–16.0m	50mm uPVC SCREEN	3–7mm Pea Gravel
	END OF BOREHOLE								

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Remarks:

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BOREHOLE LOG

Borehole BH3B

Sheet No. 2 of 2

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor-Erris, County Mayo.	1169	1:50

Grid Reference			
Easting: 084908 Northing: 323745	Elevation (mOD): 20.26m Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm Borehole Depth (m): 23.5	Date Started: 27/10/03 Date Completed: 27/10/03	Drill Contractor: Glovers SI Ltd. Drill Method: Air Rotary Logged by: KM (TES)

Depth m	Description of Strata	Legend	OD Level m	Water Inflows	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
18m	As above						Packet Test Ref.: BH2B Test section: 15.75–23.5m	50mm uPVC Screen	3–7mm Pea Gravel
23.5									

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BOREHOLE LOG

Borehole BH4

Sheet No. 1 of 2

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor–Erris, County Mayo.	1169	1:50

Grid Reference			
Easting: 084489 Northing: 323373	Elevation (mOD): 17.22 Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm Borehole Depth (m): 30m	Date Started: 01/11/03 Date Completed: 01/11/03	Drill Contractor: Irish Drilling Ltd. Drill Method: Coring Logged by: PK

Depth m	Description of Strata	Legend	OD Level m	Static Water Level 4/11/03	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
GL									
3.1	PEAT		14.81	▼				50mm uPVC CASING	BENTONITE
18	Fine grained SAND with clay/silt matrix. Medium light grey to greenish grey.							50mm uPVC SCREEN	3–7mm Pea Gravel

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BOREHOLE LOG

Borehole BH4

Sheet No. 2 of 2

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor-Erris, County Mayo.	1169	1:50

Grid Reference			
Easting: 084489 Northing: 323373	Elevation (mOD): 17.22m Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm Borehole Depth (m): 30m	Date Started: 01/11/03 Date Completed: 01/11/03	Drill Contractor: Glovers SI Ltd. Drill Method: Air Rotary Logged by: PK

Depth m	Description of Strata	Legend	OD Level m	Water Inflows	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
18m	As above							50mm uPVC Screen	3-7mm Pea Gravel
30	END OF BOREHOLE								

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Appendix 7

Hydraulic Permeability

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Report on Groundwater Sampling and Permeability Testing at Srahmore Bog, Bangor, Co. Mayo

TES Consulting Engineers

MEL Brief 1322-Q1
MEL Doc. Ref.:1322-2546

Monday, 17 November 2003

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Confidential Report To:

Morgan Burke
TES Consulting Engineers
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Minerex
Environmental Limited

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2. WORK SPECIFICATION 1

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3.2 Locations 1
3.3 Methods and Materials 1

4. PERMEABILITY TESTING 2

4.1 Purpose 2
4.2 Locations 2
4.3 Methods and Materials 2

5. RESULTS 2

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Appendices

Appendix	Title	Pages	MEL Doc. Ref.
Appendix A	Summary of Pre-Sampling Borehole Purging Results	1 x A4	1322-028.xls
Appendix B	Summary of Permeability Test Results	1 x A4	1322-019.xls
Appendix C	Aqtesolv Curve Fitted Graphs	12 x A4	1322-2548.aqt

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1. Introduction

On 30th October 2003 Minerex Environmental Limited (MEL) were commissioned by Morgan Burke of TES Consulting Engineers to undertake groundwater sampling and permeability testing at Srahmore Bog, Bangor, Co Mayo. A detailed work specification was drafted up and agreed. The main elements of this specification are outlined below. MEL carried out site work over a three day period from the 4th to the 6th of November 2003. This report outlines the methodologies and equipment used, the results obtained and the software used for data analysis and presentation.

2. Work Specification

The following outlines the main elements of the site work undertaken at Srahmore Co. Mayo. The work is subdivided into two sections.

A. Water sampling:
A total of seven (7) monitoring wells (four overburden and three bedrock) were purged and sampled. The samples were analysed by Alcontrol Laboratories Limited.

B. Permeability testing:
Permeability tests were undertaken following sampling of the four overburden boreholes. Field data was used to determine K-values for the overburden sands and gravels.

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3. Groundwater Sampling

3.1 Purpose

The installation of monitoring points allows for water levels and water samples to be taken. Seven (7) monitoring wells were drilled and installed in the week prior to sampling. The wells were drilled in four nested couples; the first three (1A/1B, 2A/2B, 3A/3B) consisting of a shallow overburden well and a deep bedrock well; and the fourth consisting of a deep overburden well (4A). The purpose of the sampling is to provide baseline data with respect to the investigation area.

3.2 Locations

Water samples were taken from the following boreholes: 1A, 1B, 2A, 2B, 3A, 3B and 4A. The locations of these boreholes were supplied to MEL by TES prior to fieldwork. MEL does not possess a map in electronic format for the site, and the production / reproduction of same is not included in the scope of this work item.

3.3 Methods and Materials

In the context of MEL's investigations, static water levels were taken in both wells within each couple prior to any purging of the groundwater. Borehole volumes were calculated to include the annulus volume and assuming an annulus porosity of 35%. At least 2 borehole volumes were removed from each monitoring point prior to sampling. Appendix A outlines a summary of borehole volumes removed prior to sampling.

A standard dipmeter was used to record water levels. All measurements were recorded in metres to the top of steel plinth (tosp) which is MEL's reference point. It should be noted that MEL was not commissioned to survey the monitoring points installed at Srahmore and does not possess reduced levels for any of the investigation points. A 2" Honda pump was used to purge the monitoring points. Due to adverse weather conditions and poor access to the monitoring points at the site, it was not possible to purge and sample all monitoring wells within one working day. 1A and 1B were purged on the 4th of November, while 2A, 2B, 3A, 3B and 4A were purged on the morning of 5th of

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November. During purging of the first borehole volume an attempt made to remove silt from the bottom of the overburden wells using the Honda pump. This was unsuccessful as the purged water continued to have a high silt content throughout purging. All monitoring wells except 4A were sampled on the evening of the 5th of November using a 1litre designated, disposable bailer. Borehole 4A was subsequently sampled on the morning of the 6th of November. Before sampling, one borehole volume was removed from each overburden well using a disposable bailer and 5 litres were removed from each of the bedrock wells. This was undertaken to remove any stagnant water within the well 24 hours post-purging, prior to sampling. Samples taken from overburden wells had a high silt content and the laboratory was requested to filter as required for analysis.

Sample containers were supplied by Alcontrol Laboratories Ltd. These were filled directly from the disposable bailer without filtering. The samples were then placed in a battery operated coolbox for transportation to the Laboratory. The samples were received by the laboratory on the evening of the 6th of November. A chain of custody was completed during the transport of the samples to the laboratory.

4. Permeability Testing

4.1 Purpose

Permeability tests were undertaken at Srahmore to produce K-values (hydraulic conductivity) for each of the overburden monitoring points installed.

4.2 Locations

The permeability tests were carried out at each of the established overburden wells: 1A, 2A, 3A and 4A. Four tests were undertaken in total.

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4.3 Methods and Materials

Both rising head permeability tests and single post-purging recovery tests were undertaken on the four overburden boreholes. The methodology for rising head tests involves the sudden removal of a small volume of water "slug" from the well after which the rise in recovering water level is measured. This displacement of water should not exceed 10% of the equilibrium piezometric head (Ref. 1). MEL used a bailer to perform these slug tests.

A second method of permeability testing was undertaken on most of the overburden boreholes on site. This involved the manipulation of the borehole purging procedure prior to sampling. Immediately after the purging was completed (by means of a 2" Honda pump) borehole water level recovery was monitored. This recovery data was used to provide a K-value for the aquifer and is likely to represent a larger volume of aquifer around the monitoring well than for the slug test results (scale factor). A summary of all permeability testing is provided in Appendix B.

The data collected was processed using aquifer analysing software, AQTESOLV. This software provides a suite of analytical solutions for determining aquifer properties from pumping tests and slug tests. From the data supplied on borehole installation design and from the static water levels recorded during fieldwork, an unconfined sands and gravel aquifer is identified at the site. In this context, two analytical solutions were used to derive K-values for the overburden aquifer. These are Hvorslev (1951) and Bouwer-Rice (1976) (Ref. 2).

5. Results

Results of the MEL's investigation work are presented in the Appendices A (summary of pre-sampling borehole purging results), Appendix B (summary of permeability test results), Appendix C (aqtesolv cuve fitted graphs) at the back of this report.

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6. References

1. British Standards Institution (1999). *Code of Practice for Site Investigations - BS 5930.*

2. Kruseman, G. P., and de Ridder, N. A., (1992). *Analysis and Evaluation of Pumping Test Data.* ILRI Publication 47, The Netherlands.

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Appendix A

Summary of Pre-Sampling Borehole Purging Results

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Appendix A

VARIABLE DATA

Seasonal monitoring data

General				Water levels		Pre-Sampling Purging			
Site ID	Weather	MEL operatives	Date (dd/mm/yy)	Static Water level (mbRef)	Measured Depth (mbRef)	One (1) borehole volume (BHV) (Litres)	Three (3) borehole volume for purging	Volume withdrawn (Litres)	BHV's withdrawn
BH 1A	Wet and Windy	LD	11/04/2003	2.57	8.40	24.8	74.25	103.00	4.16
BH 1B	Wet and Windy	LD	11/04/2003	2.85	23.65	79.5	238.41	275.00	3.46
BH 2A	Wet and Windy	LD	11/05/2003	3.25	6.04	10.6	31.74	42.00	3.97
BH 2B	Wet and Windy	LD	11/05/2003	3.23	23.50	78.0	234.00	165.00	2.12
BH 3A	Wet and Windy	LD	11/05/2003	2.02	5.56	11.5	34.38	52.00	4.54
BH 3B	Wet and Windy	LD	11/05/2003	2.24	15.78	53.0	158.85	155.00	2.93
BH 4A	Wet and Windy	LD	11/05/2003	2.51	29.00	105.8	317.37	384.00	3.63

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Appendix B

Summary of Permeability Test Results

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Appendix B

Summary of Permeability Tests

Borehole & Aquifer Details		*2 K Values according to Methodology Used (up to 3 types)				
Borehole ID	Aquifer*1	Rising Head Test (Hvorslev)	Rising Head Test (Bouwer-Rice)	Recovery (Hvorslev)	Recovery (Bouwer-Rice	Average
BH-1/A	Unconfined	N/a	N/a	3.654E-07	2.553E-07	3.104E-07
BH-2/A	Unconfined	2.030E-07	1.143E-07	7.092E-07	4.130E-07	3.599E-07
BH-3/A	Unconfined	1.210E-06	7.194E-07	N/a	N/a	9.647E-07
BH-4/A	Unconfined	2.632E-06	2.273E-06	N/a	N/a	2.453E-06
Average		1.348E-06	1.036E-06	5.373E-07	3.342E-07	1.022E-06
Max		2.632E-06	2.273E-06	7.092E-07	4.130E-07	2.453E-06
Min		2.030E-07	1.143E-07	3.654E-07	2.553E-07	3.104E-07

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*1 The aquifer is identified as being unconfined based on well installation data supplied (MEL Doc. Ref. 1322-2543) and from water levels recorded on 04-06/11/03.

*2 Where duplicate tests were undertaken, an average is provided per analytical solution

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Appendix C

Aqtesolv Curve Fitted Graphs

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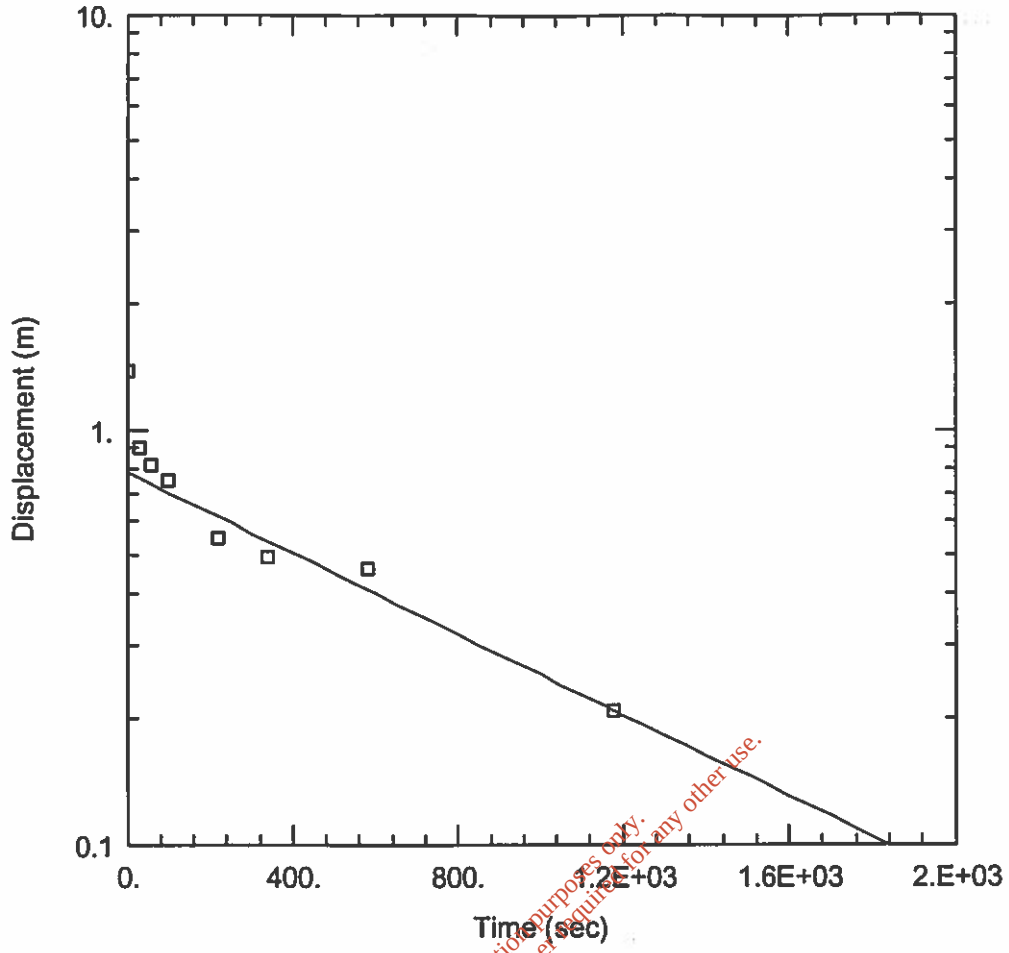

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1A - RECOVERY TEST 1

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A\1A data Recovery.aqt
Date: 11/18/03 Time: 16:55:53

PROJECT INFORMATION

Company: Minerex Environmental Limited
Client: TES Consulting Engineers
Project: 1322-Q1
Test Location: Srahmore, Bangor, Co. Mayo
Test Well: 1A
Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 10. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (1A)

Initial Displacement: 1.38 m
Water Column Height: 6.28 m
Casing Radius: 0.026 m
Wellbore Radius: 0.05 m
Screen Length: 8. m
Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 4.687E-07 m/sec
y0 = 0.7864 m

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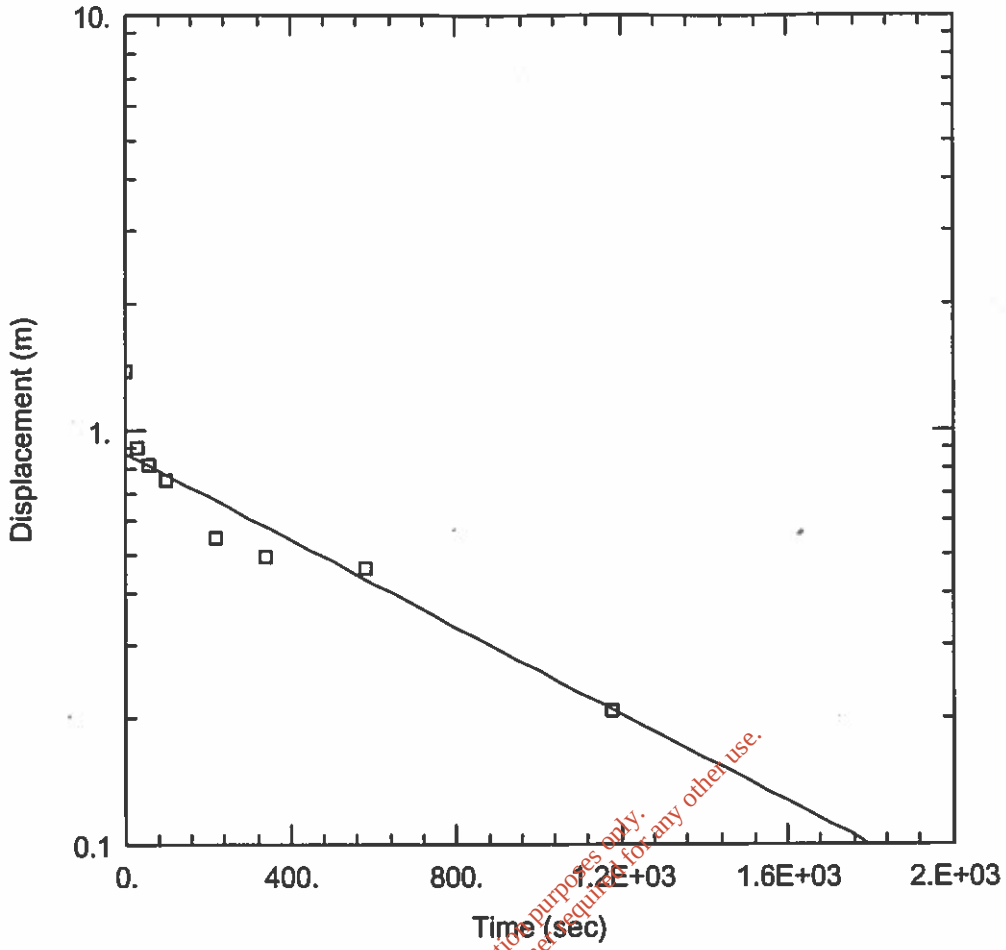

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1A - RECOVERY TEST 1

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A Data Recovery 1.aqt
Date: 11/18/03 Time: 17:00:02

PROJECT INFORMATION

Company: Minerex Environmental Limited
Client: TES Consulting Engineers
Project: 1322-Q1
Test Location: Srahmore, Bangor, Co. Mayo
Test Well: 1A
Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 10. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (1A)

Initial Displacement: 1.38 m
Casing Radius: 0.026 m
Screen Length: 8. m
Water Column Height: 6.28 m
Wellbore Radius: 0.05 m
Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined
K = 3.443E-07 m/sec
Solution Method: Bouwer-Rice
y0 = 0.8784 m

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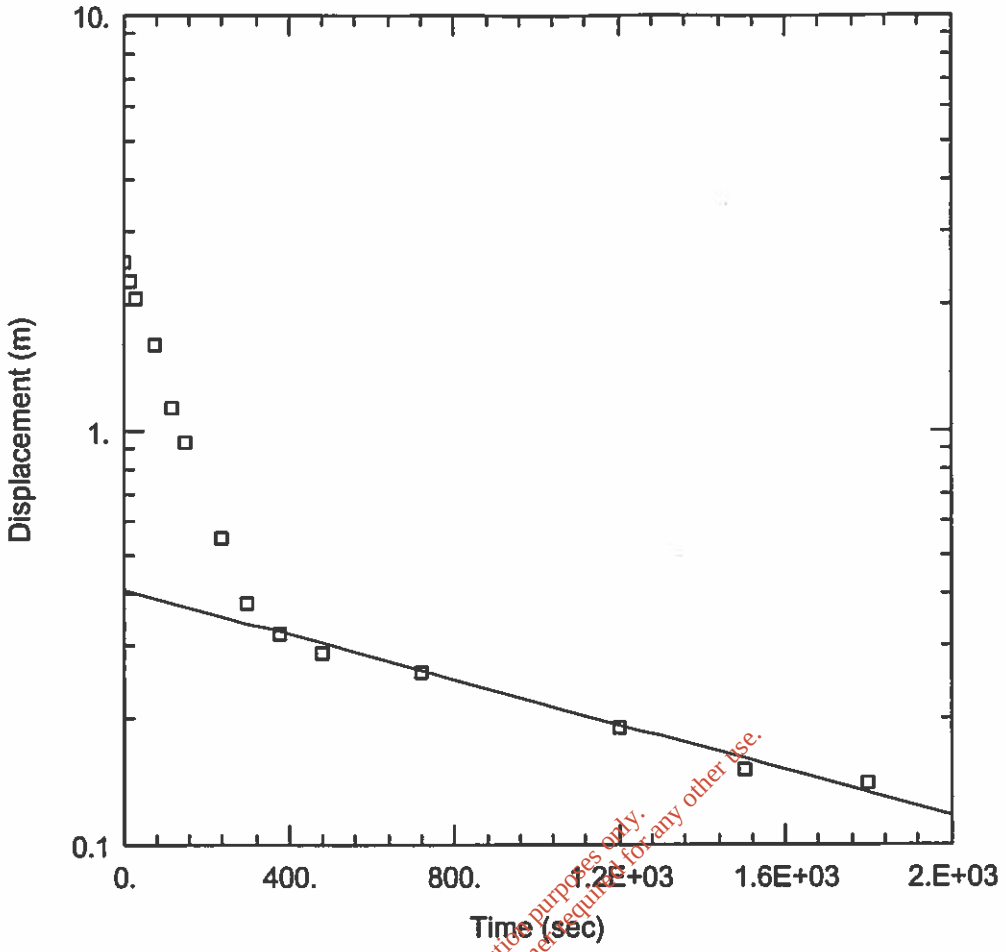

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1A - RECOVERY TEST 2

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A - FINAL\1A Data Recovery 2.aqt
Date: 11/18/03 Time: 17:05:15

PROJECT INFORMATION

Company: Minerex Environmental Limited
Client: TES Consulting Engineers
Project: 1322-Q1
Test Location: Srahmore, Bangor, Co. Mayo
Test Well: 1A
Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 10. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (1A)

Initial Displacement: 2.53 m
Casing Radius: 0.026 m
Screen Length: 8. m
Water Column Height: 6.28 m
Wellbore Radius: 0.05 m
Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined
K = 2.621E-07 m/sec
Solution Method: Hvorslev
y0 = 0.4114 m

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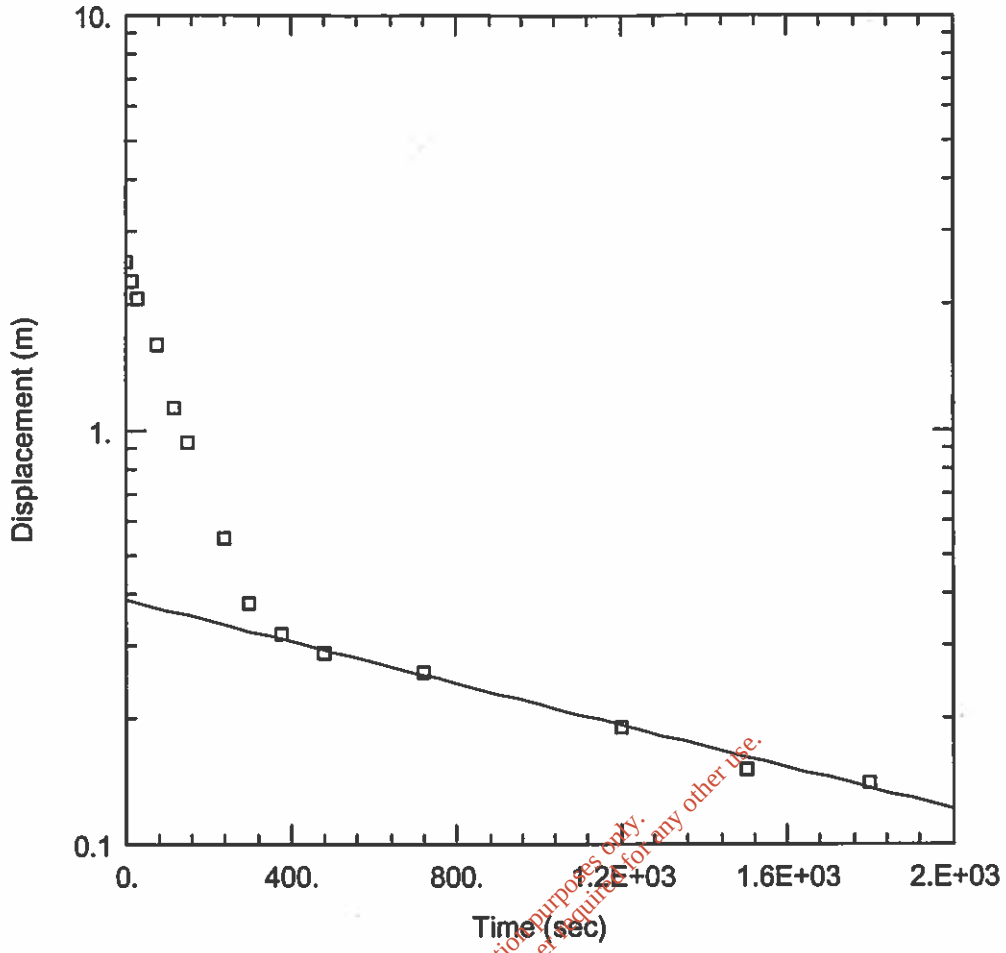

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1A - RECOVERY TEST 2

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A - FINAL\1A Data Recovery 2.aqt
Date: 11/18/03 Time: 17:04:50

PROJECT INFORMATION

Company: Minerex Environmental Limited
Client: TES Consulting Engineers
Project: 1322-Q1
Test Location: Srahmore, Bangor, Co. Mayo
Test Well: 1A
Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 10. m
Anisotropy Ratio (Kz/Kr): 1.

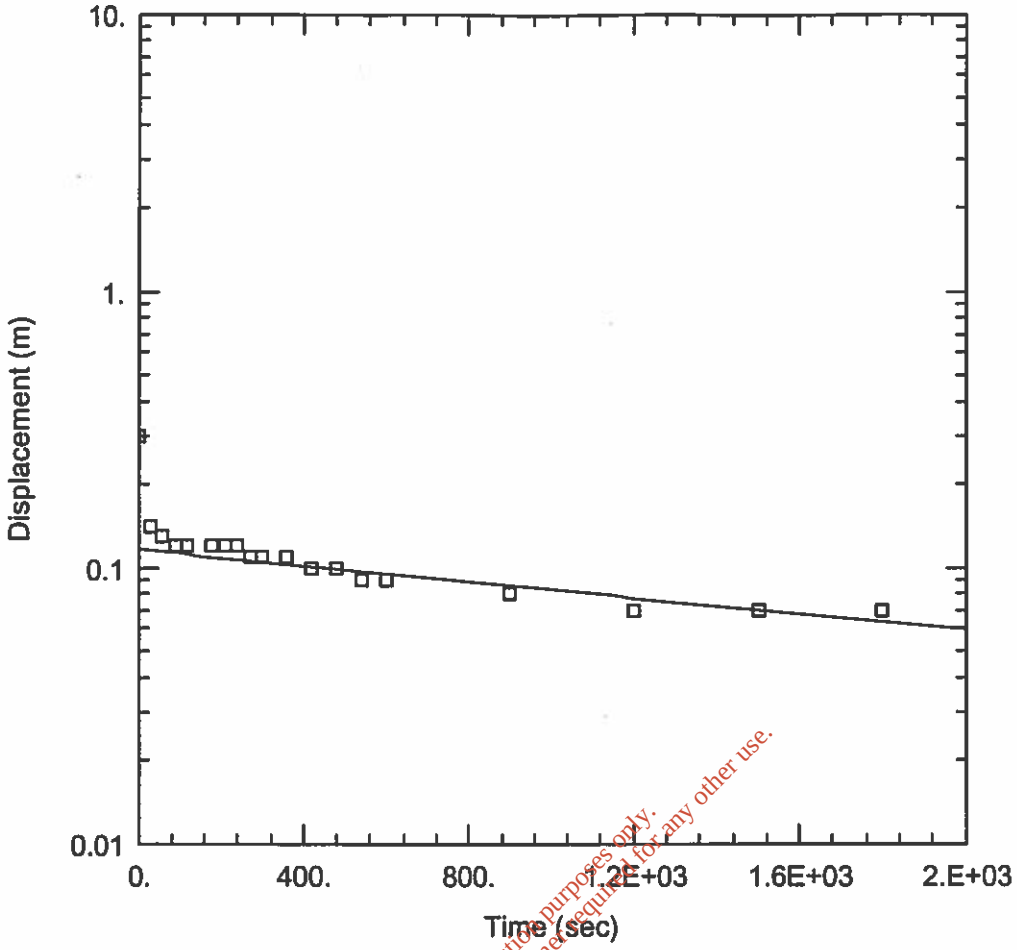
WELL DATA (1A)

Initial Displacement: 2.53 m
Casing Radius: 0.026 m
Screen Length: 8. m
Water Column Height: 6.28 m
Wellbore Radius: 0.05 m
Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.663E-07 m/sec
y0 = 0.3884 m

EPA Export 08-07-2014:23:45:59



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2A - SLUG TEST

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A - FINAL\2A SLUG.aqt
Date: 11/18/03 Time: 17:17:45

PROJECT INFORMATION

Company: Minerex Environmental Limited
Client: TES Consulting Engineers
Project: 1322-Q1
Test Location: Srahmore, Bangor, Co. Mayo
Test Well: 2A
Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 7. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (2A)

Initial Displacement: 0.3 m Water Column Height: 2.64 m
Casing Radius: 0.026 m Wellbore Radius: 0.05 m
Screen Length: 5. m Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
K = 2.03E-07 m/sec y0 = 0.1157 m

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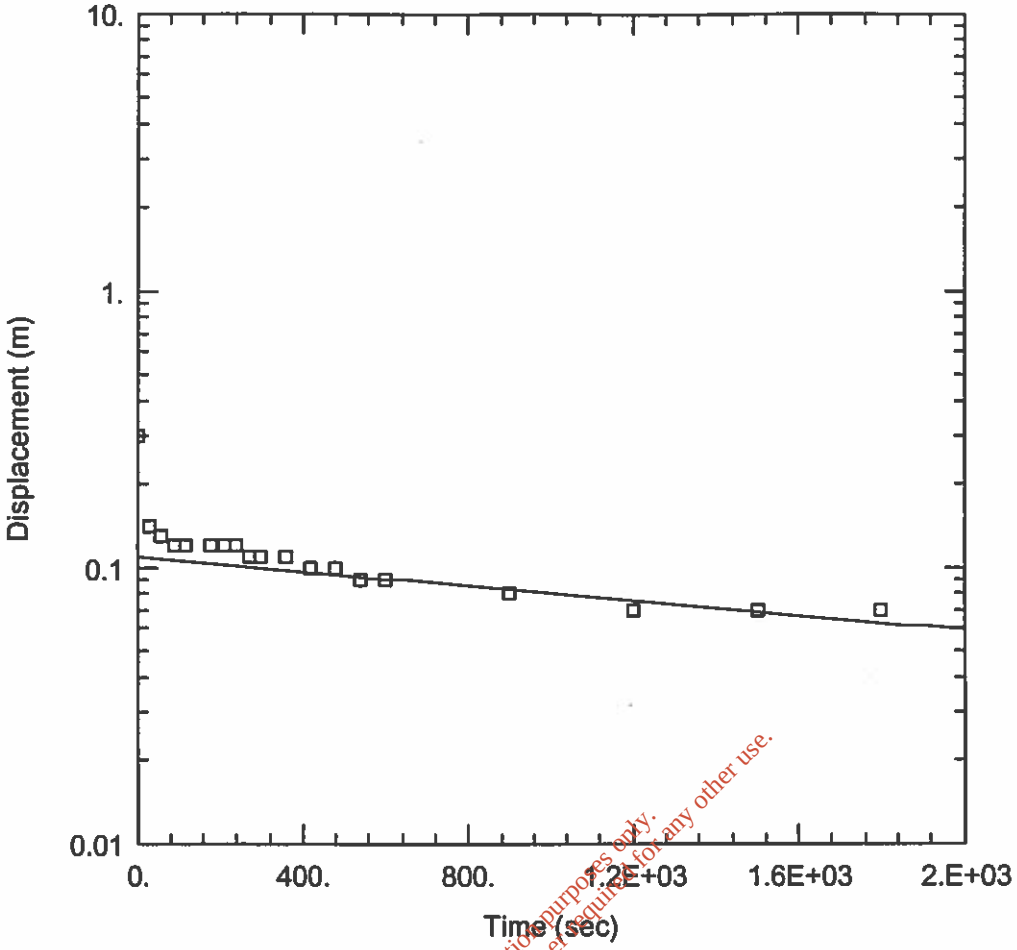

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2A - SLUG TEST

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A - FINAL\2A SLUG.aqt
Date: 11/18/03 Time: 17:18:43

PROJECT INFORMATION

Company: Minerex Environmental Limited
Client: TES Consulting Engineers
Project: 1322-Q1
Test Location: Srahmore, Bangor, Co. Mayo
Test Well: 2A
Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 7. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (2A)

Initial Displacement: 0.3 m Water Column Height: 2.64 m
Casing Radius: 0.026 m Wellbore Radius: 0.05 m
Screen Length: 5. m Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
K = 1.143E-07 m/sec y0 = 0.1093 m

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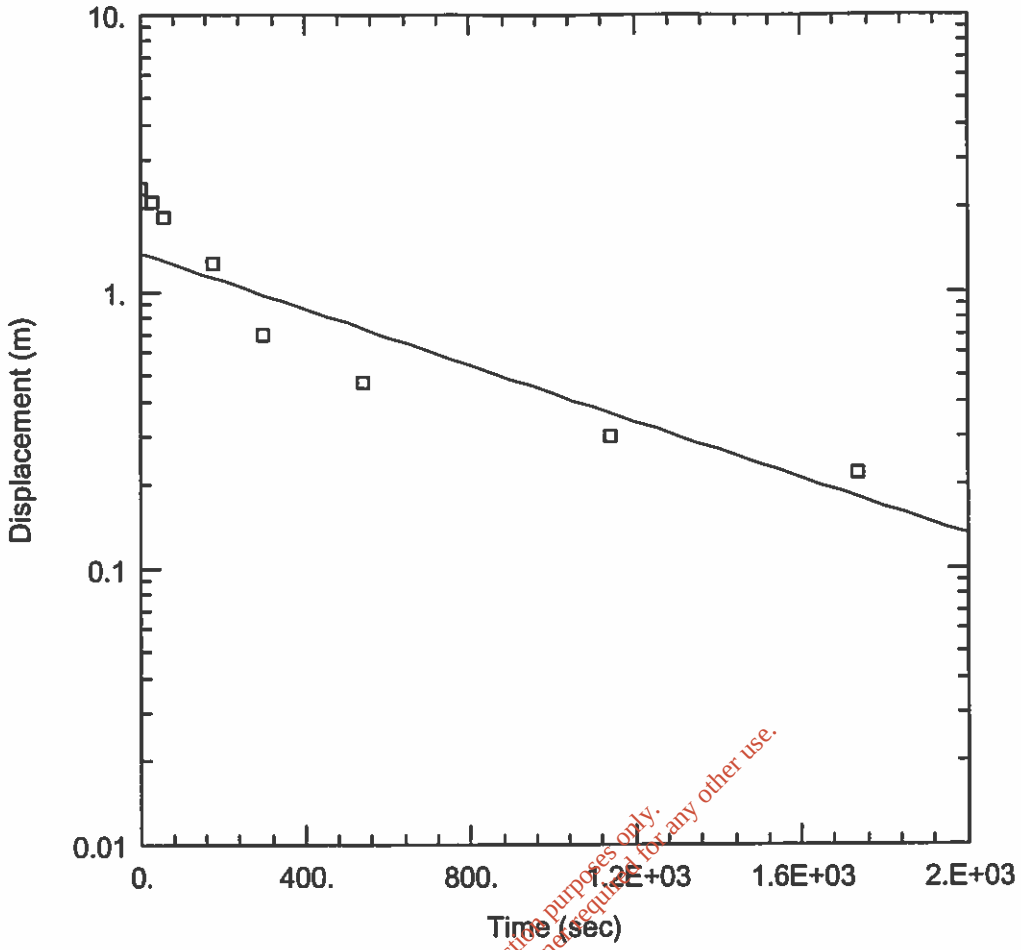

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2A - RECOVERY

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A - FINAL\2A Recovery.aqt
Date: 11/18/03 Time: 17:24:58

PROJECT INFORMATION

Company: Minerex Environmental Limited
Client: TES Consulting Engineers
Project: 1322-Q1
Test Location: Srahmore, Bangor, Co. Mayo
Test Well: 2A
Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 7. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (2A)

Initial Displacement: 2.34 m
Casing Radius: 0.026 m
Screen Length: 5. m
Water Column Height: 2.64 m
Wellbore Radius: 0.05 m
Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined
K = 7.092E-07 m/sec
Solution Method: Hvorslev
y0 = 1.371 m

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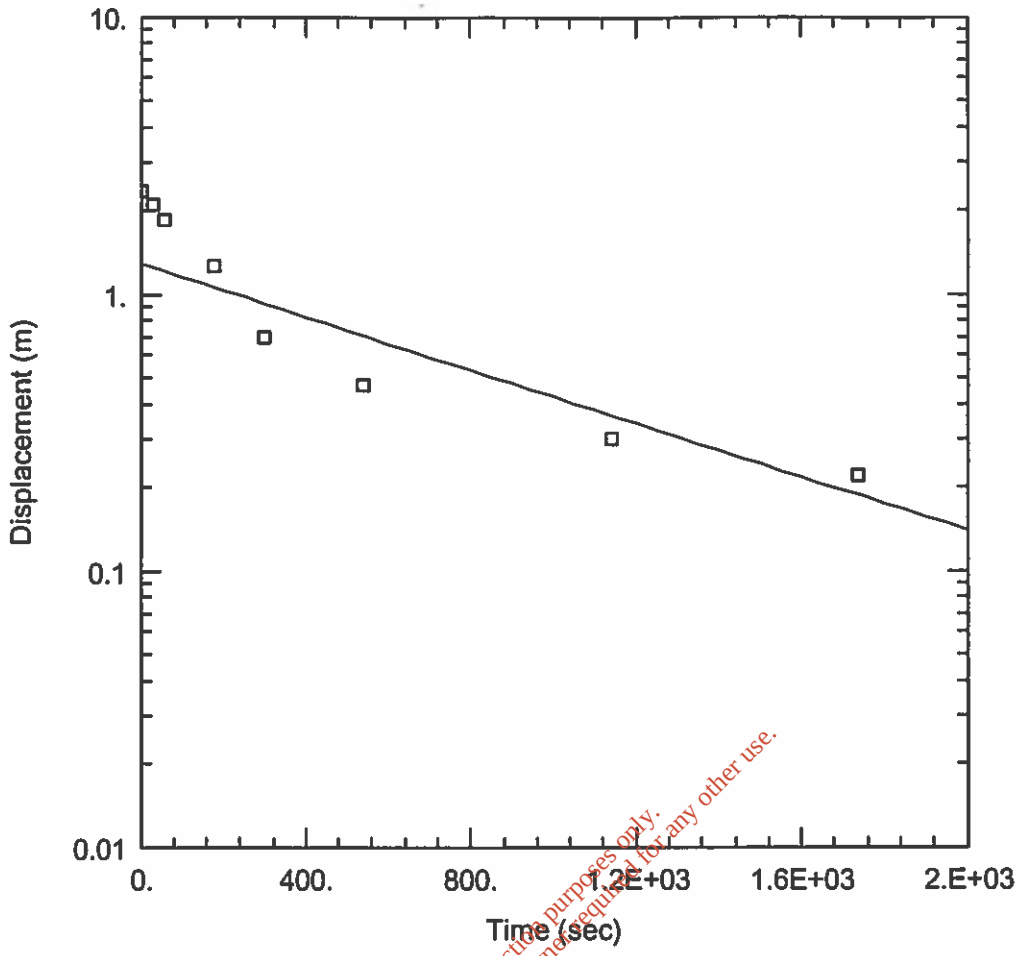

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2A - RECOVERY

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A - FINAL\2A Recovery.aqt
Date: 11/18/03 Time: 17:24:19

PROJECT INFORMATION

Company: Minerex Environmental Limited
Client: TES Consulting Engineers
Project: 1322-Q1
Test Location: Srahmore, Bangor, Co. Mayo
Test Well: 2A
Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 7. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (2A)

Initial Displacement: 2.34 m
Water Column Height: 2.64 m
Casing Radius: 0.026 m
Wellbore Radius: 0.05 m
Screen Length: 5. m
Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.13E-07 m/sec
y0 = 1.284 m

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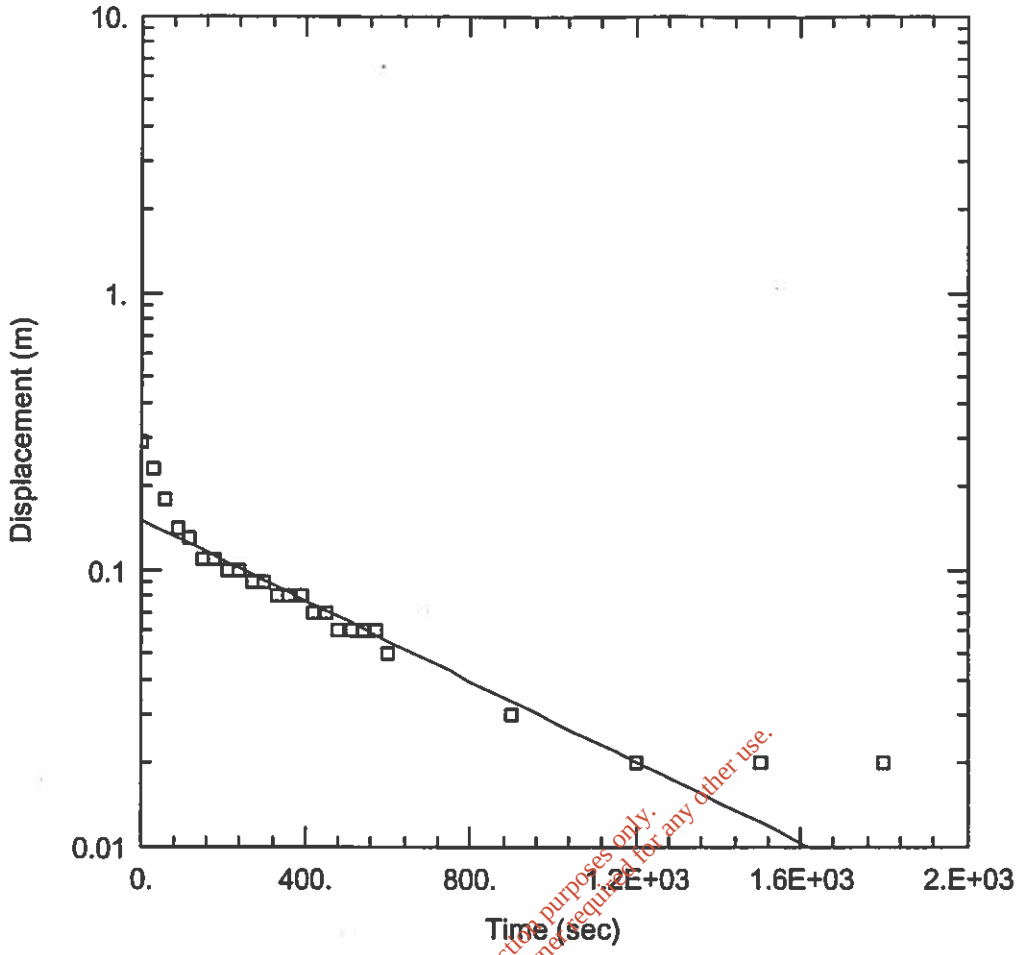

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3A - SLUG

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A - FINAL\3A SLUG.aqt
Date: 11/18/03 Time: 17:33:49

PROJECT INFORMATION

Company: Minerex Environmental Limited
Client: TES Consulting Engineers
Project: 1322-Q1
Test Location: Srahmore, Bangor, Co. Mayo
Test Well: 3A
Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 5. m Anisotropy Ratio (Kz/Kr): 1.

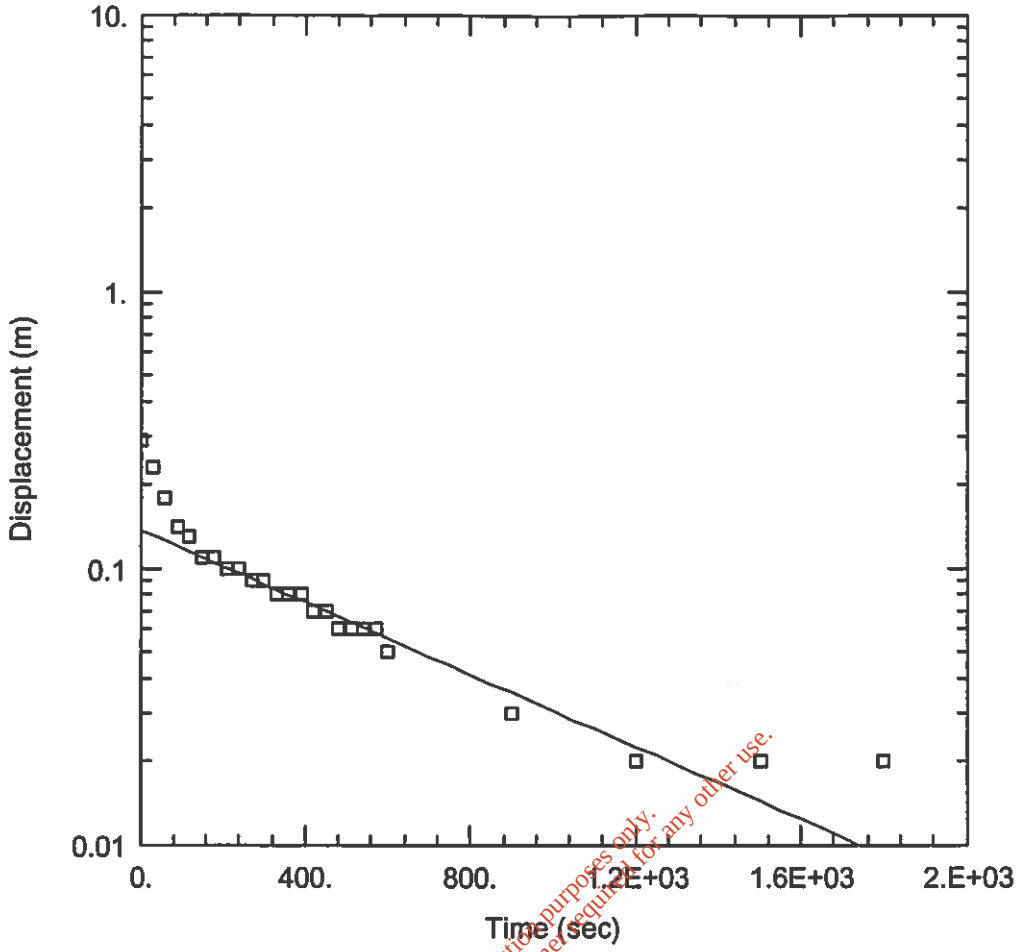
WELL DATA (3A)

Initial Displacement: 0.29 m Water Column Height: 3.12 m
Casing Radius: 0.026 m Wellbore Radius: 0.05 m
Screen Length: 4. m Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
K = 1.21E-06 m/sec y0 = 0.1515 m

EPA Export 08-07-2014:23:45:59



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3A - SLUG

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A - FINAL\3A SLUG.aqt
Date: 11/18/03 Time: 17:34:25

PROJECT INFORMATION

Company: Minerex Environmental Limited
Client: TES Consulting Engineers
Project: 1322-Q1
Test Location: Srahmore, Bangor, Co. Mayo
Test Well: 3A
Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 5. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (3A)

Initial Displacement: 0.29 m Water Column Height: 3.12 m
Casing Radius: 0.026 m Wellbore Radius: 0.05 m
Screen Length: 4. m Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
K = 7.194E-07 m/sec y0 = 0.1373 m

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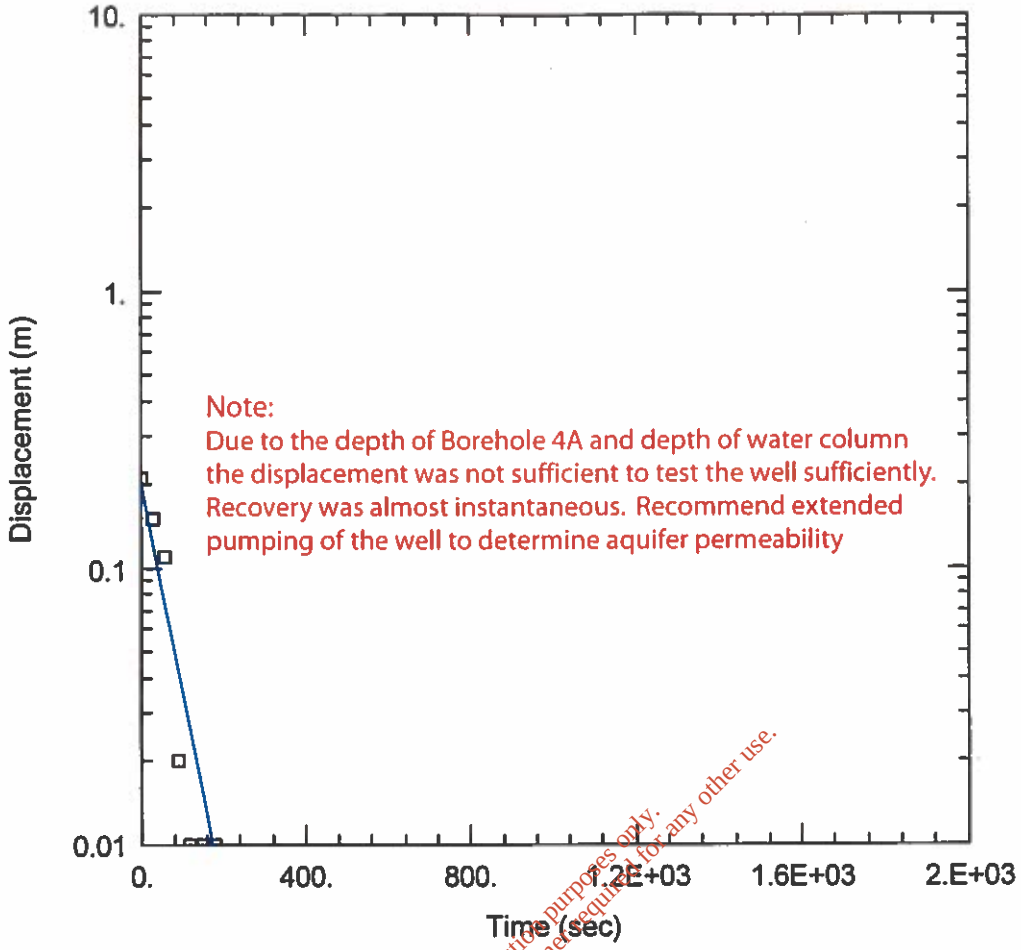

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4A - SLUG

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A - FINAL\4A SLUG (erroneous).aqt
Date: 11/18/03 Time: 18:00:36

PROJECT INFORMATION

Company: Minerex Environmental Limited
Client: TES Consulting Engineers
Project: 1322-Q1
Test Location: Srahmore, Bangor, Co. Mayo
Test Well: 4A
Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 28. m
Anisotropy Ratio (Kz/Kr): 1.

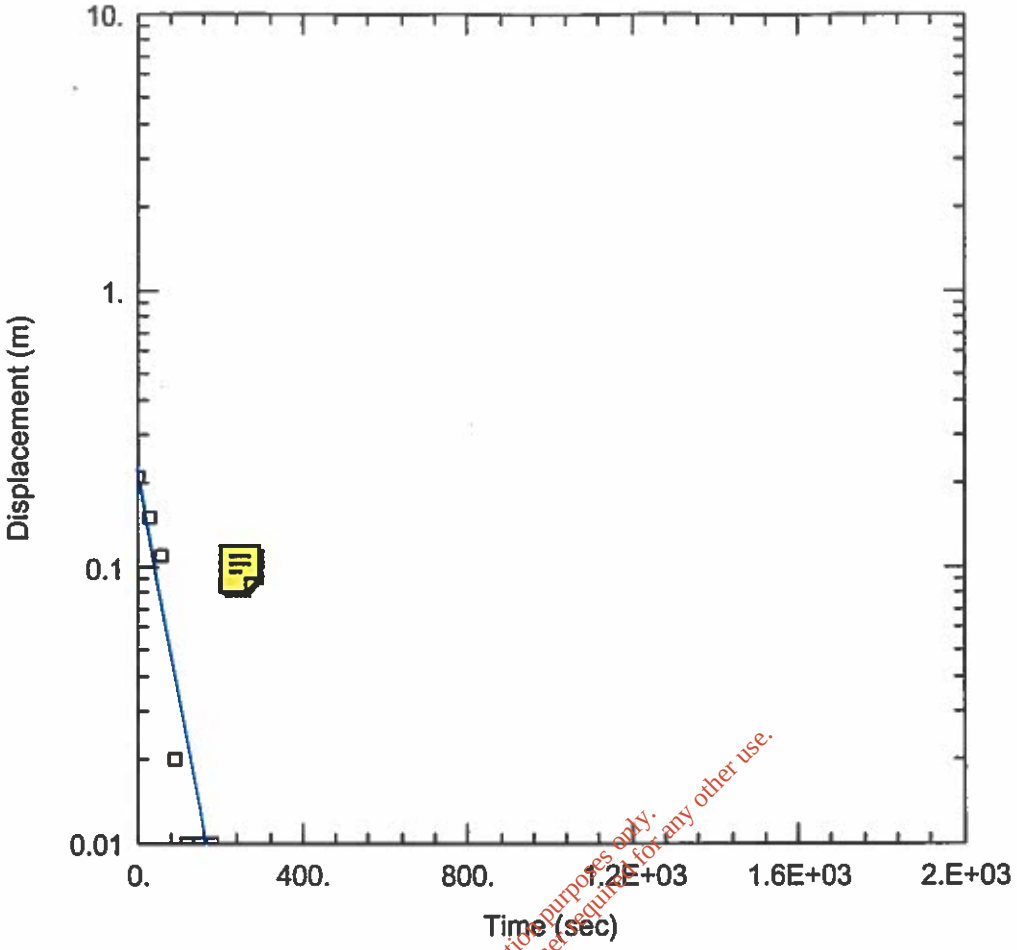
WELL DATA (4A)

Initial Displacement: 0.21 m
Casing Radius: 0.026 m
Screen Length: 27. m
Water Column Height: 27.3 m
Wellbore Radius: 0.05 m
Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined
K = 2.632E-06 m/sec
Solution Method: Hvorslev
y0 = 0.2015 m

EPA Export 08-07-2014:23:45:59



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4A - SLUG

Data Set: P:\1322 (Shell)\aqt\1322-2548\1A - FINAL\4A SLUG (erroneous).aqt
Date: 11/18/03 Time: 17:58:52

PROJECT INFORMATION

Company: Minerex Environmental Limited
Client: TES Consulting Engineers
Project: 1322-Q1
Test Location: Srahmore, Bangor, Co. Mayo
Test Well: 4A
Test Date: 04-11-03

AQUIFER DATA

Saturated Thickness: 28. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (4A)

Initial Displacement: 0.21 m
Casing Radius: 0.026 m
Screen Length: 27. m
Water Column Height: 27.3 m
Wellbore Radius: 0.05 m
Gravel Pack Porosity: 0.35

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.273E-06 m/sec
y0 = 0.2239 m

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Appendix 8

Packer Tests

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PACKER TEST RESULTS

Contract: Peat Deposit site at Bangor Erris
Client: Enterprise Oil
Engineer: TES
Borehole: 1B
Bh. size: HQ
Date: 24.10.'03

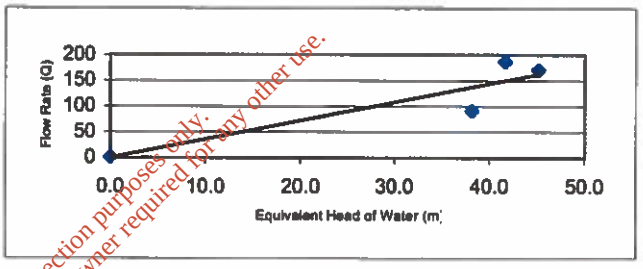
Top of test section (m bgl)	15.5
Bottom of test section (m bgl)	23.7
Centre of test section (m bgl)	19.6
Length of test section (m bgl)	8.2
Pressure gauge height (m agl)	0.95
Initial depth to G.W. (m bgl)	19.6
Packer inflation pressure (psi)	120

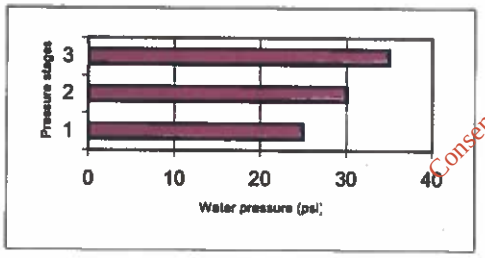
1. Site Records

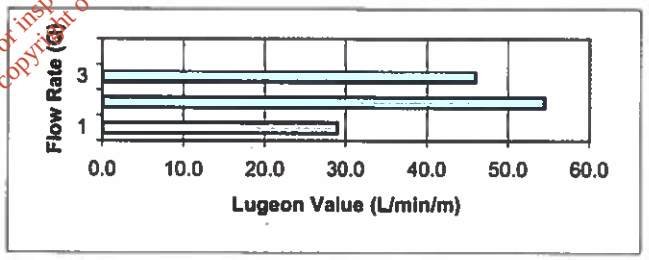
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (gal)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min gals
1	25	157265	157377	157468	157563	112	91	95	298
2	30	157563	157838	158010	158176	275	172	166	613
3	35	158176	158388	158563	158737	212	175	174	561

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Lugeon Value l/min/m
1	38.1	90.3	*28.9*
2	41.6	185.8	*54.4*
3	45.1	170.0	*45.9*
5	0	0	0







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3. Permeability (k) analysis

Lugeon Value Used (l/min) 32.3

k (m/sec) 3.23E-06
k (m/day) 2.79E-01

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PACKER TEST RESULTS

Contract: Peat Deposit site at Bangor Erris
Client: Enterprise Oil
Engineer: TES
Borehole: 2B
Bh. size: HQ
Date: 31.10.'03

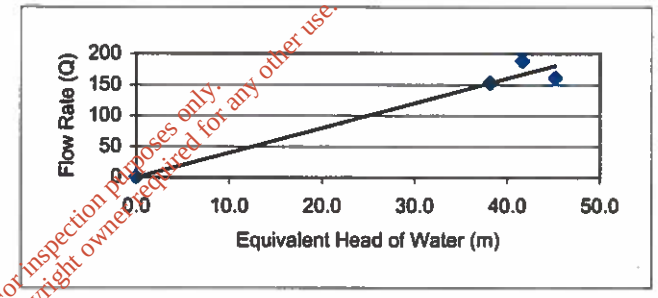
Top of test section (m bgl)	15.75
Bottom of test section (m bgl)	23.5
Centre of test section (m bgl)	19.625
Length of test section (m bgl)	7.75
Pressure gauge height (m agl)	0.95
Initial depth to G.W. (m bgl)	19.625
Packer inflation pressure (psi)	150

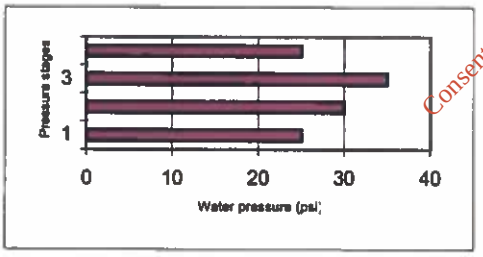
1. Site Records

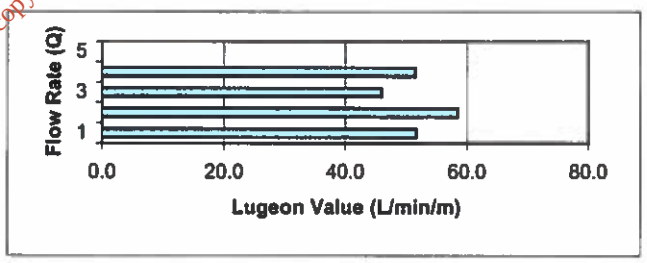
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (gal)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min gals
1	25	159215	159382	159550	159718	167	168	168	503
2	30	159718	159925	160133	160340	207	208	207	622
3	35	160430	160546	160753	160960	116	207	207	530
4	25	160960	161128	161295	161461	168	167	166	501

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Lugeon Value l/min/m
1	38.1	152.4	*51.6*
2	41.7	188.5	*58.4*
3	45.2	160.6	*45.9*
4	38.1	151.8	*51.4*
5	0	0	0







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3. Permeability (k) analysis

Lugeon Value Used (l/min) 51.8

k (m/sec) 5.18E-06
k (m/day) 4.48E-01

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PACKER TEST RESULTS

Contract:	Peat Deposit site at Bangor Erris
Client:	Enterprise Oil
Engineer:	TES
Borehole:	**3B**
Bh. size:	HQ
Date:	31.10.'03

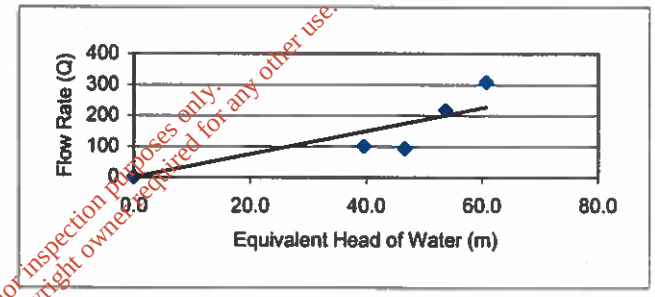
Top of test section (m bgl)	11.75
Bottom of test section (m bgl)	16
Centre of test section (m bgl)	13.875
Length of test section (m bgl)	4.25
Pressure gauge height (m agl)	1.1
Initial depth to G.W. (m bgl)	13.875
Packer inflation pressure (psi)	190

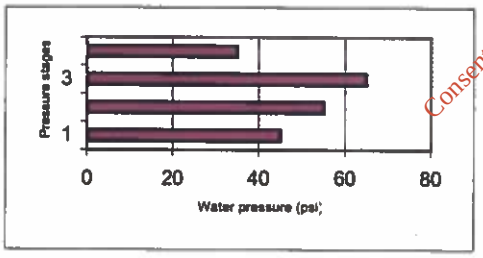
1. Site Records

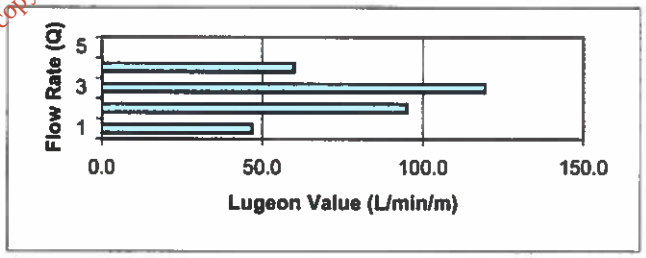
Pressure stage	Water pressure (psi)	Flow meter readings				Water taken over time period (gal)			
		start	5 min	10 min	15 min	0-5 min	5-10 min	10-15 min	0-15 min gals
1	45	162315	162402	162511	162621	87	109	110	306
2	55	162621	162851	163091	163334	230	240	243	713
3	65	163582	163929	164206	164596	347	277	390	1014
4	35	164596	164708	164820	164928	112	112	108	332

2. Calculations

Pressure stage	Equiv. head of water (m)	Flow rate (Q) l/min	Lugeon Value l/min/m
1	46.6	92.7	*46.8*
2	53.6	216.1	*94.8*
3	60.7	307.3	*119.2*
4	39.6	100.6	*59.8*
5	0	0	0







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3. Permeability (k) analysis

Lugeon Value Used (l/min)	80.1
k (m/sec)	8.01E-06
k (m/day)	0.69

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Appendix 9

Geotechnical Assessment

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CORRIB FIELD DEVELOPMENT

PRELIMINARY GEOTECHNICAL DESIGN FOR SRAHMORE PEAT DEPOSITION SITE

Prepared for:

TES Consulting Engineers

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AGEC Ltd

5 Kilcarrig Street

Bagenalstown

Co. Carlow

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DOCUMENT APPROVAL FORM

Document title:	Preliminary Geotechnical Design for Srahmore Peat Deposition Site		
File reference Number:	382_044	Document Revision No.	2
Note: Amendments marked with line in right-hand margin			

File Reference Number	Document Revision No.	Amendment/Comment

Task	Nominated authority	Approved (signature and date)
Prepared by	Authors: Paul Jennings	Paul Jennings 11.12.03
Checked by	Geotechnical Project Manager: Peter Rutty	P. Rutty 4/12/03
Approved by	Geotechnical Project Director: Turlough Johnston	T. Johnston 11-12-03
Quality check	Quality Manager: Marion English	M. English 11/12/03

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Table 2 Adopted Design Parameters for Ex Situ Peat
Table 3 Adopted Design Parameters for Mineral Soil
Table 4 Summary of Slope Factor of Safety in Area 6

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Figure 1 Site Location
Figure 2 Site Layout Plan
Figure 3 Profile of Undrained Shear Strength (c_u) of Peat with Depth from CPT Results
Figure 4 Factor of Safety for Global Stability - Case (1)
Figure 5 Factor of Safety for Localised Stability - Case (2)

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APPENDICES

Appendix A Phase 1 Ground Investigation Results
Appendix B Phase 2 Ground Investigation Results
Appendix C Review of Effective Stress Parameters for Peat
Appendix D Risk Register

DRAWINGS

Drawing No. 382_001 Preliminary Design Ground Profile for Areas 5 & 6 – Section 1-1
Drawing No. 382_002 Preliminary Design Ground Profile for Areas 5 & 6 – Section 2-2
Drawing No. 382_003 Preliminary Design Ground Profile for Areas 5 & 6 – Section 3-3

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1 INTRODUCTION

The Srahmore Peat Deposition Area is located about 1 km west of Bangor, County Mayo. The site is situated between the R313 and Bangor to Gweesalia roads in an area formerly used for peat harvesting by Bórd na Mona (Figure 1).

It is proposed to use the site as a deposition area for peat arisings from the excavation for the proposed gas terminal platform located at Bellanaboy, County Mayo.

Applied Ground Engineering Consultants Ltd (AGEC) was engaged in November 2003 by Shell E&P Ireland Ltd to carry out a preliminary geotechnical design of the site, which included the following.

(1) Procurement of ground investigation data at site for design.

(2) Interpretation of ground investigation data and selection of appropriate design parameters.

(3) Assess and clearly demonstrate that the following elements of the proposed works have an acceptable factor of safety with respect to global and local stability in the temporary as well as permanent condition.

(a) Access Roads
(b) Deposition Areas
(c) Peat Transfer Area and Car park

(4) A geotechnical risk register prepared for all activities relating to the site and the deposition activities envisaged, with the appropriate corrective and control features identified.

(5) Observation and instrumentation requirements. The long and short-term requirements, if any, for observation and instrumentation of the site.

Details of site hydrology and drainage together with a summary of soils and geology are addressed in the main Environmental Impact Statement (TES, 2003).

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2 SITE DESCRIPTION

The proposed Srahmore Peat Deposition Site (SPDS) is located to the south of the R313 (Figure 1) in an area of relatively flat to gently sloping ground. The natural ground surface at the site slopes gently from northeast to southwest with a fall about 0.2°, that is 5m fall over a distance of 1500m.

Several minor streams drain the site. These streams feed into the Munkin River to the west and the Owenmore River to the south.

The SPDS is in two parts, referred to as Area 5 and Area 6 (Figure 2). Each of these areas originally comprised natural blanket peat which has since been largely cutaway. The depth of peat cutting is some 1.5 to 2.5m.

Peat has been cutaway from Area 5 and 6 leaving a series of high- and lowfields.

(1) Lowfields comprise areas where peat has been cut-away to near the top of the underlying mineral soil, typically a depth of 1.5 to 2.5m. In places the mineral soil can be seen exposed in the base of the low field. Lowfields are typically 120 to 150m wide and are separated by high fields.

(2) Highfields comprise a strip of intact peat that has been left upstanding between low fields. The strip is some 15m wide, and has typically been used to facilitate vehicular and train access during peat harvesting operations.

The cutaway areas form an excavated basin within and surrounded by existing peat land. The highfields form internal divides within the cutaway areas which further compartmentalise the cutaway areas into rectangular excavated basins (Figure 2).

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3 PROPOSED WORKS

Within the SPDS it is proposed to use Area 5 as a reception area for peat arriving on site. The proposed work in Area 5 will include an access road from the R313. A hardstanding for peat transfer will be constructed at the end of the access road for peat handling and car parking.

Area 6 is proposed to be used as the deposition area for peat excavated from the proposed gas terminal site at Bellanaboy. The proposed average depth of placed peat within the deposition area is given as 1.04m.

The proposed sequence of placing peat in Area 6 is given in the main Environmental Impact Statement (TES, 2003). A summary is given below.

(1) Low ground bearing pressure (Haku) trailers will transport the peat from the reception area to highfields in Area 6 via internal haul roads constructed on existing peat.

(2) Haku trailers will travel along internal roadways which will be constructed on highfields in Area 6 and empty the peat by tipping onto the side of the highfield.

(3) Excavators will remove the peat from the highfield and place the peat onto the lowfield. Peat will then be bulldozed towards the centre of the lowfield to create a cambered surface with highest point in the centre sloping back toward the highfields.

(4) The height of placed peat will generally be of the order of 1.4 to 1.8m at the highest point in the centre above the existing ground levels, with a fall towards the highfields. The edge of the placed peat will be offset from the bottom toe of each of the highfields where drainage ditches are to be constructed.

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4 SUPERFICIAL DEPOSITS

The superficial deposits within the SPDS can be briefly classified into the following main types.

(1) Peat
(2) Glacial Till
(3) Weathered Rock

In general terms all superficial deposit types other than peat may be referred to as mineral soils. Exposures below the base of the peat are limited to trial pits, which indicate till underlying peat. The extent of weathered rock below till is not known, as boreholes were open-holed to top of competent rock.

4.1 Peat

Blanket peat originally covered the site. Most of the peat has been removed from the lowfields, leaving typically less than 1m thickness of peat. Original peat depth was estimated as typically 3 to 4m. Locally deeper areas of peat, up to 6m adjacent to R313, were recorded.

Based on a general soil map of Ireland (An Foras Taluntais, 1980), the site is shown to be covered in low-level blanket/basin peat.

The upper about 1m of peat is generally very fibrous and possibly desiccated which results in a relatively stronger and stiffer upper layer. Peat was described using BS: 5930 (BSI, 1999) as soft slightly moist brown PEAT with occasional fragments and large pieces of bogwood. Peat appeared to lie directly on glacial till.

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4.2 Glacial Till

Till, typically derived from local bedrock, underlies the peat. The thickness of till in Area 6 is estimated to vary from 6 to 14m based on the depth of superficial deposits given in borehole logs. Borehole logs do not distinguish between till and weathered rock, and it is possible that weathered rock is present in the lower part of the superficial deposits.

Based on trial pit logs, till is present at some locations as an upper cohesive deposit underlain by a granular deposit. Till was described from trial pits using BS: 5930 as follows.

(1) Upper cohesive deposit. Described as generally firm brown sandy CLAY. Given the presence of bogwood in the peat, this suggests that prior to peat formation the site was formerly forested, and therefore a buried soil surface layer is likely present. The upper cohesive deposit possibly represents the remnants of a buried soil surface layer. This layer does not appear to be widespread.

(2) Lower granular layer. Described as generally grey to yellow/brown clayey to slightly clayey occasionally silty gravelly fine- to medium-grained SAND with occasional to some sub-angular to sub-rounded gravels, cobbles and boulders of quartzite, schist and red sandstone. The till is layered, with occasional GRAVEL layers also recorded, though no clear stratification between trial pits was recognisable. The lower granular till layer is widespread and is more commonly found immediately below peat.

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4.3 Weathered Rock

Extent and character of weathered rock is not known as borehole logs do not distinguish between till and weathered rock, and it is possible that weathered rock is present at depth. No weathered rock was identified from trial pits which were excavated to about 3m.

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5 SOLID BEDROCK GEOLOGY

The bedrock geology of the area of the SPDS consists of rocks of the Dalradian Supergroup Series (GSI, 1992), which comprises essentially metamorphosed sedimentary rock. Boreholes within Area 6 show the depth to rockhead is variable and ranged from about 6 m bgl in BH3B to 14.3m bgl (BH2B).

The dominant rock type below the site is the Inver Schist Formation, which is a pelitic to semi-pelitic schist. Several sub-ordinate rock types also crop below the site along a northwest to southeast axis. These rock types are generally separated by a fault line and include marble, quartzite and psammitic schist.

Borehole records identified both psammite and quartzite bedrock. Psammite was described as moderately weak to moderately strong, narrowly banded, schistose (dipping 75°), fine- to coarse-grained micaceous to extremely micaceous PSAMMITE. In places the psammite was underlain by quartzite (BH1B) or quartzite was recorded at the top of rockhead (BH3B). Quartzite was described as strong to very strong, massive to narrowly banded (dipping 35° and 60°), fine- to medium-grained micaceous QUARTZITE.

Minor folding has been identified within the schists, with cleavage/schistocity dipping towards the northeast at between 35° and 75°.

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6 GROUND INVESTIGATION

6.1 Fieldwork

Ground investigation work at the SPDS was carried out in 2 phases. Phase 1 was carried out in October/November 2003 on behalf of TES Consulting Engineers (TES) to determine the nature and extent of geological and hydrological characteristics at the site. Phase 2 was carried out in November/December 2003 on behalf of TES by AGEC to provide further information for a geotechnical assessment of the site.

Ground investigation works were carried out by Irish Drilling Ltd (IDL) and Fugro Engineering Services Ltd.

The following ground investigation has been carried out at the SPDS.

(1) Boreholes (7 nos.),
(2) Trial pits (14 nos.),
(3) In situ shear vane testing using handheld vane (7 nos.),
(4) In situ shear vane using rig-mounted mechanical vane, (up to 40 nos.), and
(5) Cone penetration testing (CPT) (up to 80 nos.).

The above boreholes, and some trial pits, together with permeability/pumping tests within rock were carried out in Phase 1 (Appendix A). The results of permeability/pumping tests are not included in this report.

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Trial pits were carried out to a depth of typically 3m using a tracked excavator.

Hand-held shear vanes were generally carried out in trial pits by IDL using a Geonor H-60, 50.8mm diameter vane.

Cone penetration testing (CPT) was carried out by Fugro Ltd using both a 3 tonne mini crawler and 15 tonne mounted CPT rig. The rigs were also used to carry out shear vane testing using a mechanical Geonor H-10, 55mm diameter vane.

Ground investigation results for Phase 1 and 2 are given in Appendix A and B respectively.

6.2 Laboratory Testing

Phase 1 laboratory test results included particle size distribution, five-point compaction and index testing (Appendix A).

Previous experience of laboratory strength testing for peat using a range of triaxial, simple and direct simple shear (DSS) testing apparatus has shown that results can be scattered and difficult to interpret. This is due to the excessive deformations that peat undergoes and the difficulty in defining the resulting failure limit. In situ strength testing possibly provides the most realistic indication of peat strength.

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7 TOPOGRAPHIC SURVEY

A topographic survey of the SPDS was carried out on behalf of TES by Bórd na Mona as part of the Phase 1 investigation. This survey has been used to generate the elevation contours used to generate the geological cross-sections (See Drawing Nos. 382_001 to 003).

Additional detailed level survey was carried out by AGEC at specific locations to supplement the topographic survey.

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8 GEOTECHNICAL ASSESSMENT

8.1 General

A preliminary geotechnical design and assessment of the following elements of the SPDS has been carried out.

(1) Global stability of the deposition area (Area 6) prior to and following peat placement,

(2) Local stability of highfield/lowfield in deposition area (Area 6), and

(3) Assessment of access road, peat transfer area and car park in Area 5

8.2 Factor of Safety for Earthworks Stability

The code of practice for earthworks BS 6031:1981 (BSI, 1981) provides advice on design of both temporary and permanent earthworks. It states that for a first time failure with a good standard of site investigation the design factor of safety (FoS) of should be 1.3 to 1.4.

For the purpose of peat stability a minimum FoS of 1.3 is required.

8.3 Stability Analysis

Stability analysis was carried out using slope stability computer program Talren (Terrasol, 1997) applying Bishop's rigorous method.

Both total and effective stress analyses were examined. Total stress analysis applies to short-term conditions occurring during construction and for a time following construction until construction induced pore water pressures dissipate. Undrained shear strength values, c_u are used for total stress analysis. Effective stress analysis applies to long-term conditions where construction induced excess pore water pressure has dissipated. Effective strength parameters, c' and ϕ', are used together with assessed groundwater conditions.

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9 DESIGN PARAMETERS

9.1 Peat

Undrained shear strength (c_u) of in situ peat was determined using cautious estimates of c_u. Vane results are presented in Appendix A. The following sources were used to assess c_u for peat:

(1) In situ vane testing using both hand-held and mechanical,
(2) In situ cone penetration testing (CPT), and
(3) Results from neighbouring sites.

In situ vane test results are included in Appendix A. Results indicate that strength ranges typically from about $c_{u\ vane}$ of 10 to 23kPa for unfactored vane results.

Vane results from several works on Irish peat have used unfactored vanes (see for example Hanrahan, 1964, Piggott et al., 1992 and AGEC, 2002). These works back-analysed failures and found that unfactored vane results provided a reasonable estimate of the operating shear strength. Furthermore several of the highfields in Area 6 are upstanding by 1.5m to 2.0m with a sub-vertical face. Back-analysis of these faces shows that a minimum $c_{u\ back}$ of about 10kPa is required for stability.

CPT's were carried out across the site to establish cone resistance (q_c) and hence undrained strength ($c_{u\ CPT}$) with depth in peat (Appendix B). The relationship between $c_{u\ CPT}$ and q_c is based on an approximation of the bearing capacity equation (Sanglerat, 1972) which requires cone factor (N_k) to be determined.

Based on previous experience, $N_k = 15$ was adopted. Previous work (AGEC, 2002 and 2003) indicates that, whilst there is a scatter of data, this provides a reasonable cautious estimate of undrained strength of peat.

Depth profile of peat c_u with depth using CPT results is shown in Figure 3. This shows a stronger and stiffer layer within the upper 1m associated with more fibrous material overlying weaker more amorphous peat. At greater depth, the profile indicates little strength gain with depth. Inspection of exposed peat in the low field areas by AGEC estimated c_u of 10 to 15kPa.

Previous work on blanket peat in North Mayo (AGEC, 2002) determined effective strength parameters (c' and ϕ') for peat from DSS and DS tests. Results showed a lower bound c' = 3kPa and $\phi' = 32°$. A review of effective strength parameters for peat from Irish and international publications showed that these results are comparative to values used elsewhere (Appendix C).

Adopted design parameters for in situ peat are given in Table 1. These parameters are based on site specific results or results from neighbouring peat sites. In general, the design parameters for peat are within the range reported in the literature.

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Parameter/Characteristic	Design Value	Comments
Bulk unit weight, γ (kN/m^3)	10	-
Effective friction angle, ϕ' (degrees)	32	-
Effective cohesion, c' (kN/m^2)	3	-
Undrained shear strength	Highfield Upper 1m: 15kPa Peat below 1m: 5kPa Lowfield Upper 1m: 10kPa Peat below 1m: 5kPa	-

Table 1 Adopted Design Parameters for In Situ Peat

9.2 Ex situ Peat

The parameters for peat excavated from the gas terminal site are based on several previous site investigations (AGEC, 2002). All peat beneath the terminal is to be removed and placed at the SPDS.

Adopted design parameters for ex situ peat are given in Table 2. These parameters are based on site specific results or results from neighbouring peat sites

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Parameter/Characteristic	Design Value	Comments
Bulk unit weight, γ (kN/m^3)	10	-
Effective friction angle, ϕ' (degrees)	-	Not used
Effective cohesion, c' (kPa)	-	Not used
Undrained shear strength, c_u (kPa)	2	Remoulded strength. Based on investigations results presented in AGEC (2002)
Slope inclination	>1v:10h	For long-term stability surface profile of peat to be constructed with the shallowest gradients practicable based on previous experience.

Table 2 Adopted Design Parameters for Ex Situ Peat

9.3 Mineral Soil (Glacial Till)

Mineral soil considered to be glacial till underlies the peat and has a variable thickness. Till consists of two layers, an upper cohesive layer and a lower granular layer. The upper layer is not always present and for preliminary design till is modelled as a granular layer only.

Adopted design parameters are given in Table 3.

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Parameter/Characteristic	Design Value	Comments
Bulk unit weight, γ (kN/m^3)	20	-
Effective friction angle, ϕ' (degrees)	32	Assumed medium dense
Effective cohesion, c' (kPa)	0	-
Undrained shear strength, c_u (kPa)	0	-

Table 3 Adopted Design Parameters for Mineral Soil

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10 PRELIMINARY DESIGN GROUND PROFILE

10.1 General

Preliminary design ground profile Area 6 is presented in Drawings Nos. 382_001 and 382_002, and preliminary design profile for Area 5 is presented in Drawing No. 382_003.

The drawings show both an exact scaled profile and a profile with an exaggerated vertical scale which highlights more clearly the geometry.

10.2 Peat Layer

Bórd na Mona undertook a peat depth survey of the Srahmore site in 1998, using a 'Hiller Borer' sampler, which is a hollow stem sampler. This sampler was pushed into the peat material and the hollow stem used to indicate depth to mineral soil.

Within Area 5, the survey indicated peat thickness varied from about 0.34m to 0.7m in the zone where it is proposed to construct the peat reception hardstand. The peat thickness along the access road from the R313 to the reception hardstand varied from 0.34m to 6m. The peat thickness being greatest immediately adjacent to the R313, where no peat extraction has been undertaken.

With respect to Area 6, the Hiller Borer survey indicates that between 0.1m and 2.16m of peat overlies the mineral subsoil in the lowfields.

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10.3 Mineral Soil (Glacial Till) Layer

Mineral soil underlies the peat. The top surface of the mineral soil is variable with ground investigation results indicating a depth varying between about 3 and 6m. The thickness of mineral soil is estimated as between 6 and 14 m bgl.

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11 GEOTECHNICAL DESIGN AND STABILITY RESULTS

11.1 Area 6

Peat is to be placed within the lowfields of Area 6. Stability of lowfields during and following placement of peat has been assessed for the following cases.

(1) Global stability of the deposition area (Area 6) prior to and following peat placement.

(2) Local stability of highfield/lowfield in deposition area (Area 6).

Stability results are presented in Table 4 and Figures 4 and 5. A surcharge of 10 kPa is assumed to represent construction traffic for Case (2).

Case	Minimum Factor of Safety				Comments
	Total Stress Analysis		Effective Stress Analysis		
	Existing	Filled	Existing	Filled	
(1)	5.76	>20	3.21	>20	See Figure 4
(2)	1.39	4	1.37	1.46	See Figure 5

Table 4 Summary of Slope Factor of Safety in Area 6

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For Case (1) the FoS is high, as would be expected given the geometry of the area. The minimum FoS of 3.21 is prior to filling for global failure along perimeter of deposition (Figure 4a and b). This is greater than the required minimum of 1.3.

Where peat is placed within Area 6, global stability analyses were carried out assuming potential translational failure below deposition area. Stability along Section 2-2 (Drawing No. 382_002) was examined together with stability along the lowfield to the south of Section 1-1 (Drawing No. 382_001). The calculated FoS is greater than 20 (Figure 4c to h). The high FoS indicates that such a failure mode is inapplicable.

Case (2) examined local stability within Area 6. The minimum FoS of 1.37 for local stability was found for potential side-slope failure of highfield (Figure 5a and b). Where a surcharge load is placed up to the edge of the highfield the FoS reduces to less than 1.3 within about 2m of the edge of the highfield. Siting of concentrated loads close to the edge of the highfield, may result in localised side slope failure of highfield, and is to be avoided.

Local stability of placed peat in the western end of the lowfield was examined. This shows a minimum FoS of 1.46 (Figure 5d) and assumes failure surface passes through intact peat below placed peat. Some minor slippage of placed peat may occur from the face of the peat until such time as plant cover can be established on the placed peat surface.

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Further analyses examined potential failure of placed peat between highfields (Figure 5e and f). This shows minimum FoS of 11. 62.

11.2 Area 5

Within Area 5 it is proposed to construct an access road from the R313 to a hardstanding area for peat transfer. The hardstanding will be used for transferring peat received from the Bellanaboy site on to onto specialist low ground bearing machinery for transport to deposition in Area 6.

A geotechnical assessment of access road and peat transfer area was carried out.

11.2.1 Access Road from R313

The peat thickness along the access road from the R313 to the reception hardstand varies from 0.34m to 6m based on Bórd na Mona's peat depth survey. The peat thickness is greatest immediately adjacent to the R313, where no peat extraction took place (Drawing No. 382_003).

Where peat is to remain below the access road, then estimated settlements up to 1m would be expected. This settlement is likely to be differential varying with applied loading and thickness of peat.

Bearing failure of the road has been assessed. This indicates that where peat is left below the road, the road foundation requires a biaxial geotextile, such as Tensar SS30/40 or similar, laid within a suitable granular fill. Whilst this may reduce the potential for bearing failure and limit localised differential settlement, the total predicted settlement is likely to disrupt the running surface.

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Preliminary design options are as follows.

(1) Peat should be removed from below the road where it is proposed to construct a metalled road surface. Where there is significant depth of peat then excavations need to be fully supported. Partial removal of peat may be a viable option where it can be shown that significant settlement and bearing failure do not adversely affect the road. Alternatively stabilising peat in situ is an option, see below

(2) Where there is a significant depth of peat, modification of peat in situ can be carried out using for example vibro-compacted concrete columns, stone columns, in situ mixing of peat with cement and lime.

(3) Where no metalled road surface is required then peat can be left in place. Road construction would then consist of a suitable granular fill reinforced with a biaxial geogrid, such as Tensar SS30/40 or similar. This construction would require periodic re-levelling and grading to maintain an acceptable running surface.

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11.2.2 Peat Transfer Area

Trial pit (TP2) was excavated in the area of the proposed hardstanding for the peat transfer area (Drawing No. 382_003). The depth of peat encountered was 0.65m underlain by mineral soil. These ground conditions do not represent any great difficulty with respect the proposed construction.

Where peat is to remain below the hardstanding, then settlements of the order of about 200mm would be expected. This settlement is likely to be differential varying with applied loading and thickness of peat.

Preliminary design options are as follows.

(1) Peat should be removed from below the hardstanding where it is proposed to construct a metalled surface to the hardstanding.

(2) Where no surface to the hardstanding is proposed then a suitable granular fill reinforced with a biaxial geogrid, such as Tensar SS30/40 or similar, would suffice. This construction would require periodic re-levelling and grading of hardstanding surface.

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12 CONSTRUCTION

12.1 General

An assessment of geotechnical hazard and associated risk for the proposed construction is presented in Appendix D. The risk assessment identified no significant risks with respect to major failure or instability associated with the proposed works.

All geotechnical hazards were classified as trivial risk. Of the 6 likely geotechnical hazards identified for the works (see Table in Appendix D), 5 of these hazards affect the site work only and have no impact beyond the site boundary. The highest risk is associated with possible settlement and bearing failure of the access road from the R313. Where this road is constructed on peat then monitoring of road performance is required. Disruption of this road would have a high impact on the works.

12.2 Geotechnical Instrumentation

Geotechnical instrumentation is required to monitor key performance criteria and validate the design. Instrumentation is usually required to monitor horizontal and vertical displacement of the ground or construction access road embankments.

Given the low geotechnical risk associated with the proposed works, at the preliminary stage no requirement for geotechnical monitoring is envisaged.

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FIGURES

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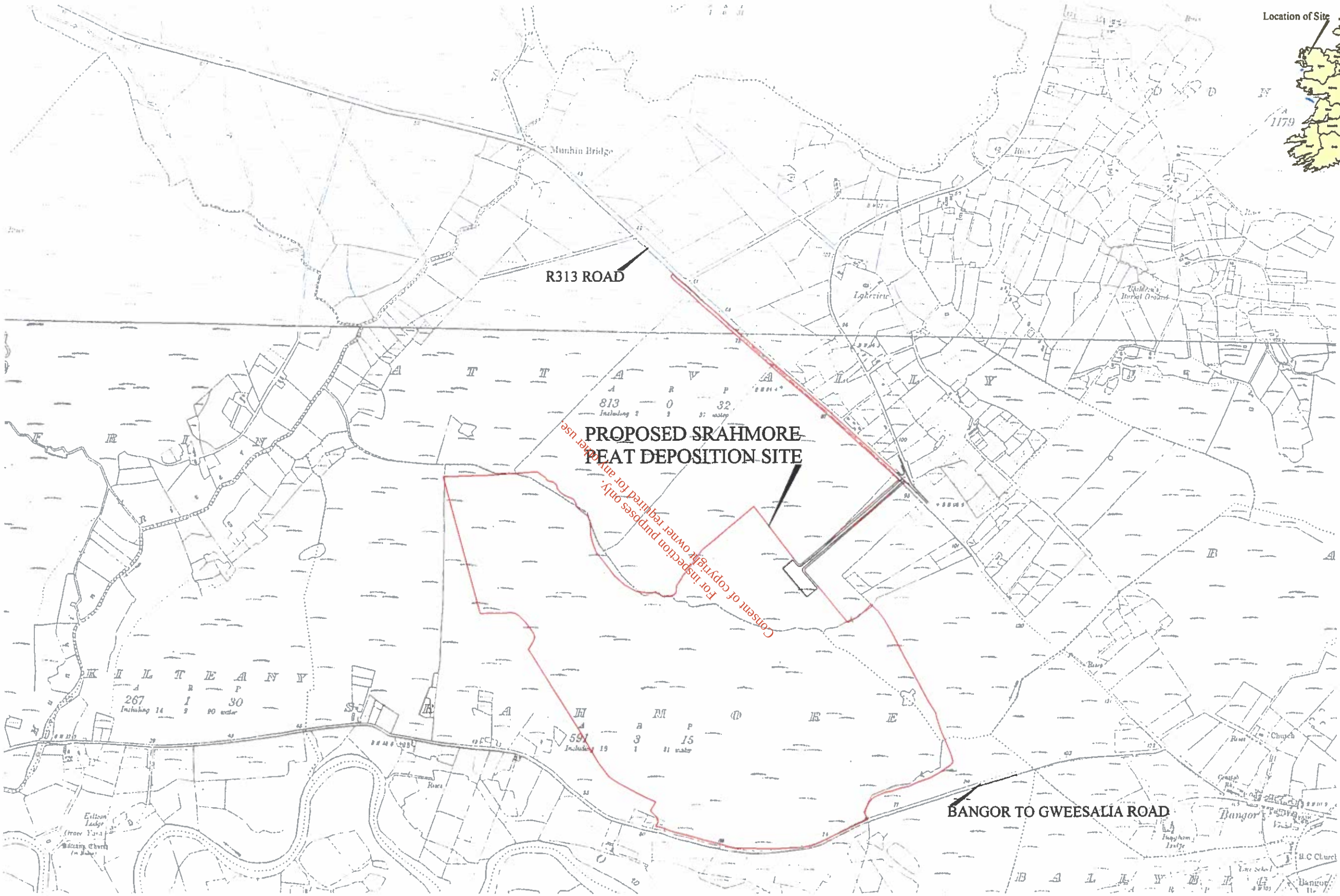

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Notes:

Scale: 1:12500	Checked: P.J.
Date: 09/12/03	Revision: A
Drawn: P.O.R.	Based on: 382_018

Client: Shell E&P Ireland Limited

Job: Preliminary Geotechnical Design for Srahmore Peat Deposition Site

Figure 1

Title: Site Location

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Ireland

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Applied Ground Engineering Consultants Limited

AREA 7

AREA 5

AREA 6

BOUNDARY OF PROPOSED SRAHMORE PEAT DEPOSITION SITE

PEAT TRANSFER HARDSTANDING

ACCESS ROAD

R313 ROAD

STREAM

ROAD

RIVER

LOWFIELD (LF)

HIGHFIELD (HF1)

TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP10 TP11 TP12 TP14

BH 1A/B BH 2A/B BH 3A/B BH 4

HF1 HF2 HF3 HF4 HF5 HF6

NOTES:
(1) PROPOSED AND COMPLETED (3 DEC. 2003) GROUND INVESTIGATION SHOWN

(2) PROPOSED GROUND INVESTIGATION TO BE COMPLETED BY END OF DEC. 2003

LEGEND:

- BHXX — BOREHOLE LOCATION
- TPXX — TRIALPIT LOCATION
- CPXXX — CONE PENETRATION TEST LOCATION
- REMAINING PROPOSED CONE PENETRATION TEST LOCATION
- X X — LOCATION CROSS SECTION

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Further notes:

Notes:

Scale: 1:2500 (A1) | Checked: P.J.
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Client: Shell E&P Ireland Limited

Job: Preliminary Geotechnical Design for Srahmore Peat Deposition Site

Figure 2

Title: Site Layout Plan

AGEC Ltd
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Fax: 353-503-23793
www.agec.ie
info@agec.ie

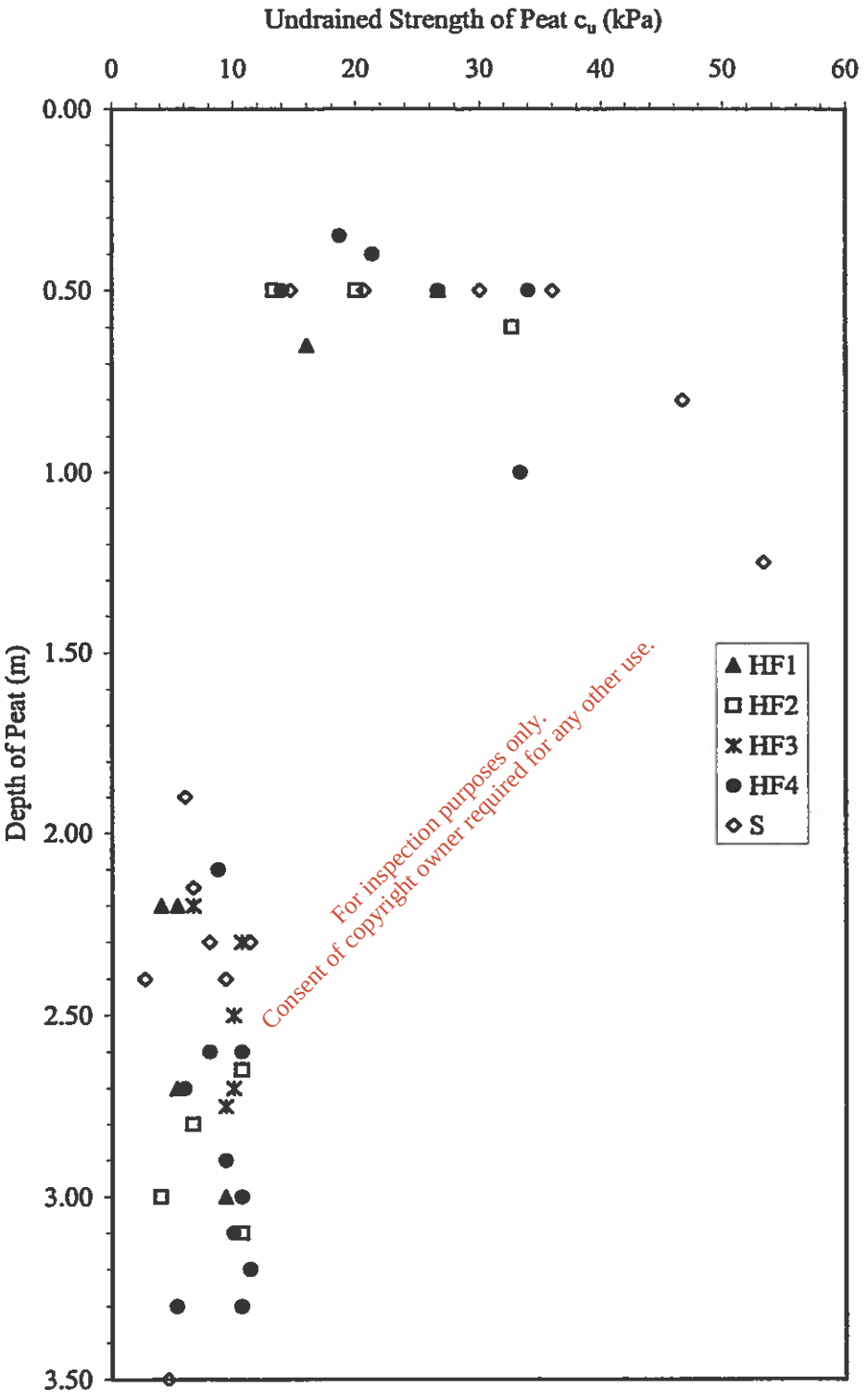

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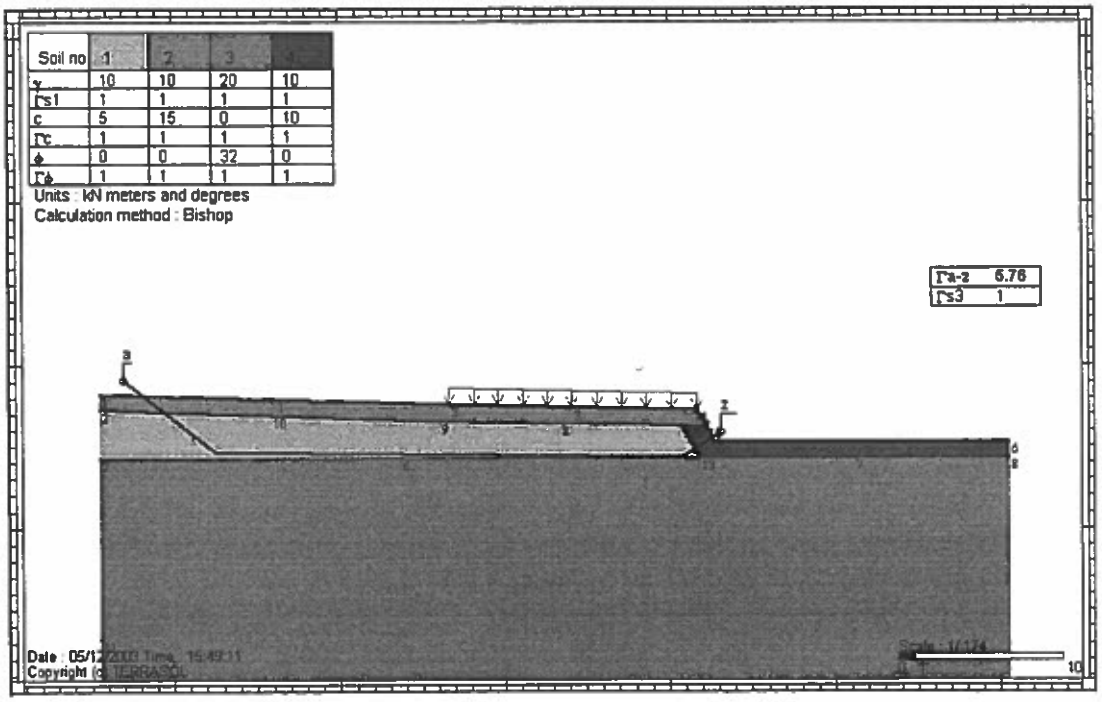
Figure 3 Profile of Undrained Shear Strength (c_u) of Peat with Depth from CPT Results

Notes
(1) Results are for highfield (HF) and southern (S) perimeter areas
(2) CPT converted to $c_{u\,CPT}$ using $N_k = 15$
(3) Results based on 30 CPT locations throughout the site

EPA Export 08-07-2014:23:46:00



(a) Showing global stability of perimeter assuming translational slide for total stress (undrained) analysis.

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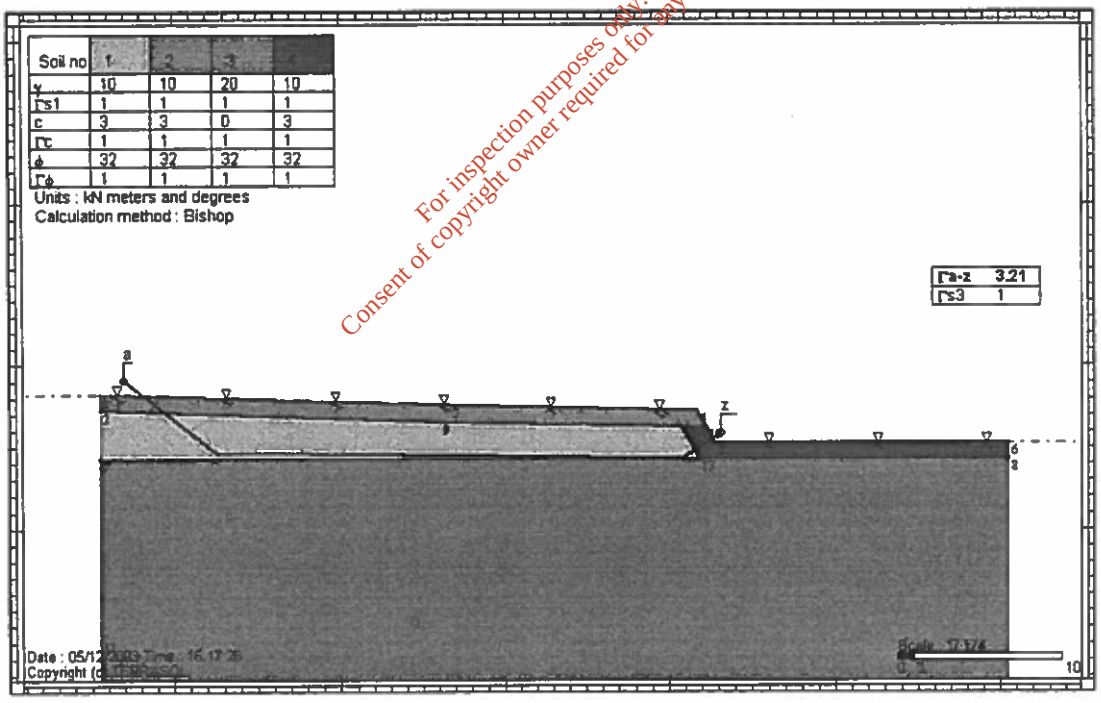
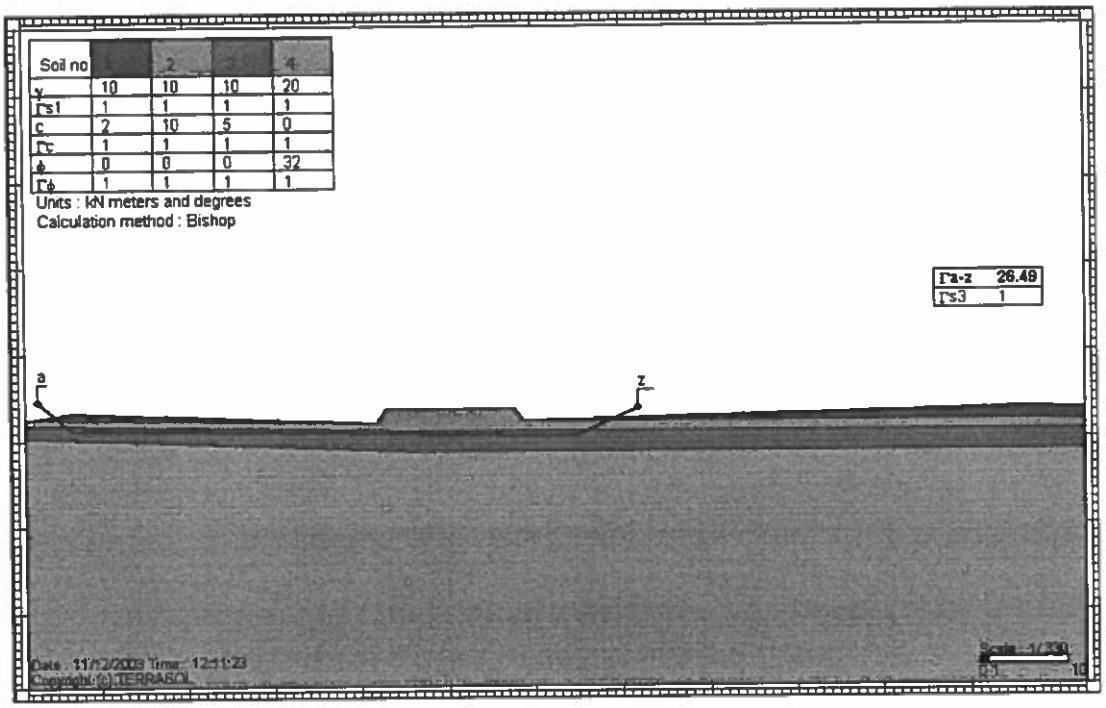


(b) Showing global stability of perimeter assuming translational slide for drained loading condition. Groundwater assumed at peat surface.

Figure 4 Factor of Safety for Global Stability - Case (1) Cont.

EPA Export 08-07-2014:23:46:00



(c) Example of global stability of under highfield along Section 2-2 following peat placement assuming translational slide for total stress (undrained) analysis

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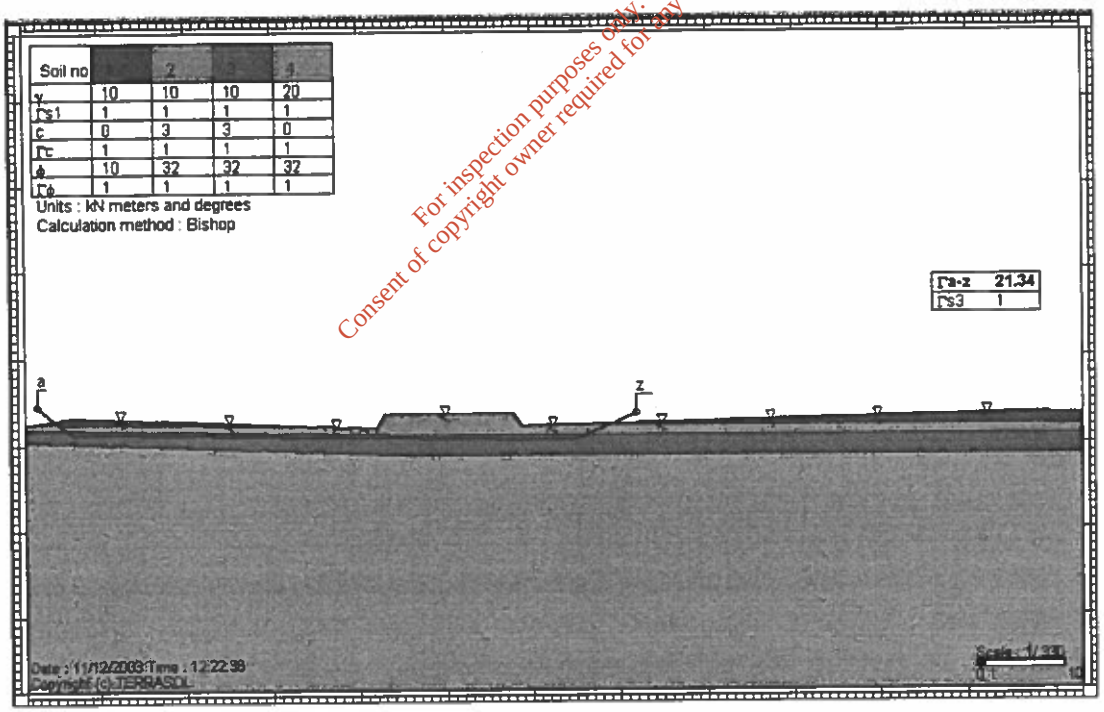

(d) Example of global stability of under highfield along Section 2-2 following peat placement assuming translational slide for drained loading condition. Groundwater assumed at peat surface.

Figure 4 Factor of Safety for Global Stability - Case (1) Cont.

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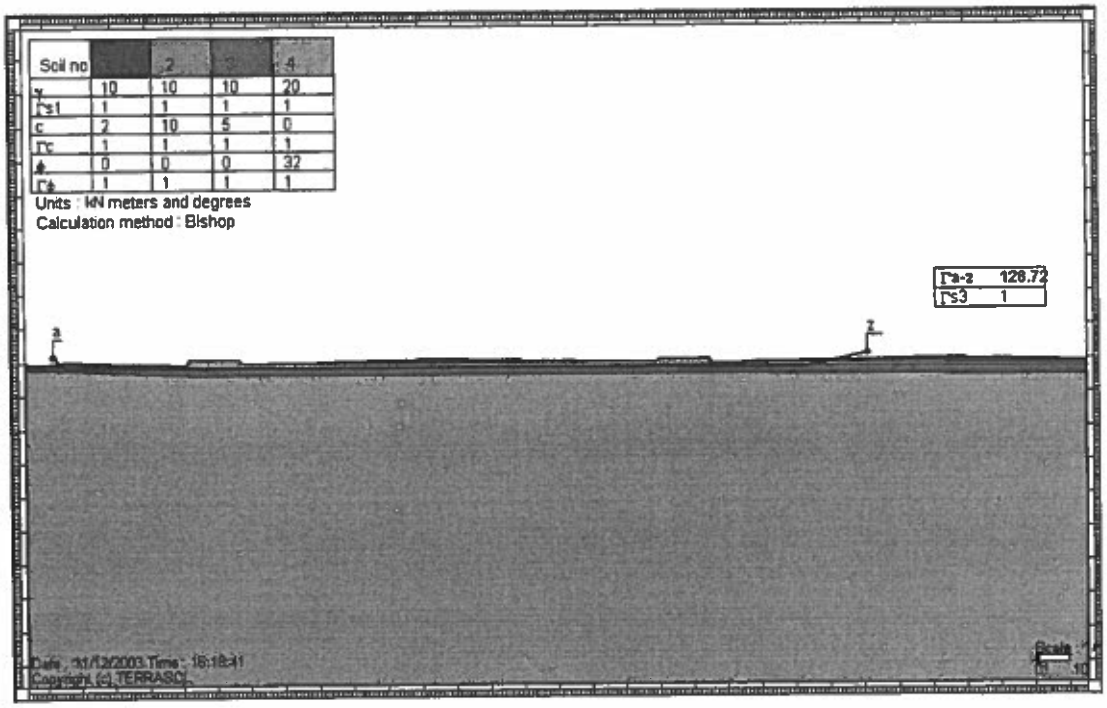
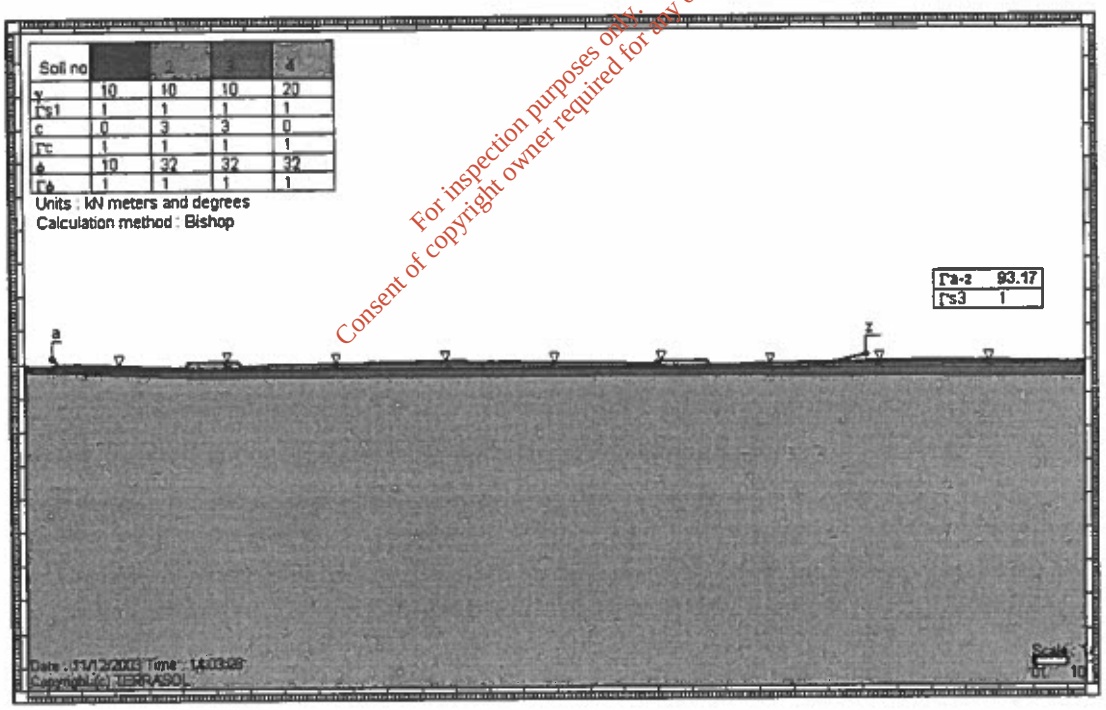


(e) Example of global stability under 2 highfields along Section 2-2 following peat placement assuming translational slide for total stress (undrained) analysis



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(f) Example of global stability under 2 highfields along Section 2-2 following peat placement assuming translational slide for drained loading condition. Groundwater assumed at peat surface.

Figure 4 Factor of Safety for Global Stability - Case (1) Cont.

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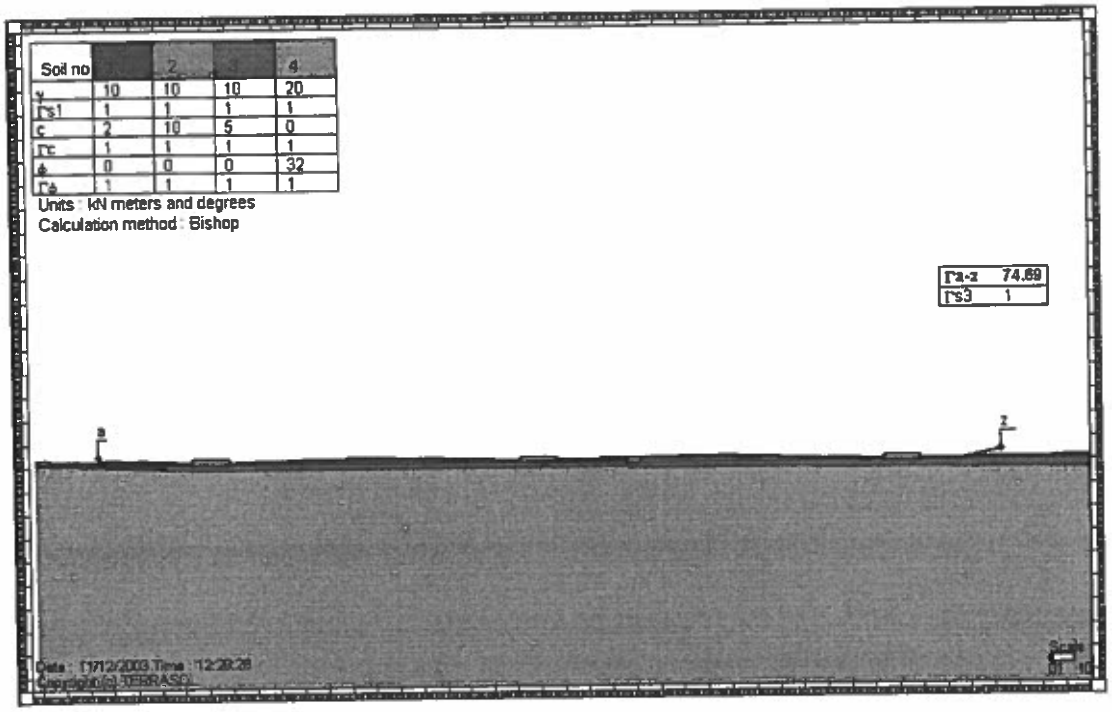

(g) Example of global stability under 3 highfields along Section 2-2 following peat placement assuming translational slide for total stress (undrained) analysis

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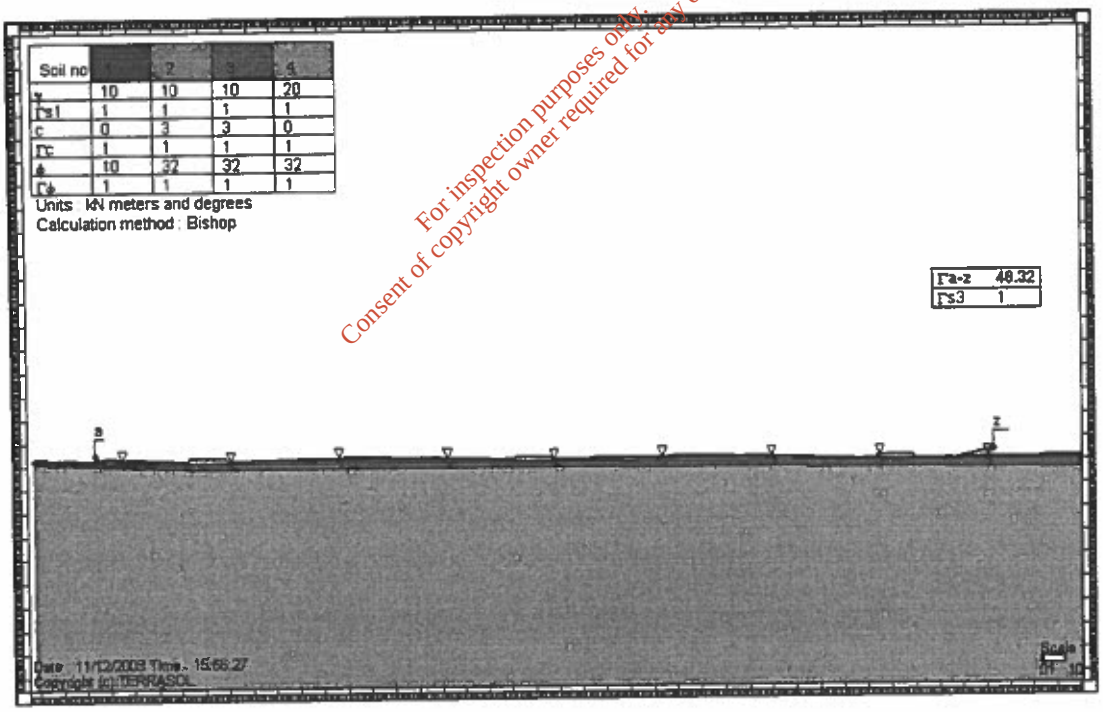

(h) Example of global stability under 3 highfields along Section 2-2 following peat placement assuming translational slide for drained loading condition. Groundwater assumed at peat surface.

Figure 4 Factor of Safety for Global Stability - Case (1) Cont.

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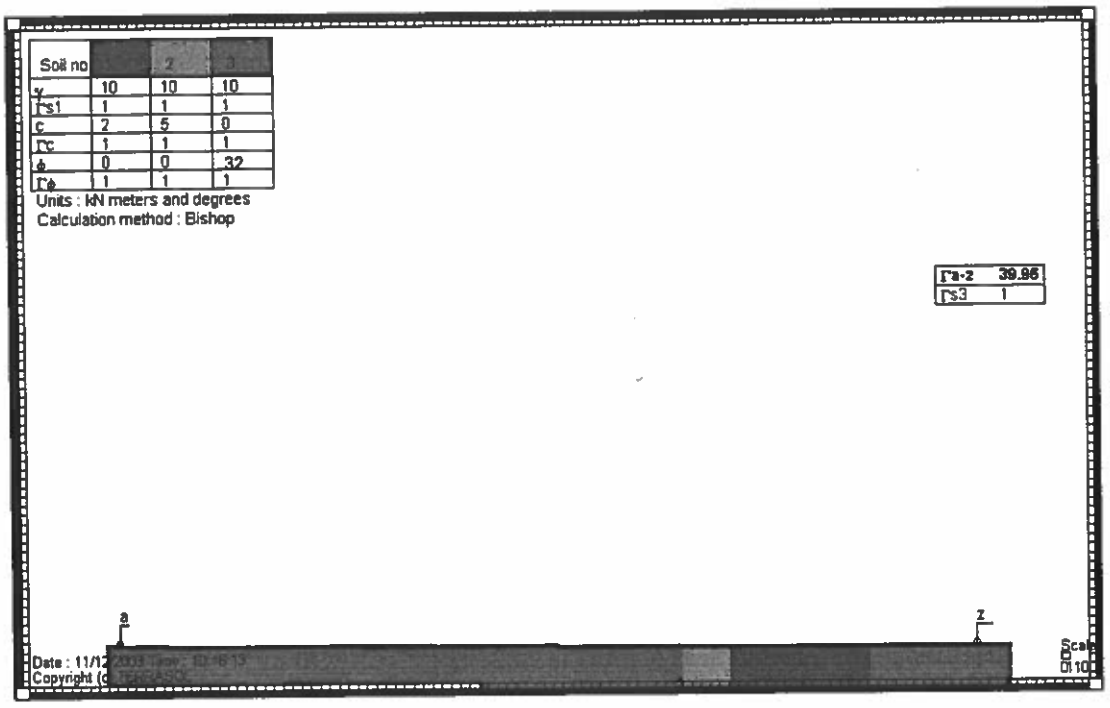
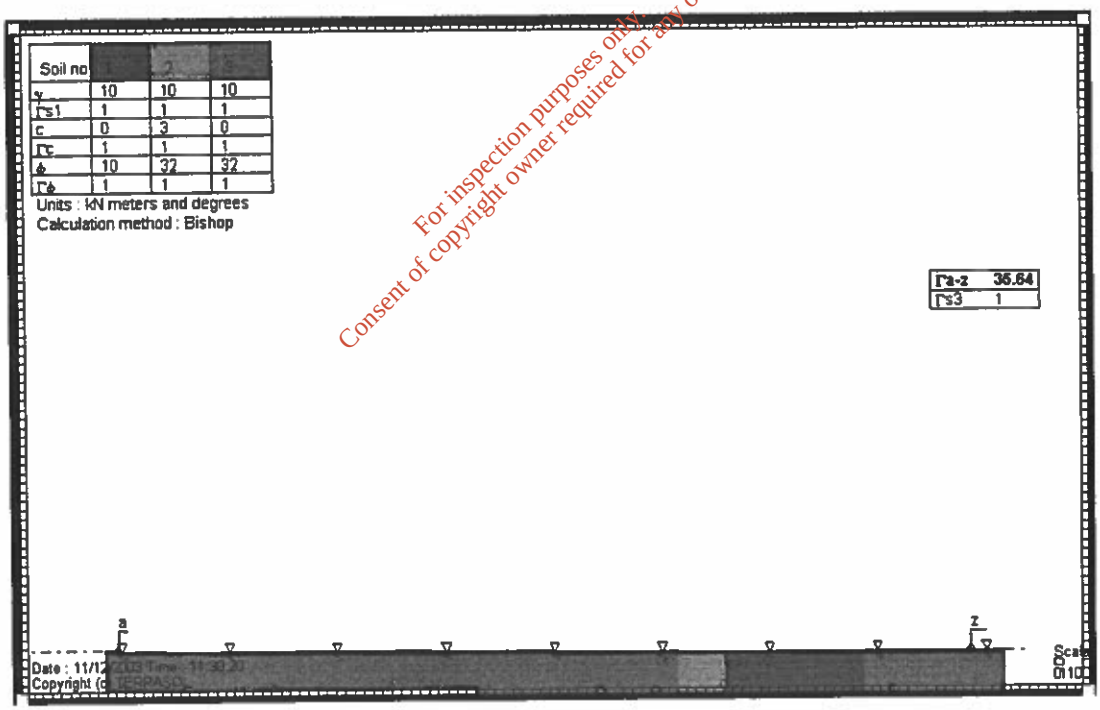


(i) Example of global stability under lowfield to south of Section 1-1 following peat placement assuming translational slide for total stress (undrained) analysis



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(j) Example of global stability under lowfield to south of Section 1-1 following peat placement assuming translational slide for drained loading condition. Groundwater assumed at peat surface.

Figure 4 Factor of Safety for Global Stability - Case (1)

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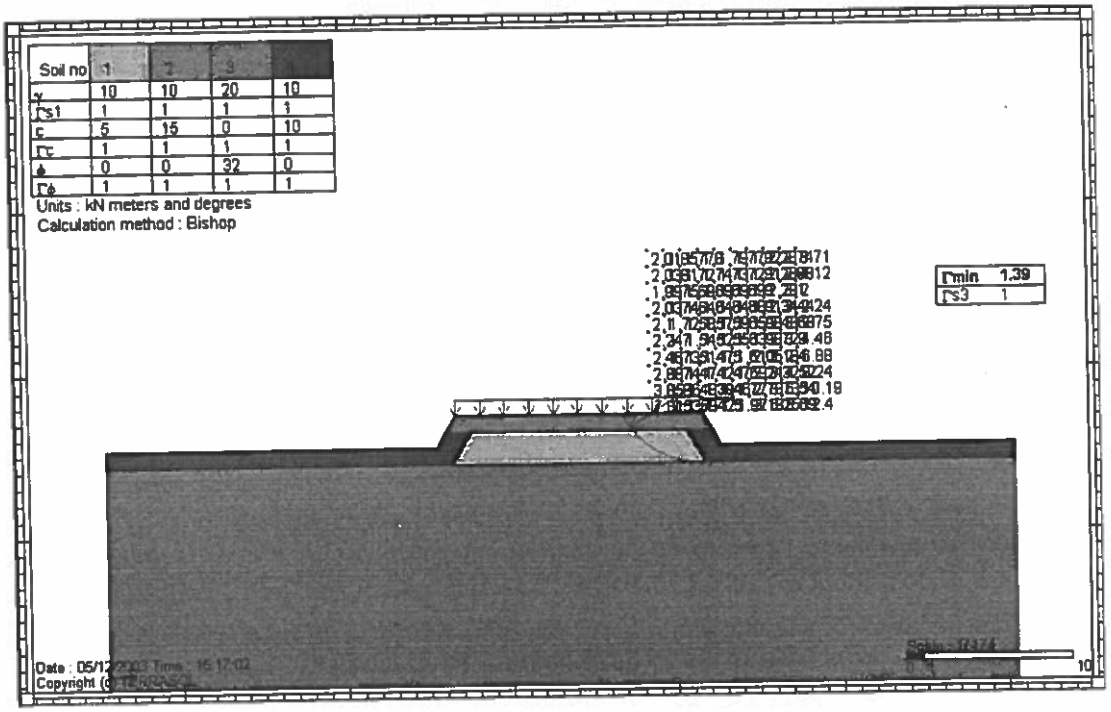

(a) Showing locally stability of highfield for total stress (undrained) analysis

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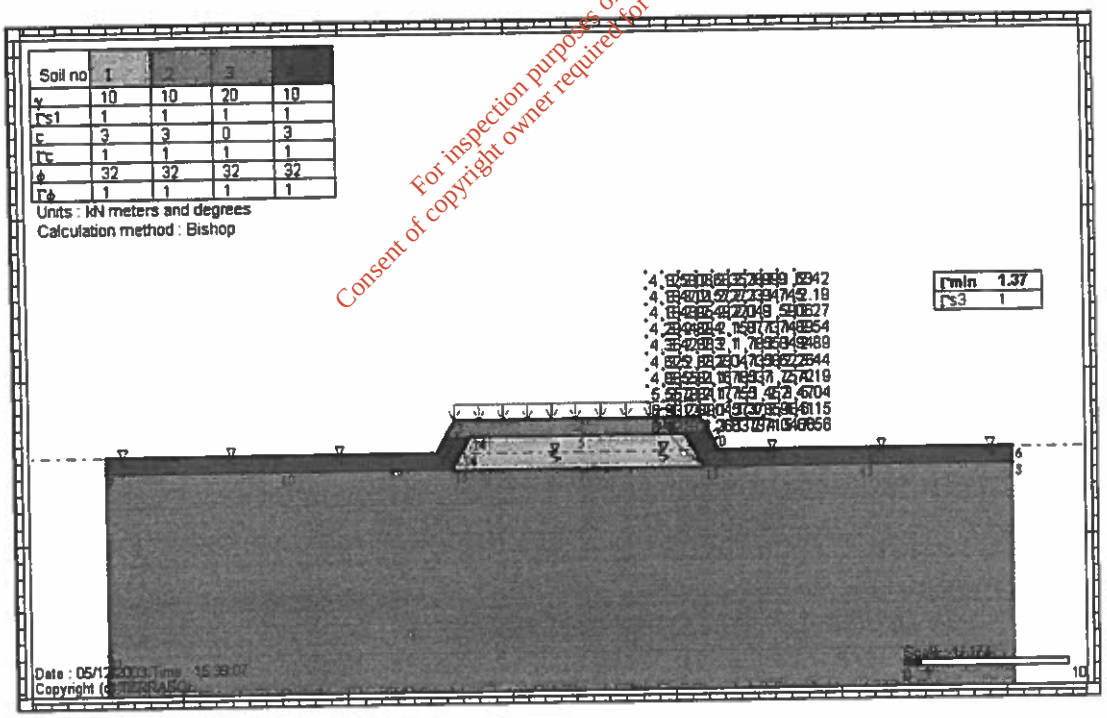

(b) Showing locally stability of highfield for effective stress (drained) analysis

Figure 5 Factor of Safety for Localised Stability - Case (2) Cont.

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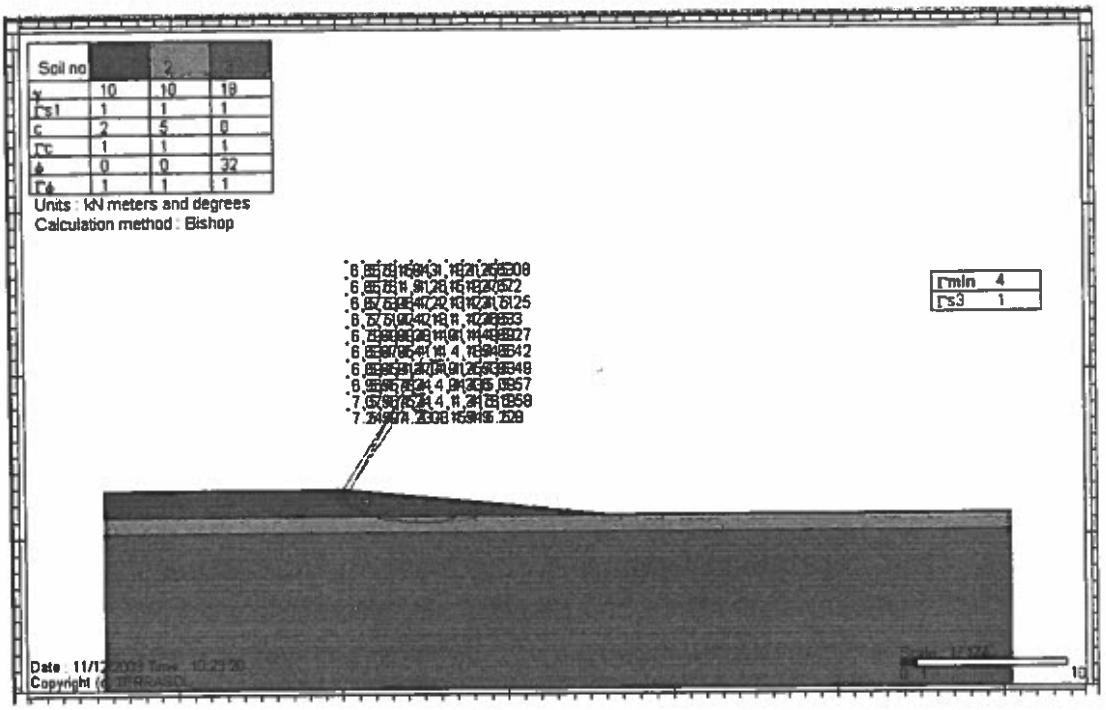

(c) Example of stability of placed peat at western end of lowfield assuming rotational slide for total stress (undrained) analysis.

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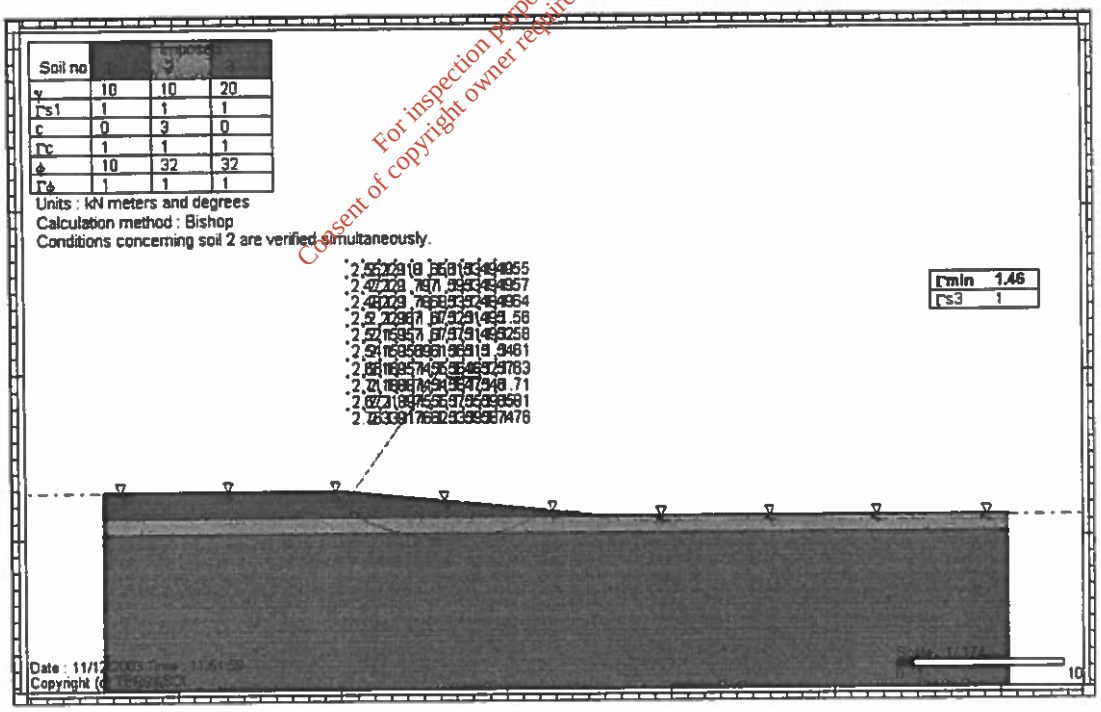

(d) Example of stability of placed peat at western end of lowfield assuming rotational slide for drained loading condition. Groundwater assumed at peat surface.

Figure 5 Factor of Safety for Localised Stability - Case (2) Cont.

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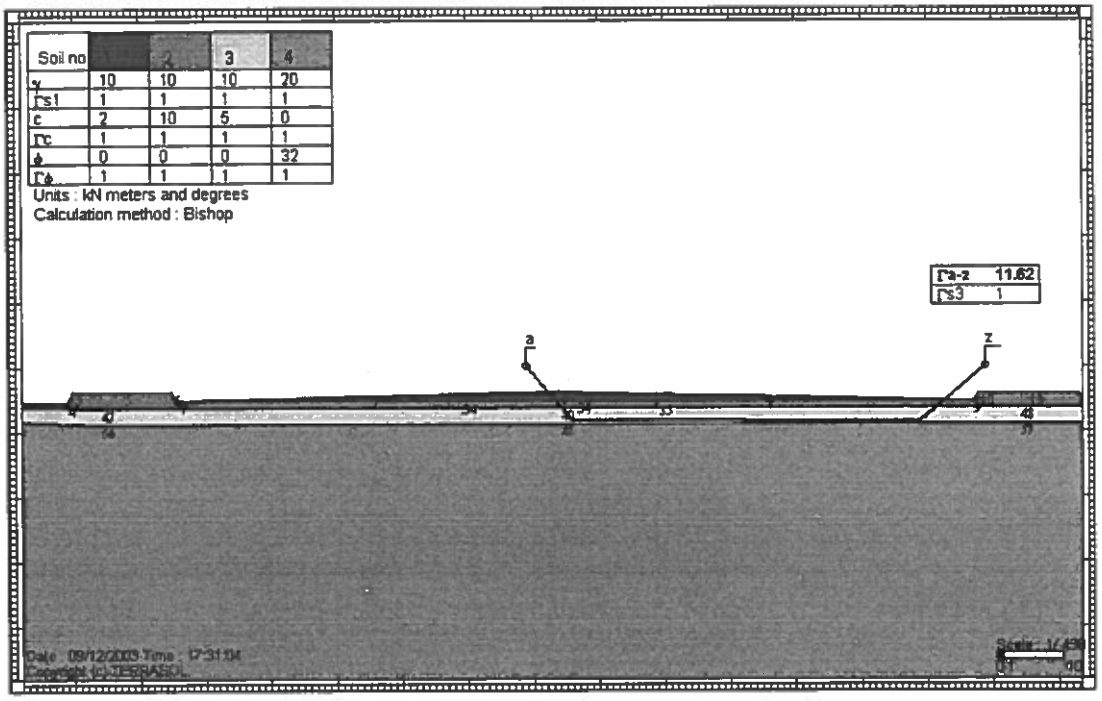
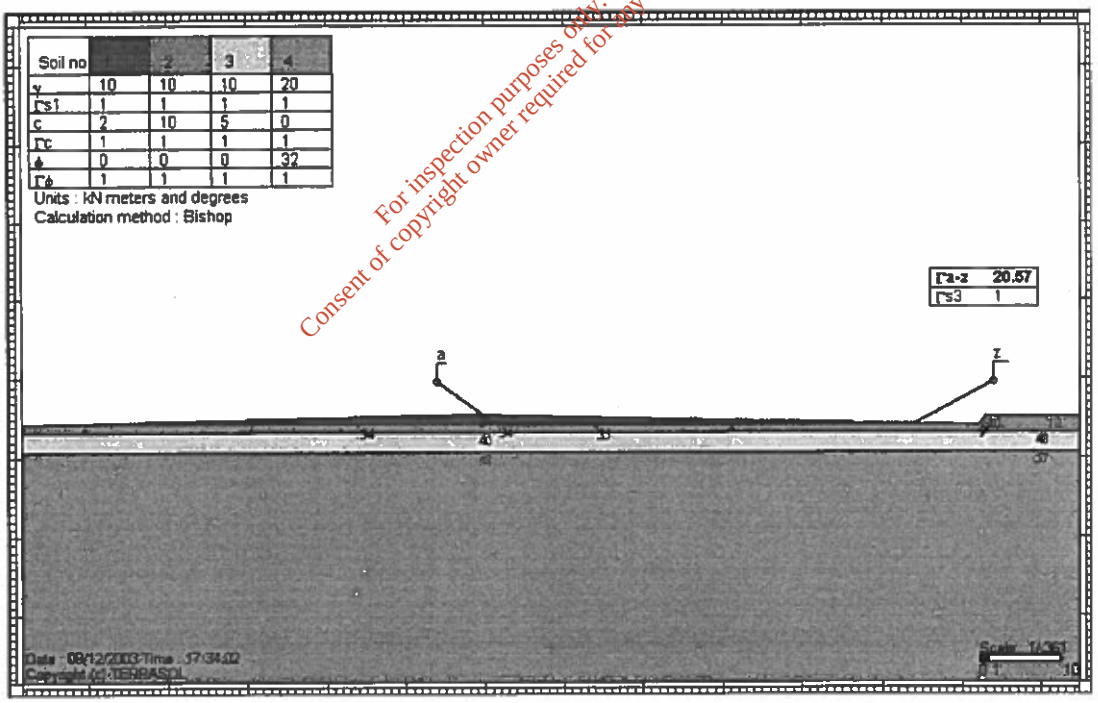


(e) Example of stability of underlying intact peat below placed peat between highfields assuming translational slide for total stress (undrained) analysis.



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(f) Example of stability within placed peat between highfields assuming translational slide for total stress (undrained) analysis.

Figure 5 Factor of Safety for Localised Stability - Case (2)

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APPENDIX A PHASE 1 GROUND INVESTIGATION RESULTS

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FIELDWORK

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BOREHOLE LOG

Borehole BH1A

Sheet No. 1 of 1

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor–Erris, Co. Mayo.	1169	1:50

Grid Reference			
Easting: E084463 Northing: N323049	Elevation (mOD): 17.56m Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm Borehole Depth (m): 13.5m	Date Started: 22/10/03 Date Completed: 22/10/03	Drill Contractor: Irish Drilling Ltd. Drill Method: Coring Logged by: P.K.

Depth m	Description of Strata	Legend	OD Level m	Static Water Level 4/11/03	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
GL									
0.55	PEAT							50MM uPVC CASING	CEMENT BENT ONITE
	Fine grained SAND, with clay/silt matrix, medium light grey to greenish grey.		15.09	▼				50MM uPVC SCREEN	3–7mm Pea Gravel
12.5								END OF CASING	
13.5	SAND with fragments of Schist and Quartzite. Light grey to light greenish grey.								
	END OF BOREHOLE								
18									

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BOREHOLE LOG

Borehole BH1B

Sheet No. 2 of 2

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor–Erris, County Mayo.	1169	1:50

Grid Reference			
Easting: 084463	Elevation (mOD): 17.254	Date Started: 23/10/03	Drill Contractor: Irish Drilling Ltd.
Northing: 323049	Borehole Diameter (Subsoil): 65mm	Date Completed: 24/10/03	Drill Method: Coring
	Borehole Diameter (Rock): 65mm		Logged by: PK
	Borehole Depth (m): 23.7m		

Depth m	Description of Strata	Legend	OD Level m	Water Inflows	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
18m									
18.5	As above								
	Strong to very strong, faintly narrowly banded, (dipping 60 degrees), white to very pale grey, fine to medium grained, micaceous QUARTZITE, fresh to slightly weathered. Mica occurs as strong orientated flakes, producing previously described narrow banding. Discontinuities: Closely to medium spaced, generally banding parallel (but also steeply dipping in at least 2 other orientations), generally planar, slightly rough surfaced, tight and clean.						Packet Test Ref.: BH1B Test section: 15.5–23.7m bgl	50mm uPVC Screen	3–7mm Pea Gravel
23.7	END OF BOREHOLE								

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BOREHOLE LOG

Borehole BH2A

Sheet No. 1 of 1

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor-Erris, Co. Mayo.	1169	1:50

Grid Reference			
Easting: E083092 Northing: N323519	Elevation (mOD): 17.20m Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm Borehole Depth (m): 6.1m	Date Started: 28/10/03 Date Completed: 28/10/03	Drill Contractor: Irish Drilling Ltd. Drill Method: Coring Logged by: P.K.

Depth m	Description of Strata	Legend	OD Level m	Static Water Level 4/11/03	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
GL									
0.55	PEAT							50MM uPVC CASING	CEMENT
	Fine grained SAND, with clay/silt matrix, medium light grey to greenish grey.		14.10	▼					BENTONITE
12.3	SAND with fragments of eroded Quartzite, Sandstone and Schist. grey.							50MM uPVC SCREEN	3-7mm Pea Gravel
14.0	END OF BOREHOLE								
18									

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BOREHOLE LOG

Borehole BH2B

Sheet No. 1 of 2

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor-Erris, County Mayo.	1169	1:50

Grid Reference	Elevation (mOD): 17.17m	Date Started: 27/10/03	Drill Contractor: Irish Drilling Ltd.
Easting: 083092	Borehole Diameter (Subsoil): 65mm	Date Completed: 27/10/03	Drill Method: Coring
Northing: 323519	Borehole Diameter (Rock): 65mm		Logged by: PK
	Borehole Depth (m): 23.5m		

Depth m	Description of Strata	Legend	OD Level m	Static Water Level 4/11/03	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
GL									
0.55	PEAT								
	Fine grained SAND with clay/silt matrix. Medium light grey to greenish grey.		14.09	▼				50mm uPVC CASING	BENTONITE
12.0	SAND with fragments/cobbles of eroded Quartzite, Sandstone and Schist.								
14.3	Moderately weak to moderately strong thinly bedded/schistose (dipping 30–45 degrees), greenish grey (changing to brown below 21.4m), fine to medium grained micaceous PSAMMITE, moderately weathered. Occasional very thin (<20mm) highly weathered zones. Discontinuities: Very closely spaced, schistosity parallel, generally planar smooth to slightly rough , thick to moderately open, strongly discoloured and clay/rock material filled.								
18									

Remarks: moderately open.

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BOREHOLE LOG

Borehole BH2B

Sheet No. 2 of 2

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor-Erris, County Mayo.	1169	1:50

Grid Reference	Elevation (mOD): 17.17m	Date Started: 27/10/03	Drill Contractor: Irish Drilling Ltd.
Easting: 083092	Borehole Diameter (Subsoil): 65mm	Date Completed: 27/10/03	Drill Method: Coring
Northing: 323519	Borehole Diameter (Rock): 65mm		Logged by: PK
	Borehole Depth (m): 23.5		

Depth m	Description of Strata	Legend	OD Level m	Water Inflows	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
18m	As above						Packet Test Ref.: BH2B Test section: 15.75–23.5m	50mm uPVC Screen	3–7mm Pea Gravel
23.5	END OF BOREHOLE								

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BOREHOLE LOG

Borehole BH3A

Sheet No. 1 of 1

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor–Erris, Co. Mayo.	1169	1:50

Grid Reference			
Easting: E084908 Northing: N323745	Elevation (mOD): 20.29m Borehole Diameter (Subsoil): 65mm Borehole Diameter (Rock): 65mm Borehole Depth (m): 12.5m	Date Started: 28/10/03 Date Completed: 28/10/03	Drill Contractor: Irish Drilling Ltd. Drill Method: Coring Logged by: P.K.

Depth m	Description of Strata	Legend	OD Level m	Static Water Level 4/11/03	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
GL									
1.55	PEAT		18.52	▼				50MM uPVC CASING	CEMENT / BENT ONITE
5.5	Fine grained SAND, with clay/silt matrix, medium light grey to greenish grey.							50MM uPVC SCREEN	3–7mm Pea Gravel
18	END OF BOREHOLE							END OF CASING	

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BOREHOLE LOG

Borehole BH3B

Sheet No. 1 of 2

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor–Erris, County Mayo.	1169	1:50

Grid Reference	Elevation (mOD): 20.26m	Date Started: 29/10/03	Drill Contractor: Irish Drilling Ltd.
Easting: 084908	Borehole Diameter (Subsoil): 65mm	Date Completed: 29/10/03	Drill Method: Coring
Northing: 323745	Borehole Diameter (Rock): 65mm		Logged by: PK
	Borehole Depth (m): 16m		

Depth m	Description of Strata	Legend	OD Level m	Static Water Level 4/11/03	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
GL									
1.55	PEAT								
6.0	Fine grained SAND with clay/silt matrix. Medium light grey to greenish grey.		18.02	▼				50mm uPVC CASING	BENTONITE
16	Strong to very strong, massive but locally narrowly banded (dipping 35 degrees), grey to yellowish grey, fine grained micaceous QUARTZITE, fresh to slightly weathered. Mica locally occurring as close to very closely spaced bands/laminae dipping circa 35 degrees. Discontinuities: Between non–intact zones fractures are closely to very closely spaced, bedding parallel, (dipping about 35 degrees), generally sub–planar, smooth to slightly rough, generally clean.						Packet Test Ref.: BH3B Test section: 11.75–16.0m	50mm uPVC SCREEN	3–7mm Pea Gravel
	END OF BOREHOLE								

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BOREHOLE LOG

Borehole BH3B

Sheet No. 2 of 2

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor-Erris, County Mayo.	1169	1:50

Grid Reference	Elevation (mOD): 20.26m	Date Started: 27/10/03	Drill Contractor: Glovers SI Ltd.
Easting: 084908	Borehole Diameter (Subsoil): 65mm	Date Completed: 27/10/03	Drill Method: Air Rotary
Northing: 323745	Borehole Diameter (Rock): 65mm		Logged by: KM (TES)
	Borehole Depth (m): 23.5		

Depth m	Description of Strata	Legend	OD Level m	Water Inflows	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
18m	As above						Packet Test Ref.: BH2B Test section: 15.75–23.5m	50mm uPVC Screen	3–7mm Pea Gravel
23.5									

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BOREHOLE LOG

Borehole BH4

Sheet No. 1 of 2

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor-Erris, County Mayo.	1169	1:50

Grid Reference			
Easting: 084489	Elevation (mOD): 17.22	Date Started: 01/11/03	Drill Contractor: Irish Drilling Ltd.
Northing: 323373	Borehole Diameter (Subsoil): 65mm	Date Completed: 01/11/03	Drill Method: Coring
	Borehole Diameter (Rock): 65mm		Logged by: PK
	Borehole Depth (m): 30m		

Depth m	Description of Strata	Legend	OD Level m	Static Water Level 4/11/03	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
GL									
	PEAT		14.81 ▼					50mm uPVC CASING	BENTONITE
3.1	Fine grained SAND with clay/silt matrix. Medium light grey to greenish grey.							50mm uPVC SCREEN	3-7mm Pea Gravel
18									

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BOREHOLE LOG

Borehole BH4

Sheet No. 2 of 2

Client:	Site:	Job No.:	Scale:
Bord na Mona/Shell E&P	Srahmore, Bangor–Erris, County Mayo.	1169	1:50

Grid Reference	Elevation (mOD): 17.22m	Date Started: 01/11/03	Drill Contractor: Glovers SI Ltd.
Easting: 084489	Borehole Diameter (Subsoil): 65mm	Date Completed: 01/11/03	Drill Method: Air Rotary
Northing: 323373	Borehole Diameter (Rock): 65mm		Logged by: PK
	Borehole Depth (m): 30m		

Depth m	Description of Strata	Legend	OD Level m	Water Inflows	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
18m	As above							50mm uPVC Screen	3–7mm Pea Gravel
30	END OF BOREHOLE								

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TRIAL PIT LOG

Trial Pit No. 1

Sheet No. 1 of 1

Excavator Type:	Date:	Client:
HITACHI	23/10/03	Bord na Mona/Shell E&P
Grid Reference:	**Elevation (mOD):**	**Site:**
E084643, N324121		Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	PEAT Soft, medium light brown to medium brown, occasional fragments of bog wood, slightly moist.			Vane Test	TP1			
2.4	Yellowish brown to light yellowish brown gravelly, clayey SAND, with some angular subangular cobbles of schist at base.			Disturbed Sample	TP1			
3.0	END OF TRIAL PIT							

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Logged by:	Job No.:	Remarks:
P.K.	1169	1. Shear vane test undertaken on peat, disturbed soil sample obtained for Particle Size Distribution testing.
Scale:	Rev.:	2. No significant groundwater inflow recorded during excavation.
1:25		3. Excavation terminated at 3m due to obstruction/compaction of subsoil.

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TRIAL PIT LOG

Trial Pit No. 2

Sheet No. 1 of 1

Excavator Type:	Date: 23/10/03	Client: Bord na Mona/Shell E&P
Grid Reference: E084646, N323870	Elevation (mOD):	Site: Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	PEAT Soft, medium dark brown to dark brown, occasional fragments of bog wood.			Vane Test	TP2			
0.65	Medium light grey to light greenish grey, gravelly, clayey slightly micaceous SAND. The Gravels are platey, angular to subangular Quartzites.			Disturbed Sample	TP2			
3.0	END OF TRIAL PIT							

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Logged by: P.K.	Job No.: 1169	Remarks: 1. Shear vane test undertaken on peat, disturbed soil sample obtained for Particle Size Distribution testing. 2. No significant groundwater inflow recorded during excavation.
Scale: 1:25	Rev.:	

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Blanchardstown
Dublin 15

TRIAL PIT LOG

Trial Pit No. 3

Sheet No. 1 of 1

Excavator Type:	Date: 23/10/03	Client: Bord na Mona/Shell E&P
Grid Reference: E084890, N323700	Elevation (mOD):	Site: Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	PEAT Soft, medium brown to light brown, fragments of bog wood and rootlets, slightly moist.			Vane Test	TP3			
1.8	Greenish grey to light greenish grey to light grey SAND, with some angular to subangular gravels and cobbles of schist.			Disturbed Sample	TP3			
3.45	END OF TRIAL PIT							

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Logged by: P.K.	Job No.: 1169	Remarks: 1. Shear vane test undertaken on peat, disturbed soil sample obtained for Particle Size Distribution testing. 2. Slight to moderate groundwater inflow recorded at 2.5m during excavation. 3. Excavation terminated due to obstruction/compaction of subsoil at 3.45m.
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 4

Sheet No. 1 of 1

Excavator Type:	Date: 23/10/03	Client: Bord na Mona/Shell E&P
Grid Reference: E084164, N323332	Elevation (mOD):	Site: Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	PEAT Soft to very soft, medium brown to medium dark brown, with fragments of bog wood and roolets, moist.			Vane Test	TP4			
1.1								
	Medium greenish grey to grey, clayey, fine grained SAND with occasional subrounded to rounded gravel and cobbles.			Disturbed Sample	TP4			
1.4								
1.65	Medium grey to light brownish grey GRAVEL with some sub–rounded to subangular cobbles.							
	END OF TRIAL PIT							

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Logged by: P.K.	Job No.: 1169	Remarks: 1. Shear vane test undertaken on peat, disturbed soil sample obtained for Particle Size Distribution testing. 2. Excavations terminated at 1.65m bgl due to unstable ground and pit wall collpase caused by water inflow.
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 5

Sheet No. 1 of 1

Excavator Type:	Date: 23/10/03	Client: Bord na Mona/Shell E&P
Grid Reference: E084474, N323382	Elevation (mOD):	Site: Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	PEAT Soft, medium dark brown fragments of bog wood and rootlets, moist.			Vane Test	TP5			
0.9								
	Yellowish brown to greyish brown, gravelly, cobbley SILT/ SAND. The gravels are subangular to subrounded.			Disturbed Sample	TP5			
3.0	END OF TRIAL PIT							

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Logged by: P.K.	Job No.: 1169	Remarks:
Scale: 1:25	Rev.:	1. Shear vane test undertaken on peat, disturbed soil sample obtained for Particle Size Distribution testing. 2. Slight to moderate groundwater inflow at 2.5m bgl.

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TRIAL PIT LOG

Trial Pit No. 6

Sheet No. 1 of 1

Excavator Type:	Date: 23/10/03	Client: Bord na Mona/Shell E&P
Grid Reference: E084852, N323176	Elevation (mOD):	Site: Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	PEAT Soft, dark brown to brownish black, fragments of bog wood, moist.			Vane Test	TP6			
0.95								
	Light yellowish brown clayey, fine grained SAND with occasional gravels that are subrounded to rounded							
1.9								
	Medium brown to dark brown subangular to subrounded GRAVELS, with some Cobbles.			Disturbed Sample	TP6			
2.5	END OF TRIAL PIT							

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Logged by: P.K.	Job No.: 1169	Remarks: 1. Shear vane test undertaken on peat, disturbed soil sample obtained for Particle Size Distribution testing. 2. No significant groundwater inflows noted during excavation.
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 7

Sheet No. 1 of 1

Excavator Type:	Date: 23/10/03	Client: Bord na Mona/Shell E&P
Grid Reference: E084001, N323713	Elevation (mOD):	Site: Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	PEAT Soft, dark brown to brownish black, fragments of bog wood, moist. Occurance of more recent plant material and heather.			Vane Test	TP7			
0.85	Light yellowish brown to light yellowish grey clayey SAND with occasional gravels that are subrounded to rounded. Gravel content increases with depth and becomes angular at base.			Disturbed Sample	TP7			
2.5	END OF TRIAL PIT							

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Logged by: P.K.	Job No.: 1169	Remarks: 1. Shear vane test undertaken on peat, disturbed soil sample obtained for Particle Size Distribution testing. 2. No significant groundwater inflows noted during excavation.
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 8

Sheet No. 1 of 1

Excavator Type:	Date: 23/10/03	Client: Bord na Mona/Shell E&P
Grid Reference: E084402, N323988	Elevation (mOD):	Site: Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
0.2	Medium dark, soft PEAT							
	Medium light grey to greenish grey, gravelly, cobbley SILT/ SAND. The gravels are subangular to subrounded and occasionally well rounded Quartzites, with occasional Red Sandstones and Slate.							
2.6	END OF TRIAL PIT							

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Logged by: P.K.	Job No.: 1169	Remarks:
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 9

Sheet No. 1 of 1

Excavator Type:	Date: 23/10/03	Client: Bord na Mona/Shell E&P
Grid Reference: E084402, N323988	Elevation (mOD):	Site: Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
0.4	Medium dark, soft PEAT							
2.5	Medium light grey to greenish grey, gravelly, cobbley SILT/ SAND. The gravels are subangular subrounded and occasionally well rounded Quartites, with occasional Red Sandstone and Slate.							
	END OF TRIAL PIT							

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Logged by:	Job No.:	Remarks:
P.K.	1169	
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 10

Sheet No. 1 of 1

Excavator Type:	Date: 18/11/03	Client: Bord na Mona/Shell E&P
Grid Reference: E083780, N323797	Elevation (mOD):	Site: Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
0.1	Dark brown, peaty GRAVEL, with many cobbles and boulders. Gravels subangular to subrounded Quartzite, Schist, Slate and Red Sandstone							
0.7	Medium brown, clayey, gravelly, fine grained SAND. Gravels are subangular to subrounded							
1.45	Medium grey to greenish grey to light brownish grey, clayey, gravelly, fine to medium grained SAND, with occasional subangular to subrounded cobbles.			Bulk Sample	TP10			
3.2	Medium light grey, sandy, slightly clayey, subangular GRAVEL, with occasional angular, subangular and subrounded cobbles and boulders of Quartzite, Schist and Red Sandstone.							
	END OF TRIAL PIT							

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Logged by: P.K.	Job No.: 1169	Remarks: 1. Surface water running into pit excavation because of heavy rain
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 11

Sheet No. 1 of 1

Excavator Type:	Date: 18/11/03	Client: Bord na Mona/Shell E&P
Grid Reference: E083837, N323823	Elevation (mOD):	Site: Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
0.2	Medium brown, sandy, slightly clayey, peaty GRAVEL, with some cobbles. Gravel is subangular to angular Quartzite, with occasional Schist and Sandstone							
	Light brown to yellowish grey, slightly clayey, gravelly, fine SAND. Subangular gravels of Quartzite and occasional angular boulders of banded Gneiss			Bulk Sample	TP11			
3.0	END OF TRIAL PIT							

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Logged by: P.K.	Job No.: 1169	Remarks: 1. No water inflows to pit, dry.
Scale: 1:25	Rev.:	

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TRIAL PIT LOG
Trial Pit No. 12
Sheet No. 1 of 1

Excavator Type:	Date: 18/11/03	Client: Bord na Mona/Shell E&P
Grid Reference: E083925, N323806	Elevation (mOD):	Site: Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
0.3	Medium brown, slightly clayey fine grained SAND, with thin layers of peat on top							
	Medium light grey, gravelly, slightly clayey, slightly micaceous SAND with some subangular cobbles and occasional subangular boulders. Gravels are subangular to subrounded Quartzite.							
				Bulk Sample	TP12A			
	Medium grey to medium light grey gravelly, fine grained SAND with some cobbles and some blocky boulders of Gneiss. Gravels are subrounded and occasionally well rounded							
				Bulk Sample	TP12B			
3.0	END OF TRIAL PIT							

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Logged by: P.K.	Job No.: 1169	Remarks: 1. Increase in moisture content at 3m bgl.
Scale: 1:25	Rev.:	

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TRIAL PIT LOG

Trial Pit No. 13

Sheet No. 1 of 1

Excavator Type:	Date:	Client:
	18/11/03	Bord na Mona/Shell E&P
Grid Reference:	**Elevation (mOD):**	**Site:**
E084417, N324002		Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	Medium dark brown to brownish black, soft PEAT, with angular and subrounded gravels and boulders of Quartzite and Schist							
0.25								
	Medium dark brown to medium brown, Firm CLAY							
0.75								
	Light grey to medium light grey and light greyish brown, gravelly, silty, fine grained SAND with occasional subangular to subrounded blocky boulders of Gneiss. Gravels are subangular to subrounded, occasionally well rounded, composed of Quartzite Schist, Red Sandstone and Slate.			Bulk Sample	TP13A			
				Bulk Sample	TP13B			
3.2	END OF TRIAL PIT							

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Logged by:	Job No.:	Remarks:
P.K.	1169	
Scale:	Rev.:	
1:25		

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TRIAL PIT LOG

Trial Pit No. 14

Sheet No. 1 of 1

Excavator Type:	Date: 18/11/03	Client: Bord na Mona/Shell E&P
Grid Reference: E084647, N324207	Elevation (mOD):	Site: Srahmore, Bangor–Erris, Co. Mayo.

Depth m	Description of Strata	Legend	OD Level m	Samples Type	Samples Ref. No.	Water Inflows	Pit Completion Lining:	Pit Completion Backfill:
0.0								
	Medium brown, gravelly, slightly clayey, fine grained SAND, with some angular cobbles and boulders of Quartzite. Gravels are subangular to angular.							
0.75								
	Light grey to light yellowish grey, gravelly, cobbley, slightly clayey SAND with some angular boulders of Gneiss. Gravels are subangular to subrounded Quartzite and Red Sandstone.							
2.0				Bulk Sample	TP14A			
	Medium grey, gravelly, slightly clayey, slightly micaceouas SAND with some subangular to subrounded cobbles of Quartzite. Gravels are subangular to subrounded Quartzite.							
3.5				Bulk Sample	TP14B			
	END OF TRIAL PIT							

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Logged by: P.K.	Job No.: 1169	Remarks: 1. Increase in moisture content at 1.5m bgl.
Scale: 1:25	Rev.:	

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TEST RESULTS

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IRISH DRILLING LTD.
Loughrea Co. Galway

Tel: (091) 841274 Fax: (091) 847687

Contract: Peat Deposit Site at Bangor Erris

Date: 23.10.'03
Eng.: DJ

In-situ Shear Vane

Trial Pit	Depth m	Co-ordinates	Undrained Shear strength Uncorrected kN/m^2	Undrained Shear strength *Corrected (based on plasticity) kN/m^2
1	1.5	84643, 24121	12	6
2	0.5	84646, 23870	12	6
3	1.0	84890, 23700	23	12
4	0.9	84164, 23332	10	5
5	0.7	84474, 23382	10	5
6	0.6	84852, 23173	19	9.5
7	0.8	84001, 23713	14	7

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* Correction factor based on Bjerrum's (1972,1973) correction factor for field vane strength as a function of Plasticity Index

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IRISH DRILLING LTD.
Loughrea Co. Galway.

Tel: (091)841274 Fax: (091) 847687

Contract: Peat deposit site at Bangor Erris
Client: Enterprise Oil
Engineer: TES

Date: 20/11/2003
Tested By: DD Checked: DJ

Summary of Soil Classification Tests

BS1377: Part 2: 1990

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Borehole/ Trialpit	Type	Depth m	Bulk Density Mg/m3	Moisture Content %	Particle Density Mg/m3	Liquid Limit %	Plastic Limit %	Plasticity Index %	% passing 425 micron %		Description of fraction passing 425 micron sieve.
TP 1		1.0		840							
		2.0		877.8							
		3.0		20.8			Non plastic		93		
TP 2		0.5		448.1							
		1.5		14			Non plastic		94		
		2.5		14.3							
TP 3		1.0		343.6							
		2.5		23.8			Non plastic		95		
		3.5		23.7							

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Borehole/ Trialpit	Type	Depth m	Bulk Density Mg/m3	Moisture Content %	Particle Density Mg/m3	Liquid Limit %	Plastic Limit %	Plasticity Index %	% passing 425 micron %		Description of fraction passing 425 micron sieve.
TP 4		0.5		205							
		1.0		12.5			Non plastic		32		
		1.5		16.1							
TP 5		0.5		984.1							
		1.5		39.2			Non plastic		40		
		2.5		10							
TP 6		0.0		1005.9							
		1.5		14.7			Non plastic		20		
		2.5		19							
TP 7		0.5		286.1							
		1.5		19							
		2.5		23.2			Non plastic		75		

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PROJECT: Bangor Erris

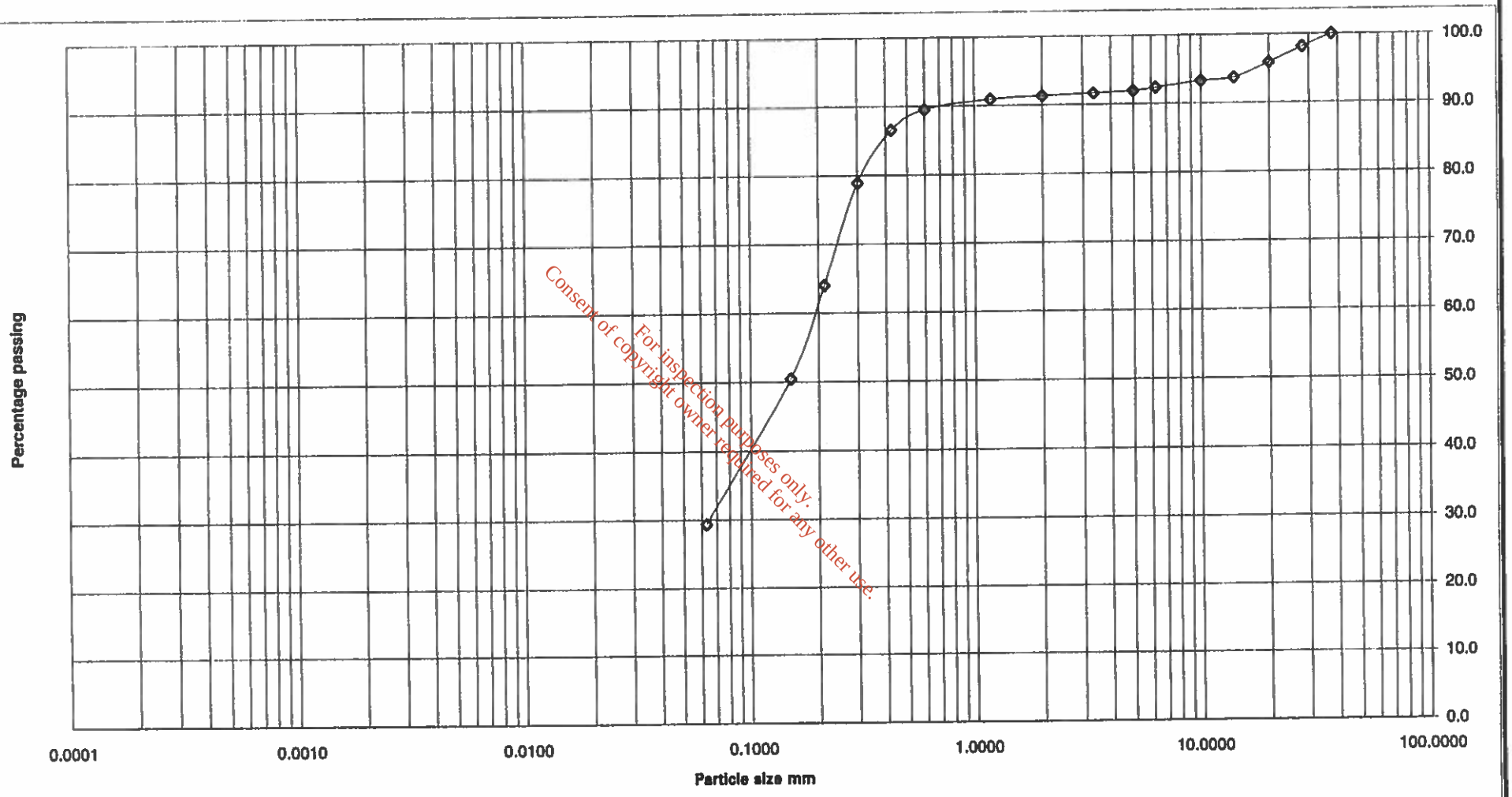
CLIENT: Irish Drilling

Project No: T169

Reference: 0415

PARTICLE SIZE DISTRIBUTION

Borehole No. TP1 Sample No. Depth 3.00 m



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CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLES
	SILT			SAND			GRAVEL			

Visual Description: Pale grey silty SAND with little gravel

K4 SOILS LABORATORY

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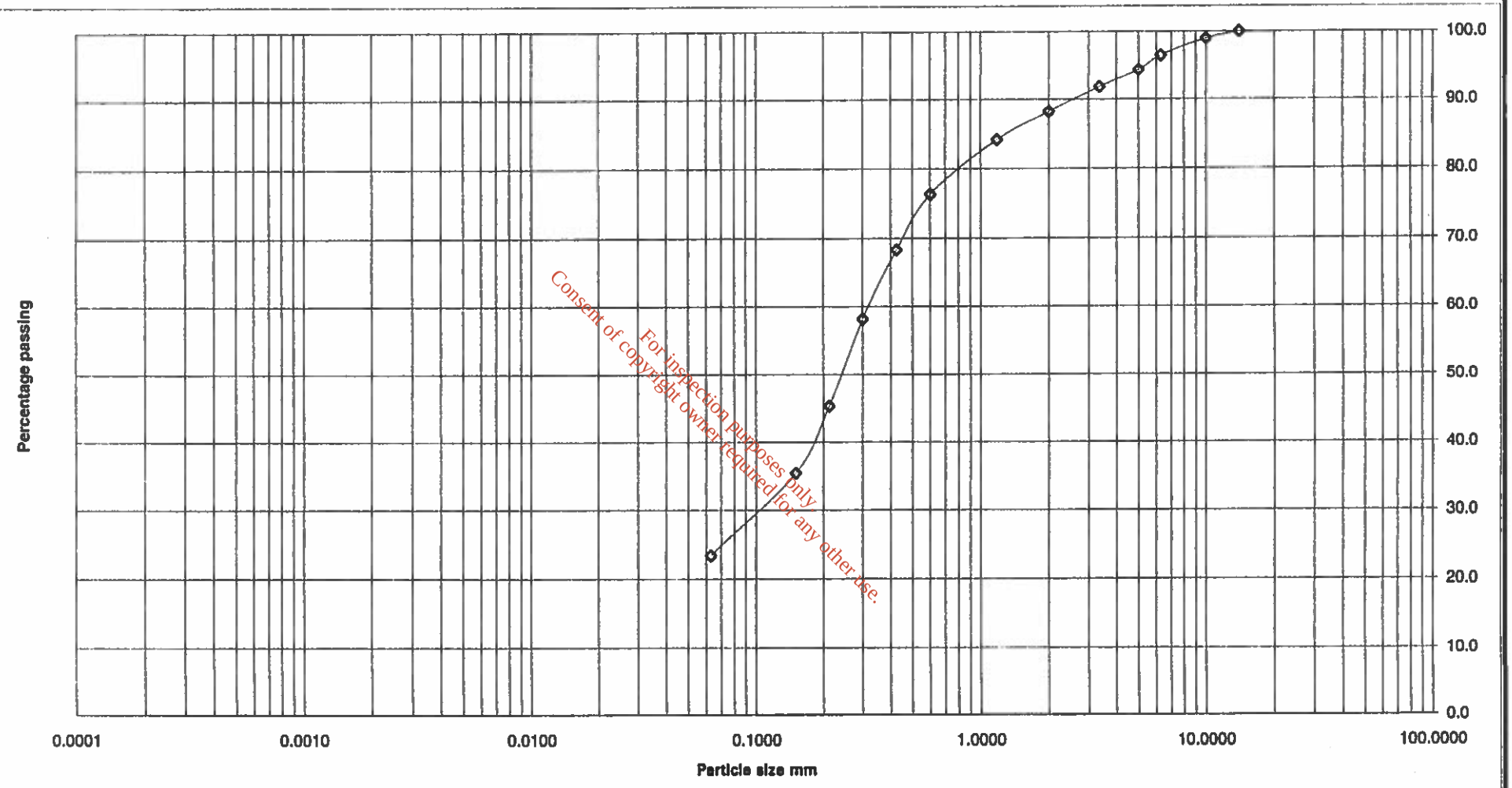
PROJECT:	Bangor Erris	Project No:	89
CLIENT:	Irish Drilling	Reference:	0415

PARTICLE SIZE DISTRIBUTION

Borehole No. TP2 Sample No. Depth 2.50 m



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CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLES
	SILT			SAND			GRAVEL			

Visual Description: Grey silty SAND with a little gravel

K4 SOILS LABORATORY

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PROJECT: Bangor Erris

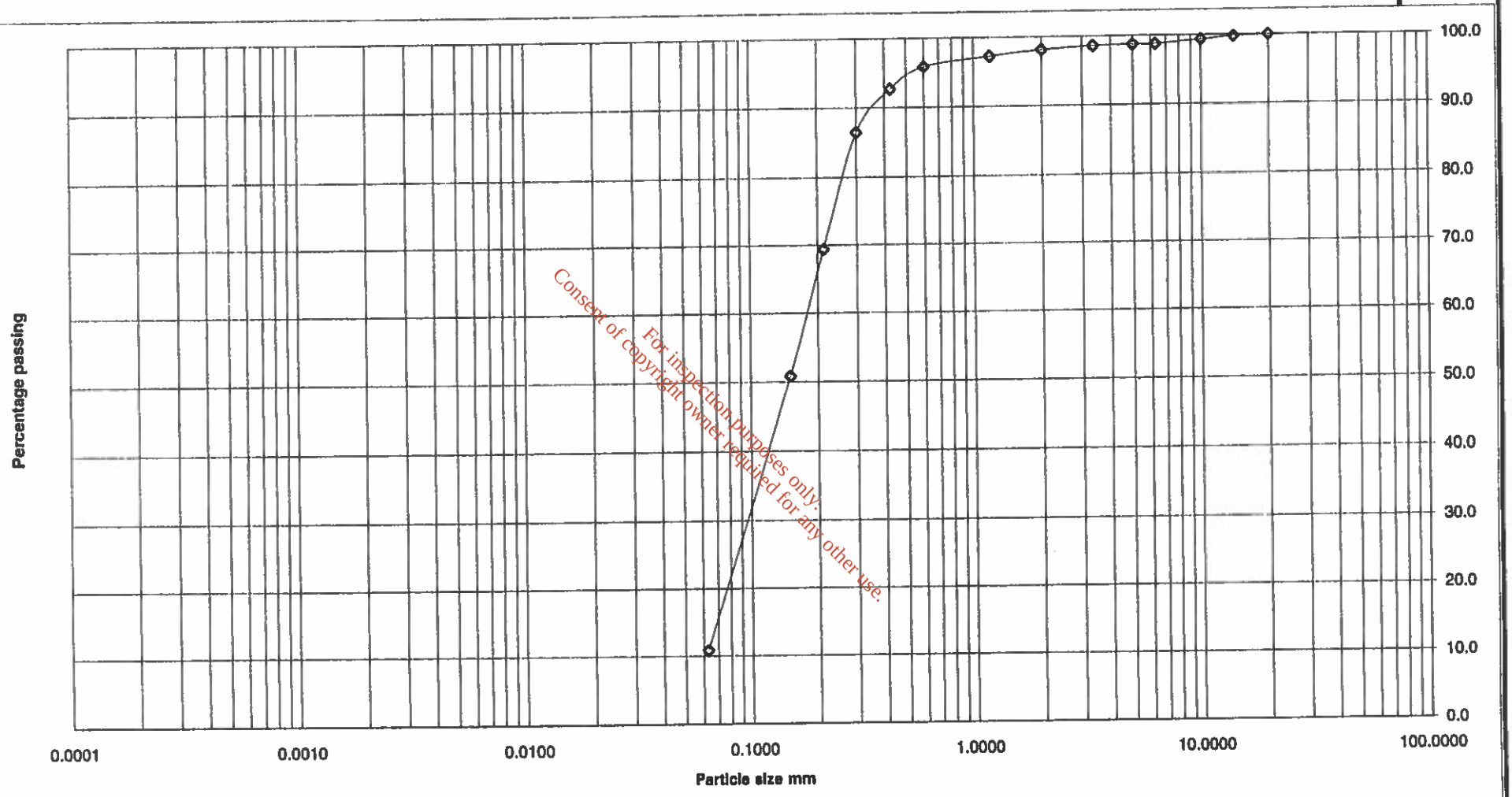
CLIENT: Irish Drilling

Project No: 1169

Reference: 0415

PARTICLE SIZE DISTRIBUTION

Borehole No. TP3 Sample No. Depth 2.50 m



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CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLES
	SILT			SAND			GRAVEL			

Visual Description: Pale grey SAND with a trace of gravel

K4 SOILS LABORATORY

E.P.A. Export 09-07-2014:13:46:02

PROJECT: Bangor Erris

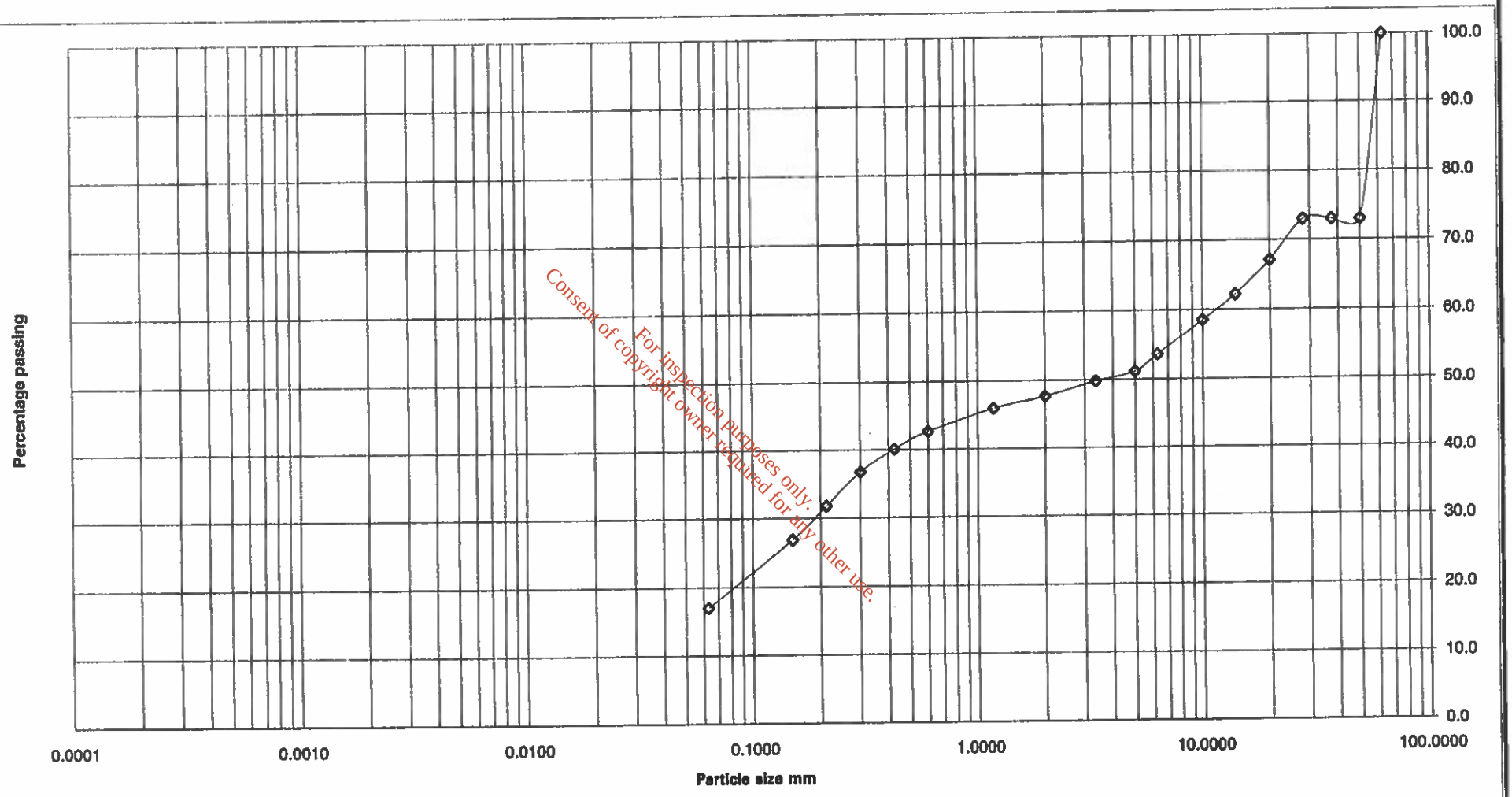
CLIENT: Irish Drilling

Project No: 1169

Reference: 0415

PARTICLE SIZE DISTRIBUTION

Borehole No. TP4 Sample No. Depth 1.00 m



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CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLES
	SILT			SAND			GRAVEL			

Visual Description: Grey silty SAND and GRAVEL

K4 SOILS LABORATORY

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PROJECT: Bangor Erris

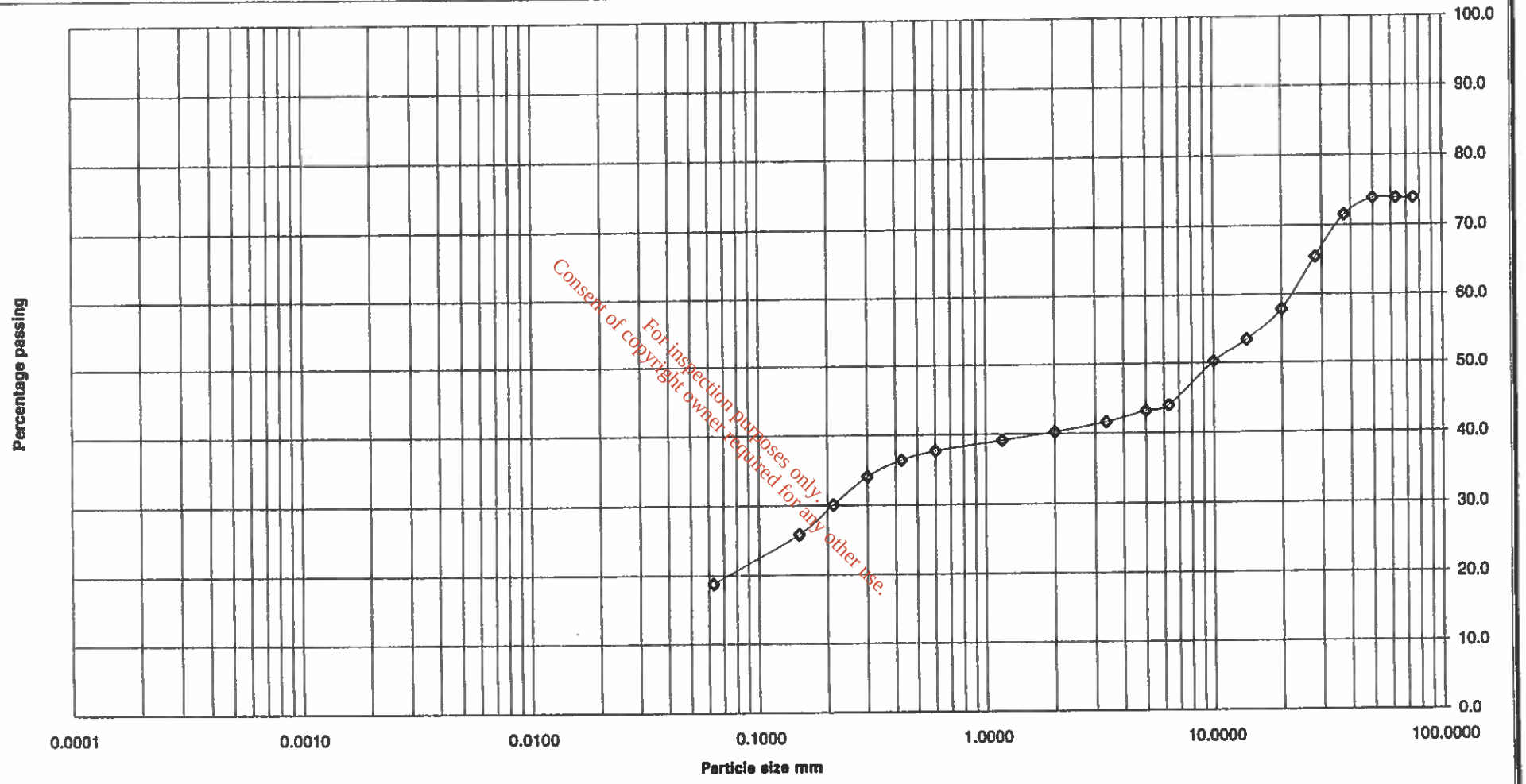
CLIENT: Irish Drilling

Project No: [illegible]89

Reference: 0415

PARTICLE SIZE DISTRIBUTION

Borehole No. TP5 Sample No. Depth 1.50 m



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CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLES
	SILT			SAND			GRAVEL			

Visual Description: Grey silty sandy GRAVEL with occasional cobbles

K4 SOILS LABORATORY

E.P.A. Export 09-07-2014:23:49:20

PROJECT: Bangor Erris

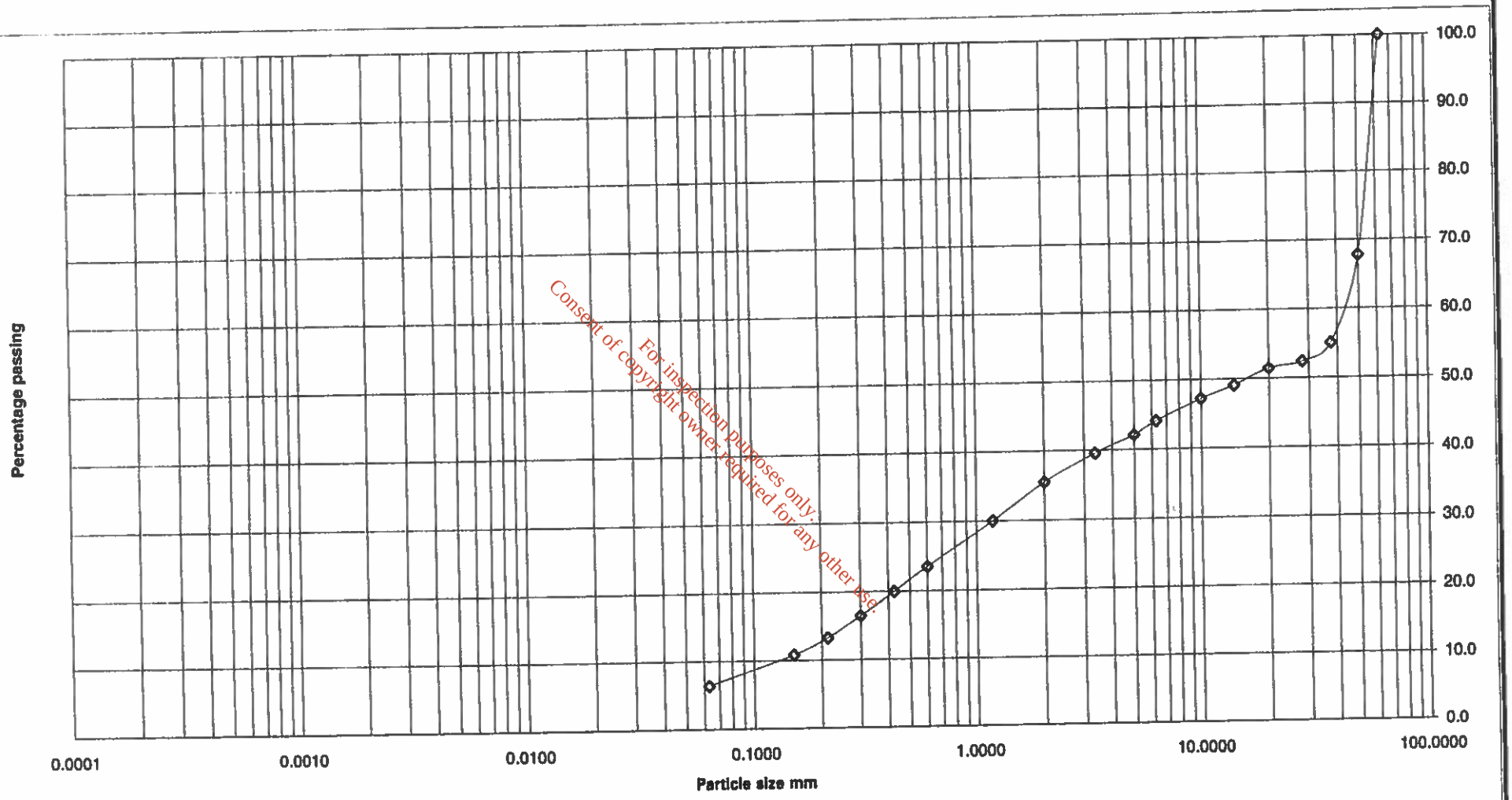
CLIENT: Irish Drilling

Project No: [illegible]9

Reference: 0415

PARTICLE SIZE DISTRIBUTION

Borehole No. TP6 Sample No. Depth 2.50 m



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For inspection purposes only.

CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	COBBLES
	SILT			SAND			GRAVEL			

Visual Description: Grey sandy GRAVEL

K4 SOILS LABORATORY

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Compaction/CBR/Moisture content test

2.5kg rammer
BS1377:1990; Part 4, Clause 3.4, 7

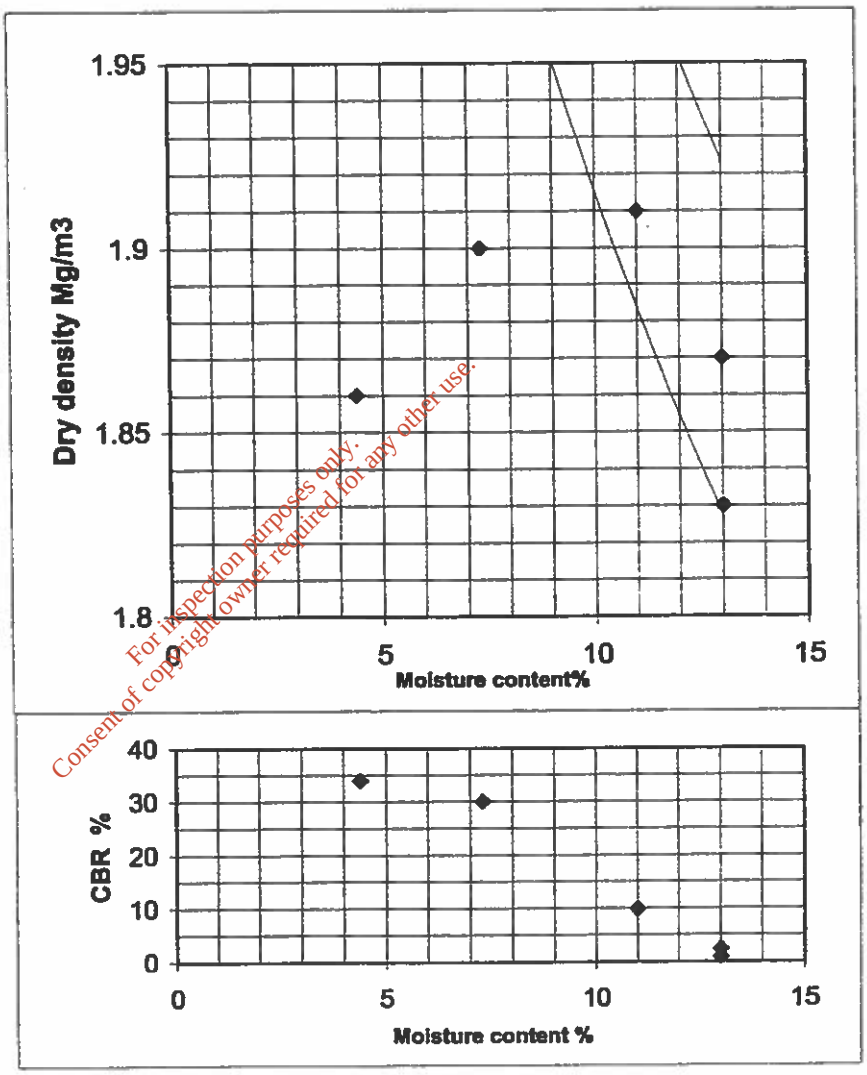
IRISH DRILLING LTD. **Loughrea, Co. Galway**	**Contract:** Peat Deposit Site at Bangor Erris (1169) **Client:** Enterprise oil **Engineer:** TES **Date:** 20/11/2003 **Tested:** DD **Chckd:** DJ	**Location:** TP 2 **Depth:** 1.5 m

Description: Grey slighlty clayey fine to medium SAND.

Moisture Content %	Dry Density Mg/m³
4.4	1.86
7.3	1.9
11	1.91
13	1.83
13	1.87

moisture content %	CBR %
4.4	34
7.3	30
11	9.8
13	2.4
13	0.9

Gs assumed: 2.55



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RESULTS:

Maximum dry density:	1.91	Mg/m³
Optimum moisture content:	11.00	%
Natural moisture content * :	13.00	%
Retained on 20mm Sieve:		%
Natural moisture content **:		%

* refers to bulk sample before removal of coarse particles

** refers to sample after removal of coarse particles

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Compaction/CBR/Moisture content test

2.5kg rammer
BS1377:1990; Part 4, Clause 3.4, 7

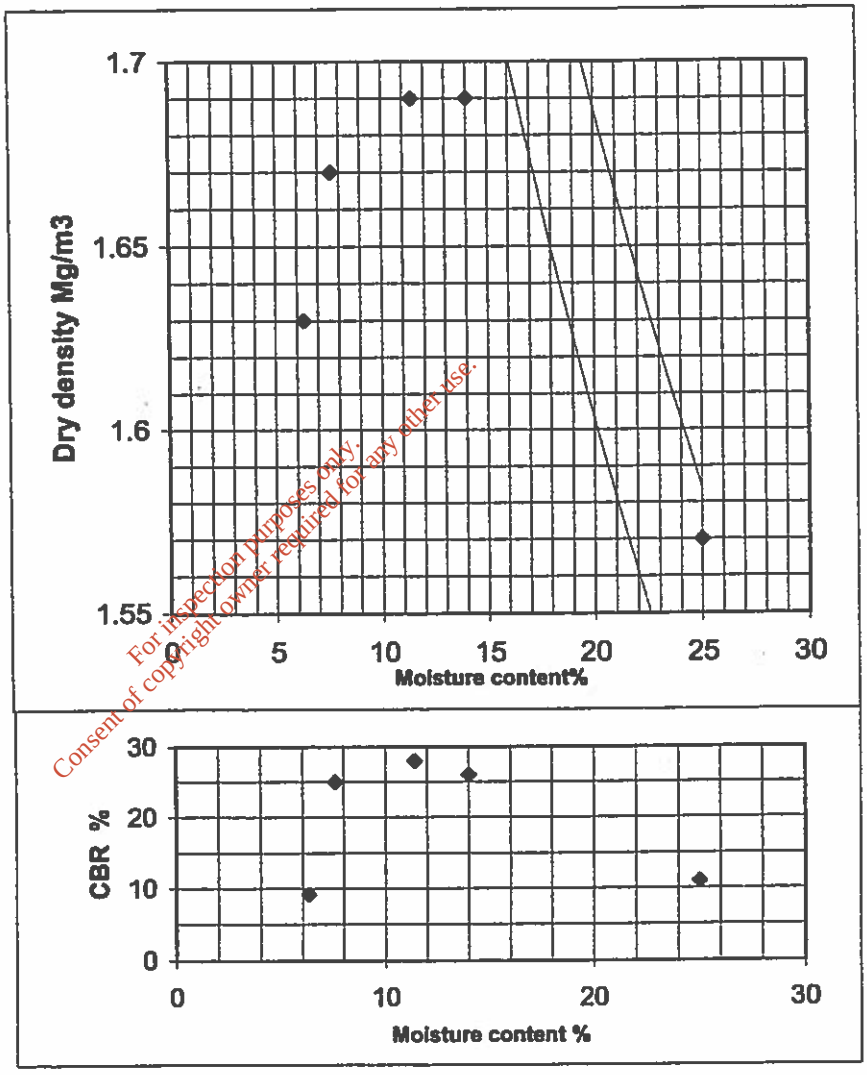
IRISH DRILLING LTD. **Loughrea, Co. Galway**	**Contract:** Peat Deposit Site at Bangor Erris (1169) **Client:** Enterprise oil **Engineer:** TES **Date:** 20/11/2003 **Tested:** DD **Chckd:** DJ	**Location:** TP 3 **Depth:** 2.5 m

Description: Dark grey-green SAND with occasional peat pockets.

Moisture Content %	Dry Density Mg/m³
6.3	1.63
7.6	1.67
11.4	1.69
14	1.69
25	1.57

moisture content %	CBR %
6.3	9.2
7.6	25
11.4	28
14	26
25	11

Gs assumed: 2.55



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RESULTS:

Maximum dry density:	1.69	Mg/m³
Optimum moisture content:	11.50	%
Natural moisture content * :	25.00	%
Retained on 20mm Sieve:		%
Natural moisture content **:		%

* refers to bulk sample before removal of coarse particles

** refers to sample after removal of coarse particles

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Compaction/CBR/Moisture content test

2.5kg rammer
BS1377:1990; Part 4, Clause 3.4, 7

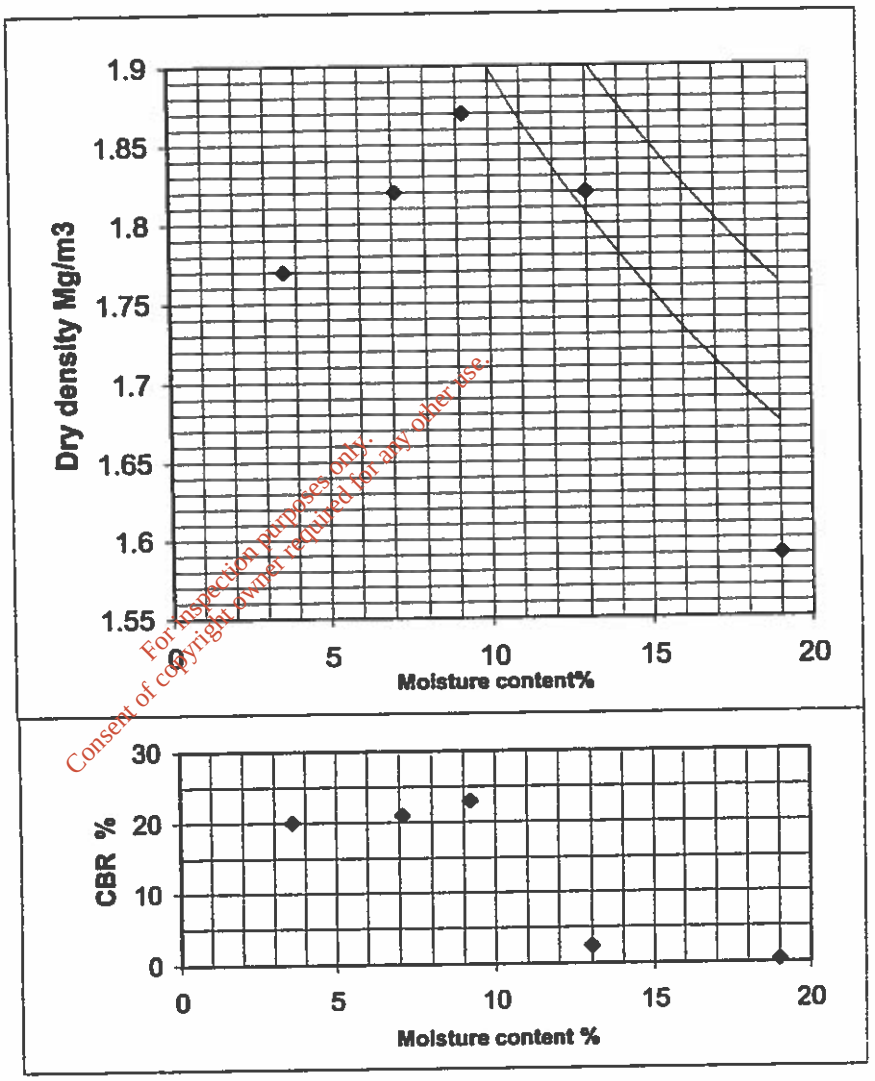
IRISH DRILLING LTD. **Loughrea, Co. Galway**	**Contract:** Peat Deposit Site at Bangor Erris (1169) **Client:** Enterprise oil **Engineer:** TES **Date:** 20/11/2003 **Tested:** DD **Chckd:** DJ	**Location:** TP 5 **Depth:** 1.5 m

Description: Dark grey very sandy CLAY with fine, medium to coarse gravel.

Moisture Content %	Dry Density Mg/m³
3.6	1.77
7.1	1.82
9.2	1.87
13	1.82
19	1.59

moisture content %	CBR %
3.6	20
7.1	21
9.2	23
13	2.4
19	0.36

Gs assumed: 2.55



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RESULTS:

Maximum dry density:	1.87	Mg/m³
Optimum moisture content:	9.20	%
Natural moisture content * :	19.00	%
Retained on 20mm Sieve:		%
Natural moisture content **:		%

* refers to bulk sample before removal of coarse particles

** refers to sample after removal of coarse particles

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Compaction/CBR/Moisture content test

2.5kg rammer
BS1377:1990; Part 4, Clause 3.4, 7

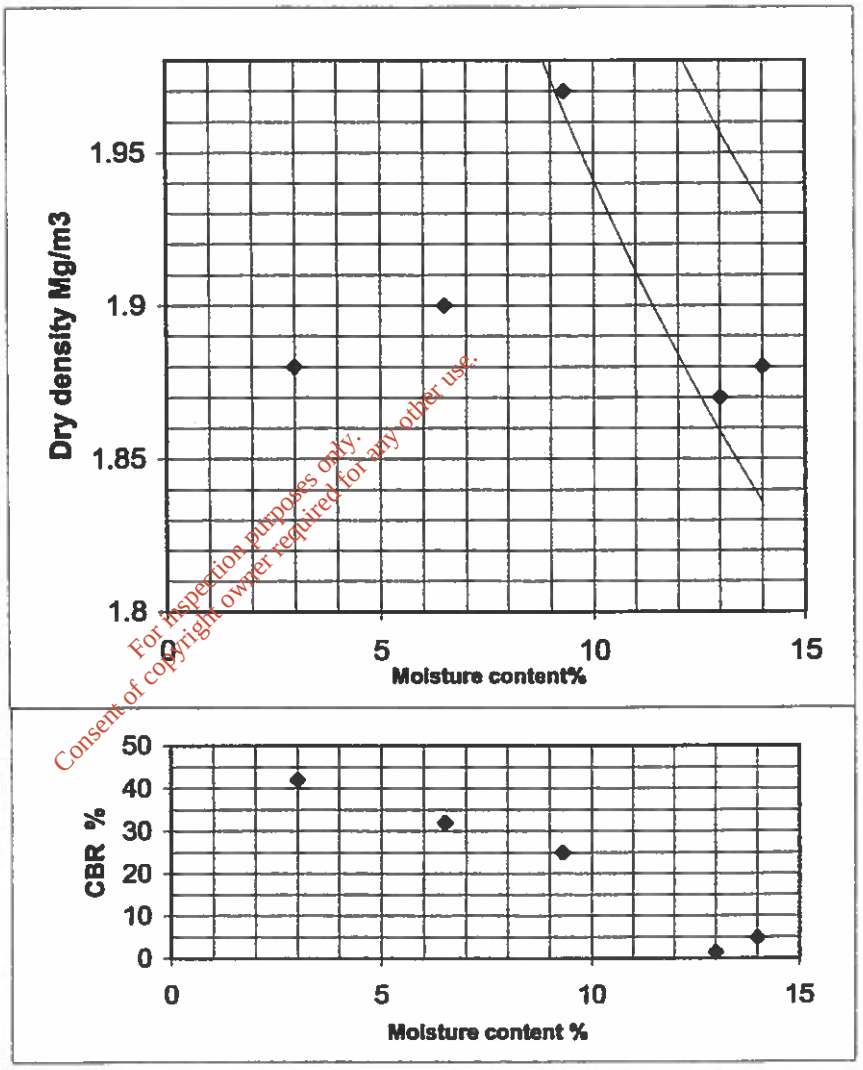
IRISH DRILLING LTD. **Loughrea, Co. Galway**	**Contract:** Peat Deposit Site at Bangor Erris (1169) **Client:** Enterprise oil **Engineer:** TES **Date:** 20/11/2003 **Tested:** DD **Chckd:** DJ	**Location:** TP 6 **Depth:** 1.5 m

Description: Grey SAND with a little gravel.

Moisture Content %	Dry Density Mg/m³
3	1.88
6.5	1.9
9.3	1.97
13	1.87
14	1.88

moisture content %	CBR %
3	42
6.5	32
9.3	25
13	1.4
14	4.79

Gs assumed: 2.60



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RESULTS:

Maximum dry density:	1.97	Mg/m³
Optimum moisture content:	9.30	%
Natural moisture content * :	14.00	%
Retained on 20mm Sieve:		%
Natural moisture content **:		%

* refers to bulk sample before removal of coarse particles

** refers to sample after removal of coarse particles

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Compaction/CBR/Moisture content test

2.5kg rammer
BS1377:1990; Part 4, Clause 3.4, 7

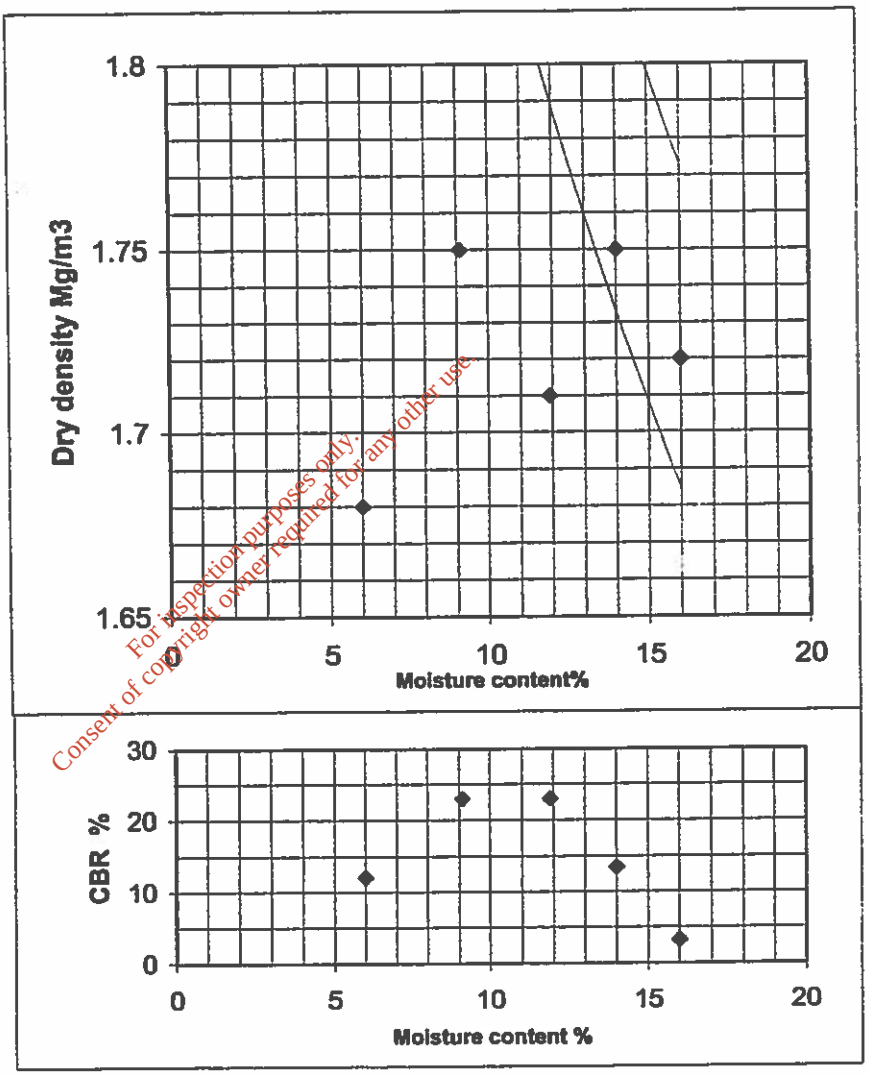
IRISH DRILLING LTD. **Loughrea, Co. Galway**	**Contract:** Peat Deposit Site at Bangor Erris (1169) **Client:** Enterprise oil **Engineer:** TES **Date:** 20/11/2003 **Tested:** DD **Chckd:** DJ	**Location:** TP 7 **Depth:** 2.5 m

Description: Grey SAND with a little gravel.

Moisture Content %	Dry Density Mg/m³
6	1.68
9.1	1.75
11.9	1.71
14	1.75
16	1.72

moisture content %	CBR %
6	12
9.1	23
11.9	23
14	13.4
16	3.2

Gs assumed: 2.45



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RESULTS:

Maximum dry density:	1.97	Mg/m³
Optimum moisture content:	9.30	%
Natural moisture content * :	14.00	%
Retained on 20mm Sieve:		%
Natural moisture content **:		%

* refers to bulk sample before removal of coarse particles

** refers to sample after removal of coarse particles

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APPENDIX B PHASE 2 GROUND INVESTIGATION RESULTS

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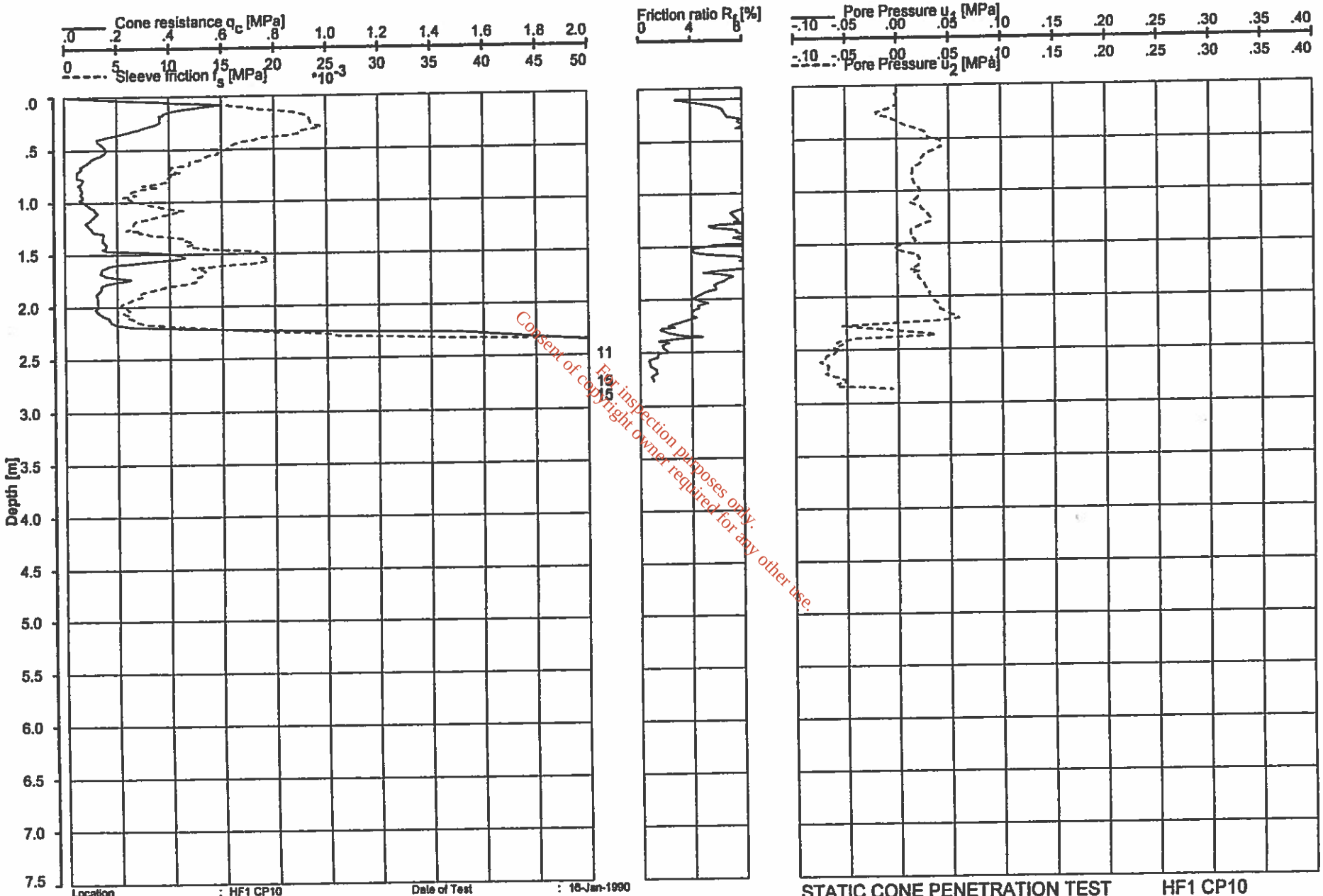

Consent of copyright owner required for any other use.
For inspection purposes only.

Location	: HF1 CP10	Date of Test	: 16-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Hf1cp10.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST HF1 CP10
EASINGTON LANFALL PIPELINE
STATOIL

FUGRO ENGINEERING SERVICES LIMITED

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EPA Export 09-07-2014:23:46:02

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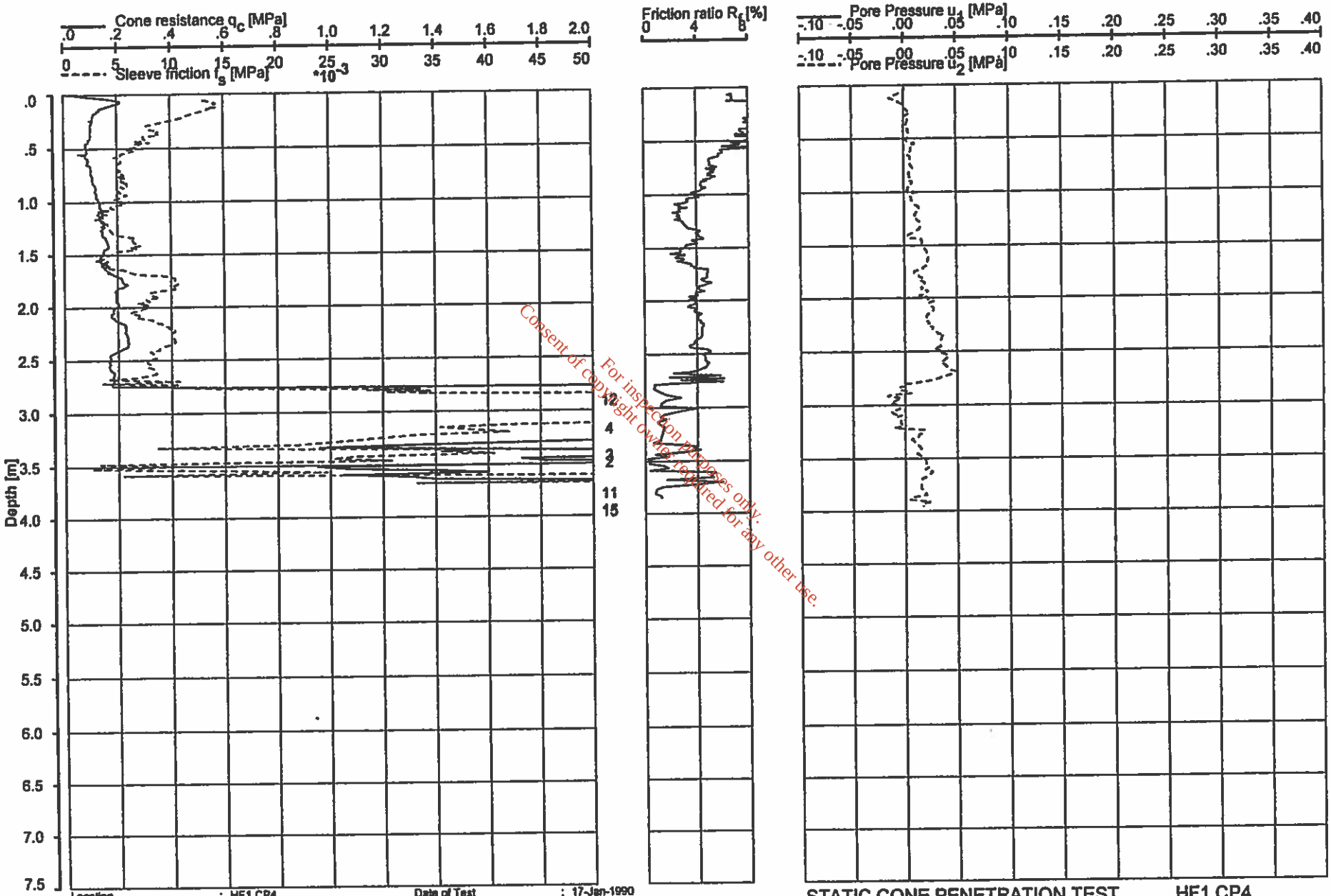

Consent of copyright owner required for any other use.
For inspection purposes only.

Location	: HF1 CP4	Date of Test	: 17-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Hf1cp4.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: —

STATIC CONE PENETRATION TEST HF1 CP4
EASINGTON LANFALL PIPELINE
STATOIL

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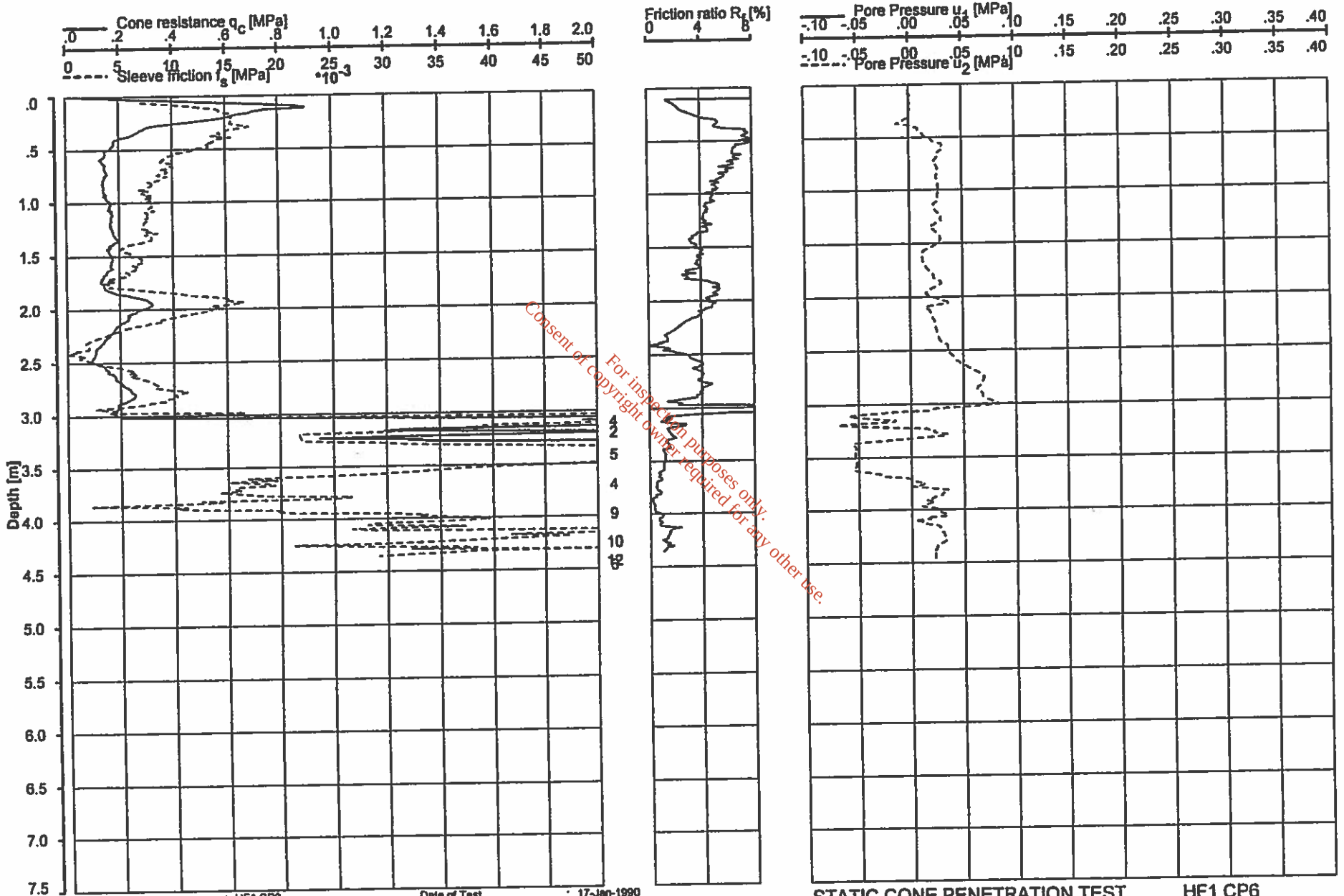

Consent of copyright owner required for any other use.
For inspection purposes only.

Location	: HF1 CP6	Date of Test	: 17-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Hf1cp6.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST HF1 CP6
EASINGTON LANFALL PIPELINE
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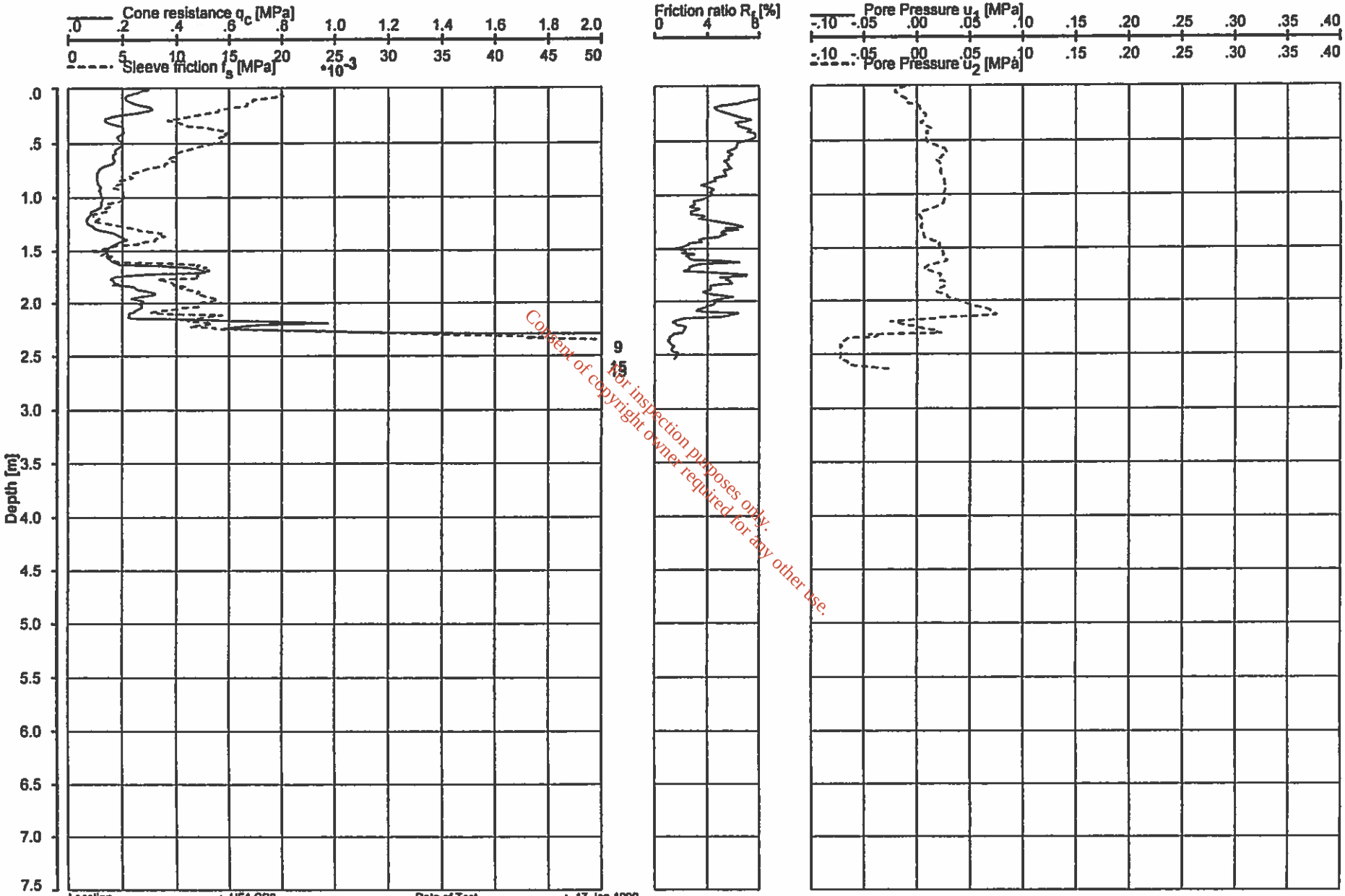

Content of copyright owner required for any other use.
For inspection purposes only.

Location	: HF1 CP8	Date of Test	: 17-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Hf1cp8.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

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STATIC CONE PENETRATION TEST HF1 CP8
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EPA Export 08-07-2014:23:46:02

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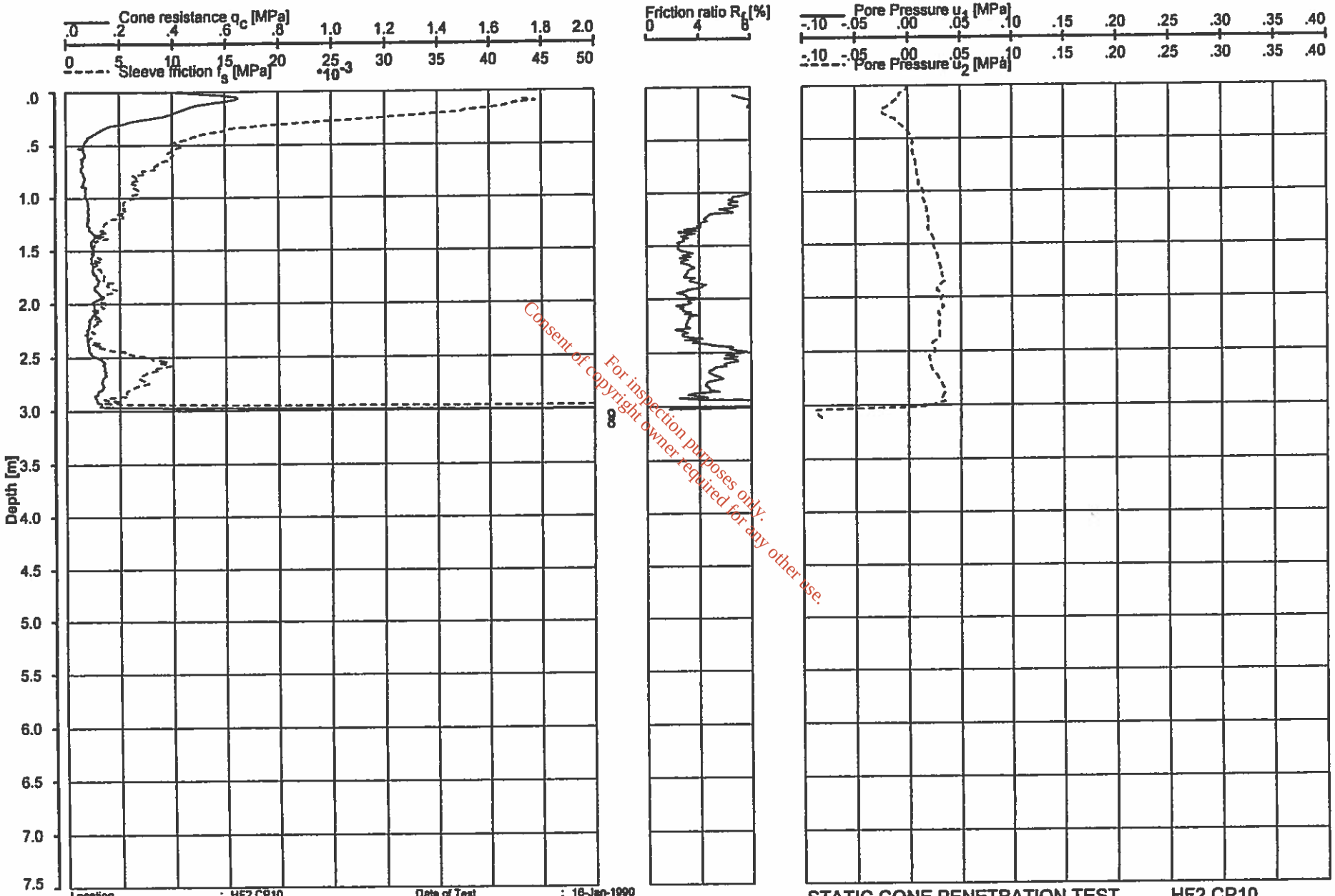

Consent of copyright owner required for any other use.
For inspection purposes only.

Location	: HF2 CP10	Date of Test	: 16-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Hf2cp10.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST HF2 CP10
EASINGTON LANFALL PIPELINE
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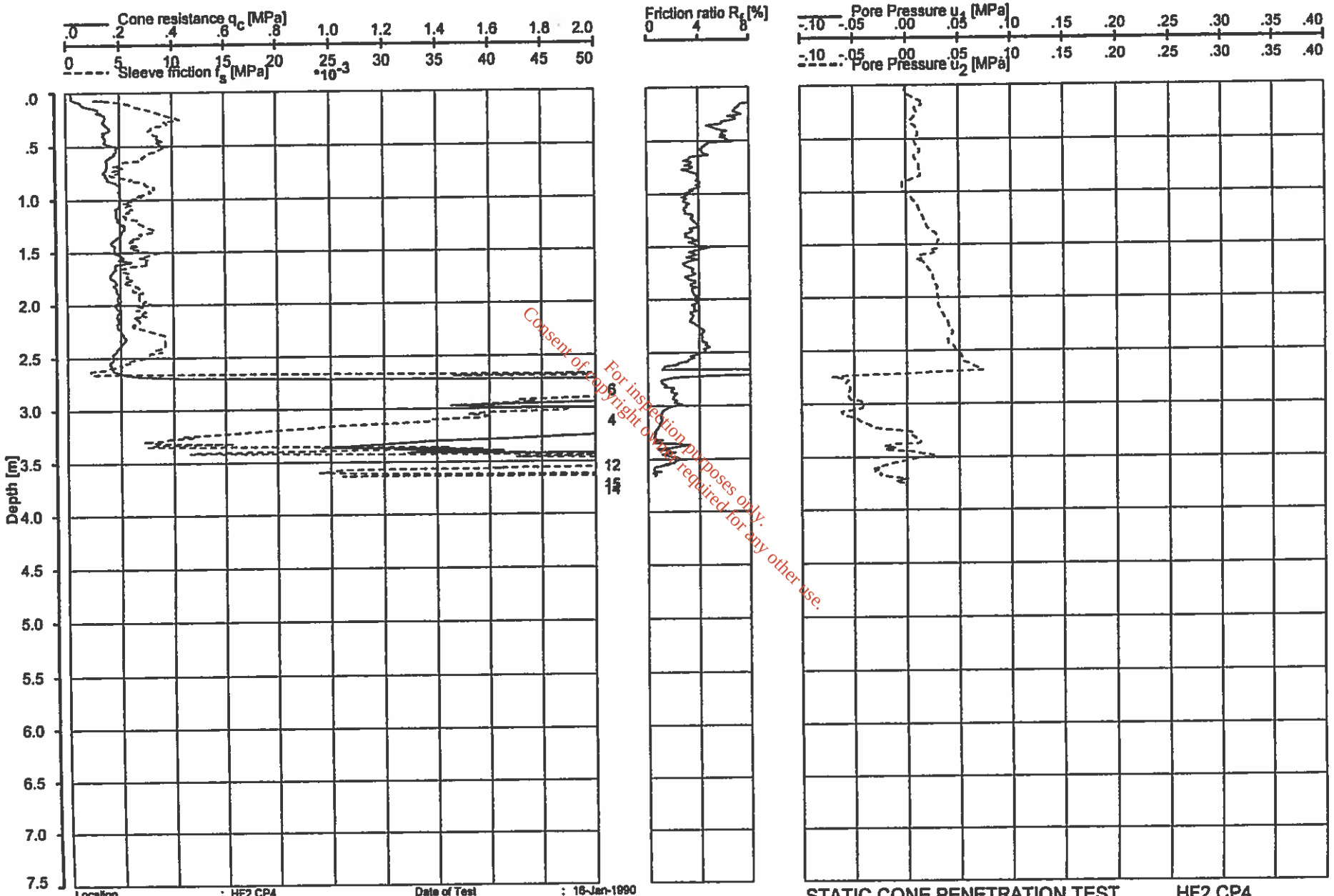

Consent of copyright owner required for any other use.
For inspection purposes only.

Location	: HF2 CP4	Date of Test	: 16-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Hf2cp4.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST HF2 CP4
EASINGTON LANFALL PIPELINE
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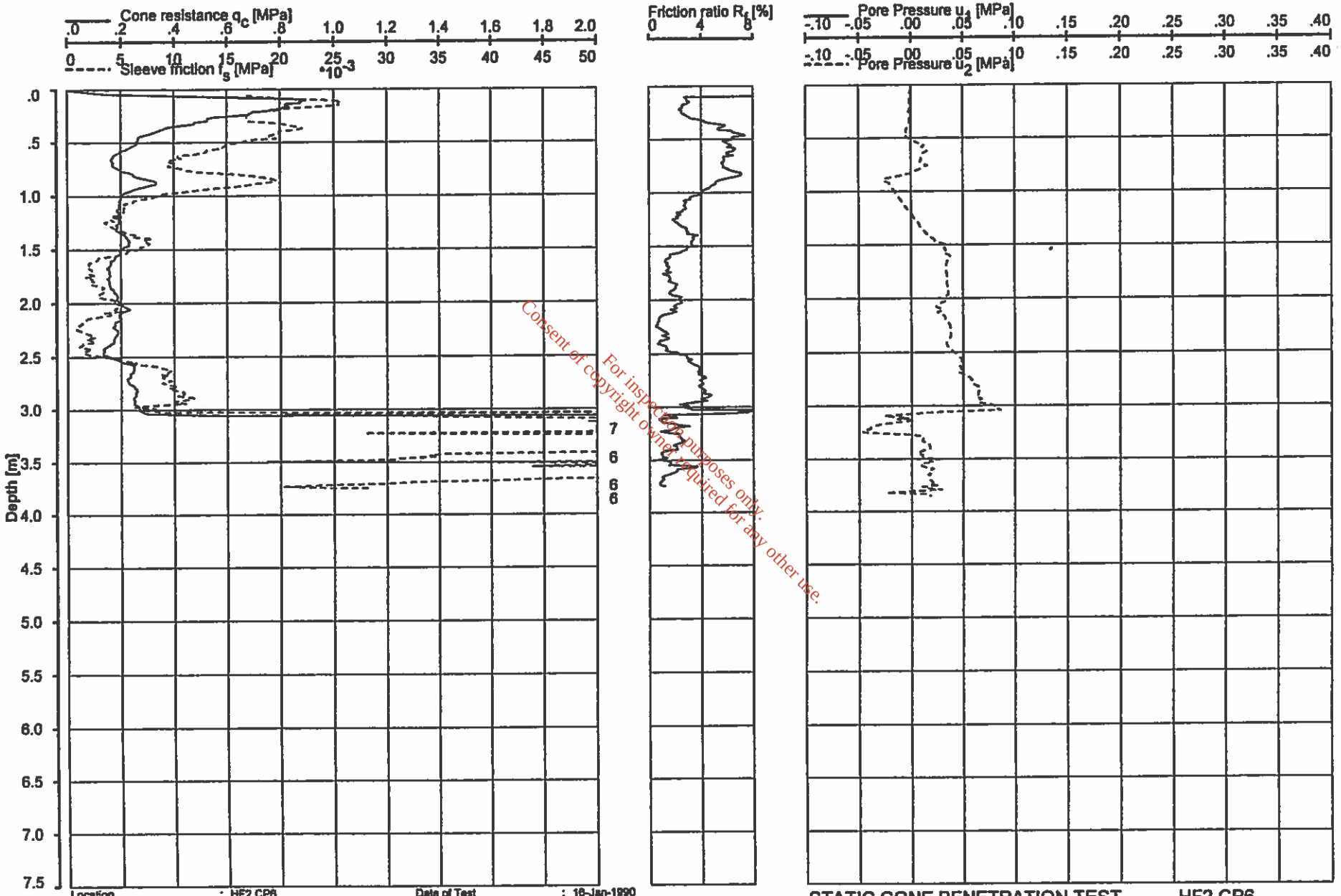

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For inspection purposes only.

Location	: HF2 CP6	Date of Test	: 16-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Ht2cp6.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST HF2 CP6
EASINGTON LANFALL PIPELINE
STATOIL

FUGRO ENGINEERING SERVICES LIMITED

31619-1 (01)

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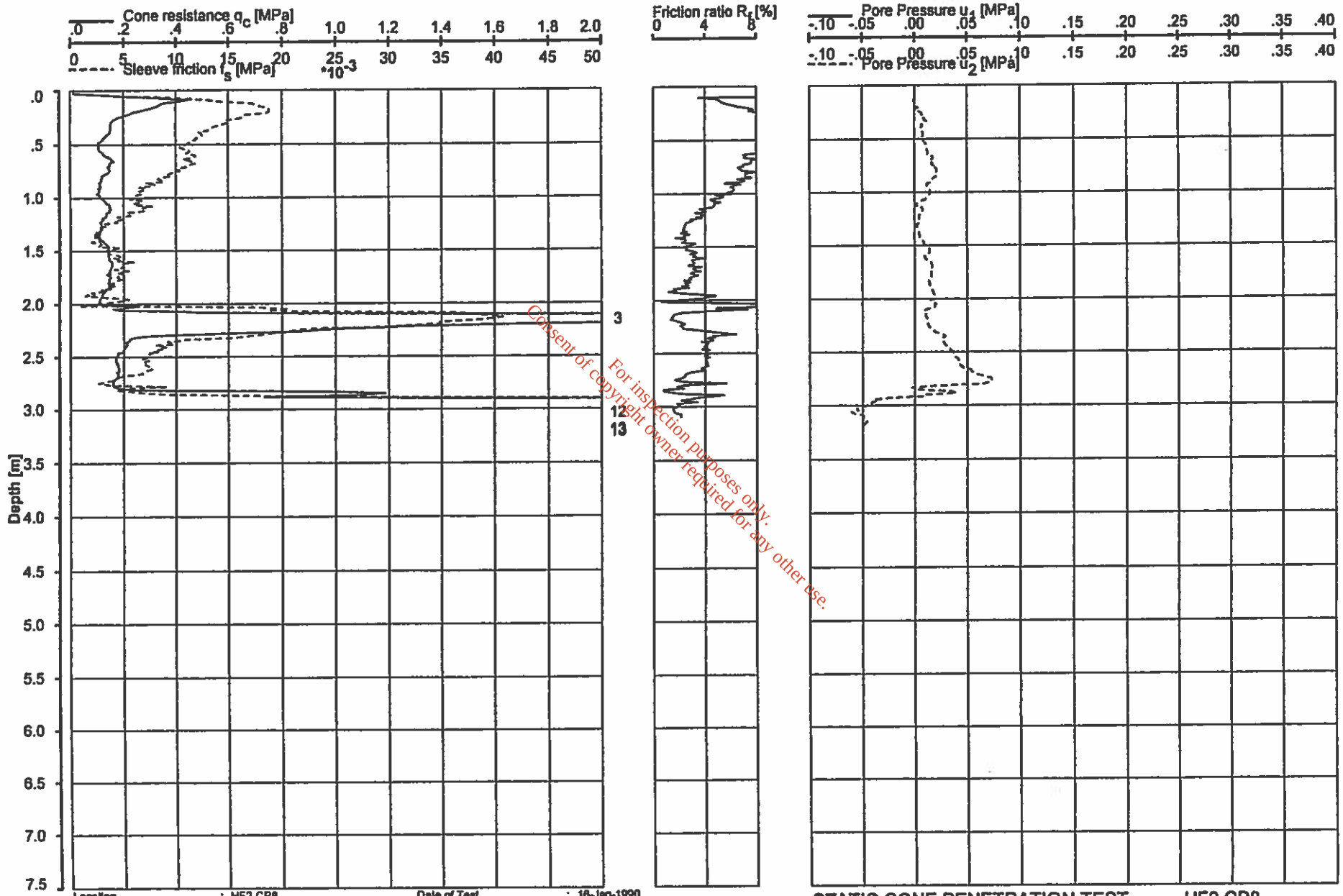

Consent of copyright owner required for any other use.
For inspection purposes only.

Location	: HF2 CP8	Date of Test	: 16-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level (m)	:	File name	: Hf2cp8.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST HF2 CP8
EASINGTON LANFALL PIPELINE
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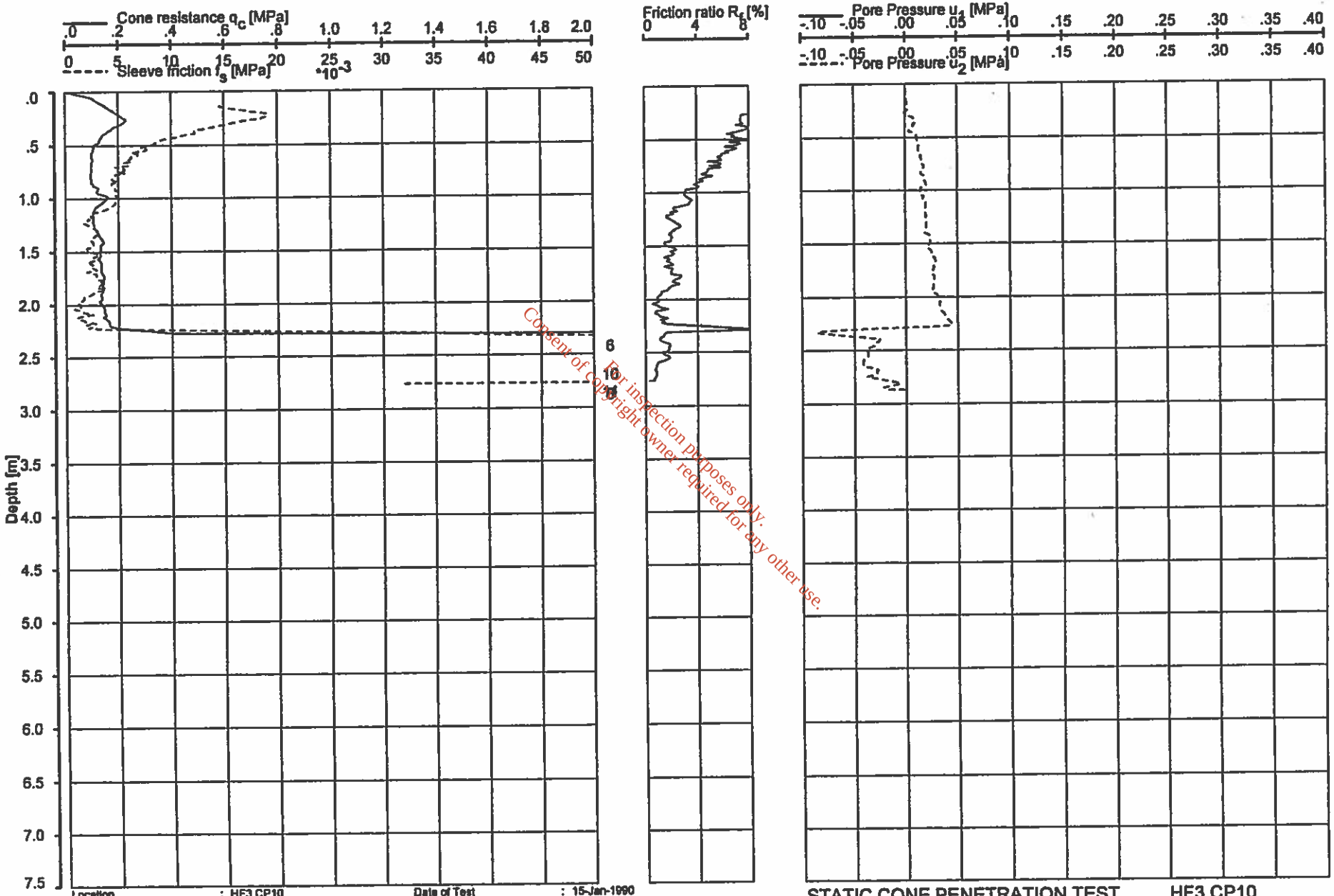

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Location	: HF3 CP10	Date of Test	: 15-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level (m)	:	File name	: Hf3cp10.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

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STATIC CONE PENETRATION TEST HF3 CP10
EASINGTON LANFALL PIPELINE
STATOIL

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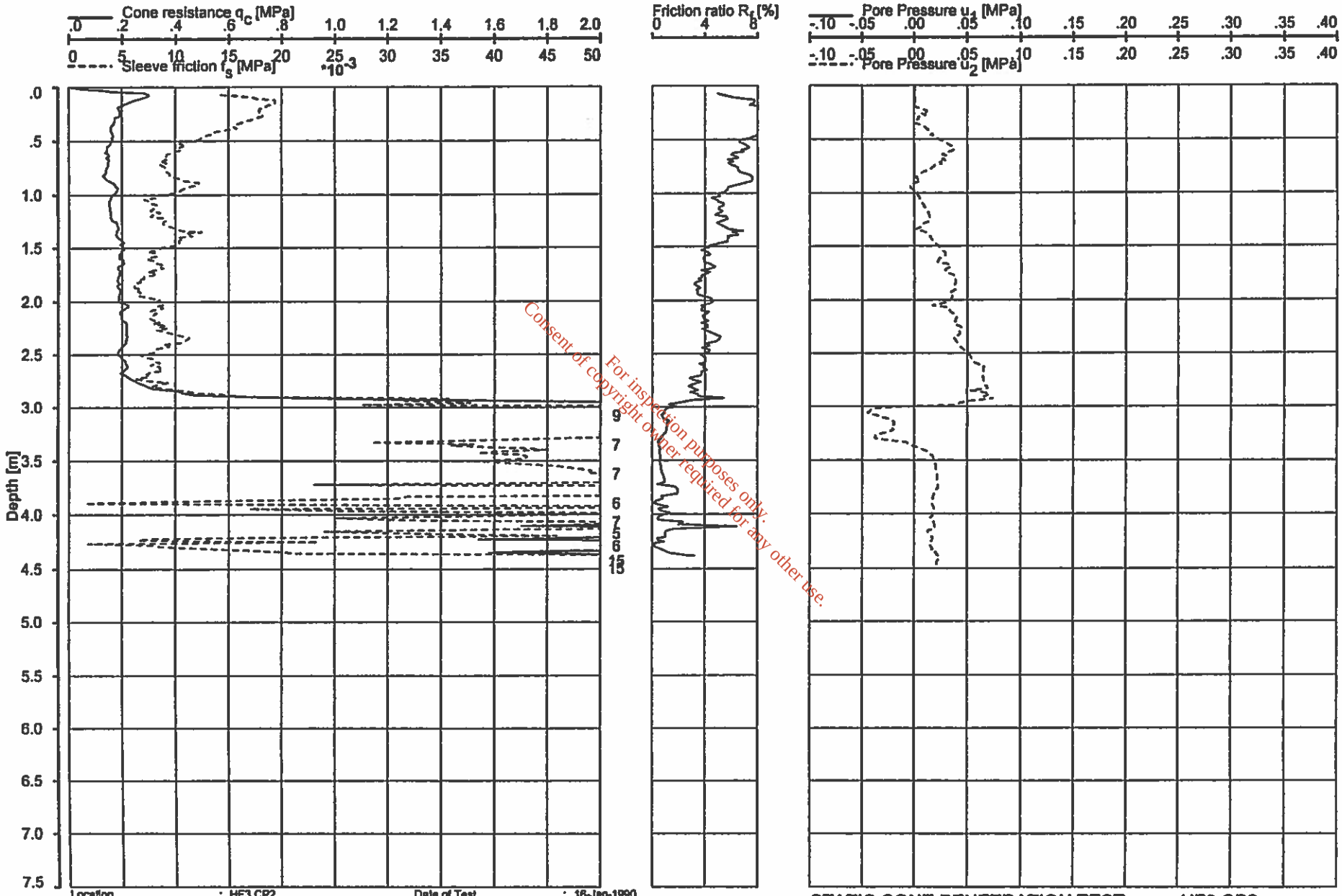

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Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Hf3cp2.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST HF3 CP2
EASINGTON LANFALL PIPELINE
STATOIL

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EPA Export 08-07-2014:23:46:02

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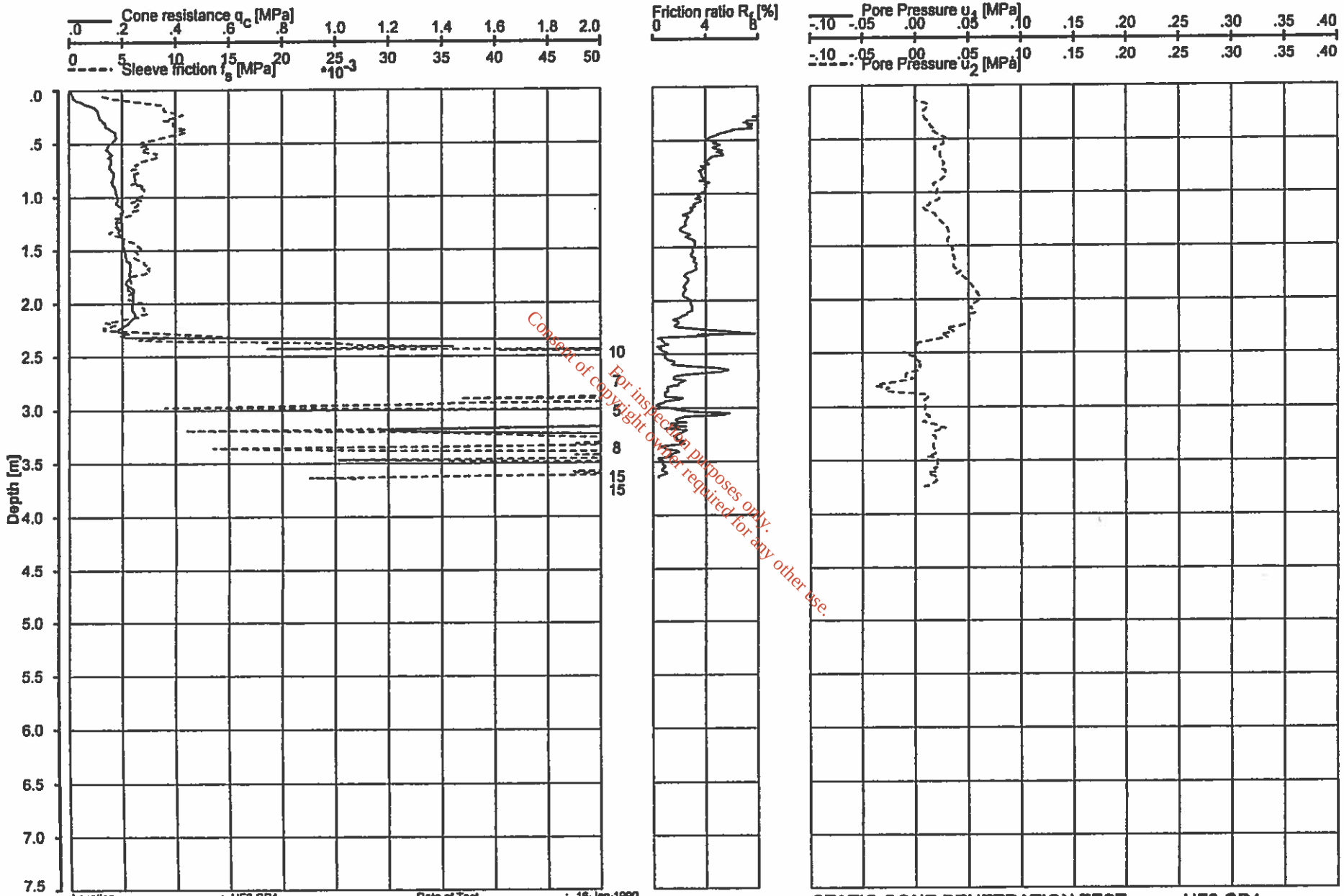

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For inspection purposes only.

Location	: HF3 CP4	Date of Test	: 16-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Hf3cp4.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST HF3 CP4
EASINGTON LANFALL PIPELINE
STATOIL

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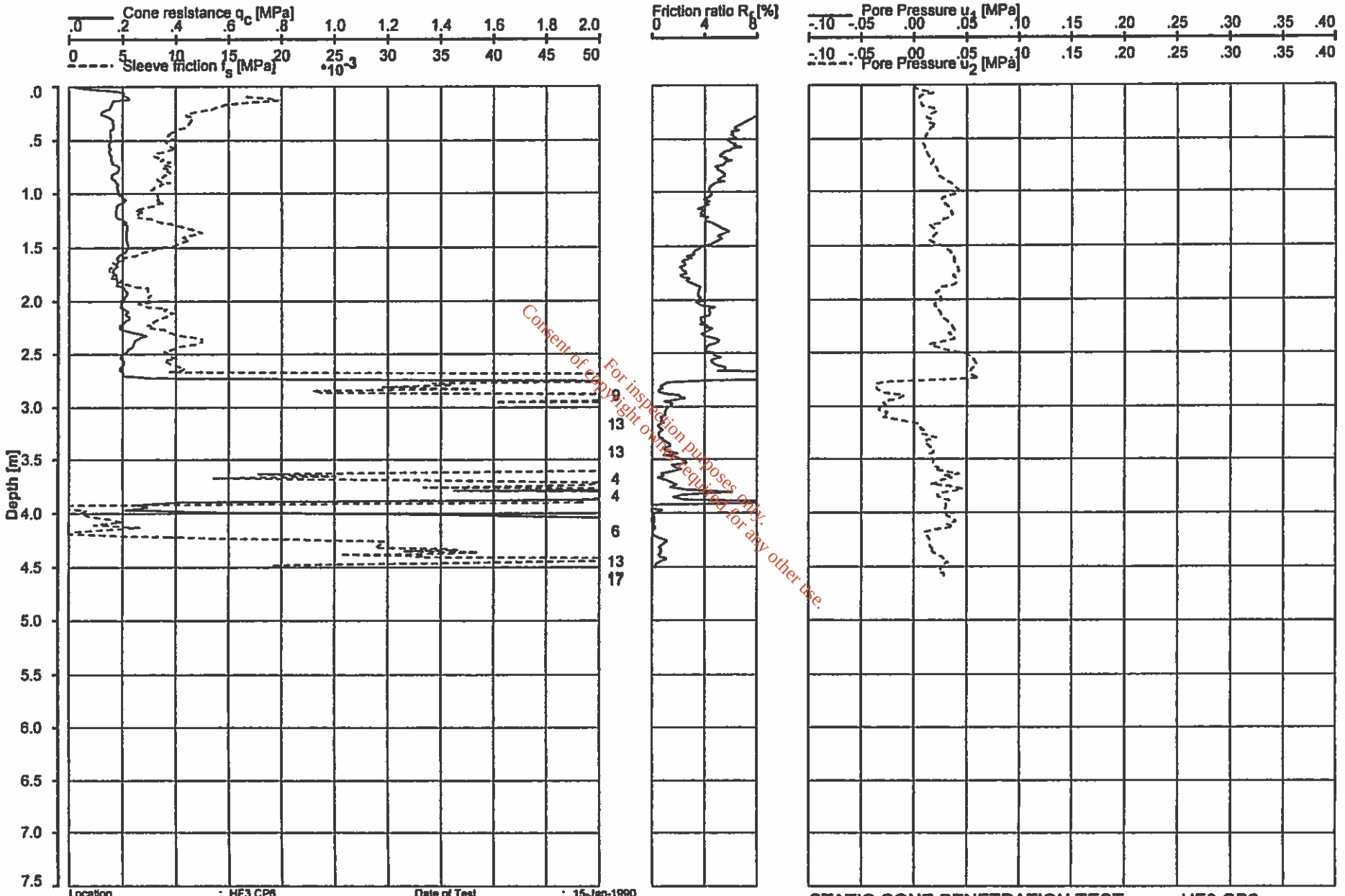
EPA Export 08-07-2014:23:46:02

UNIPLOT 02.15.NL /16:48:42/02QCFSU1.CMD Made by: dd: 4-Dec-2003 Checked by:



Location : HF3 CP6
Coordinates :
Ground Level (m) :
Cone used : F7.5CKEW$_2$/V 1515

Date of Test : 15-Jan-1990
Date of Plot : 02-Dec-2003
File name : Hf3cp6.000
Interpretation Checked by : ...

31619-1 (01)

STATIC CONE PENETRATION TEST HF3 CP6
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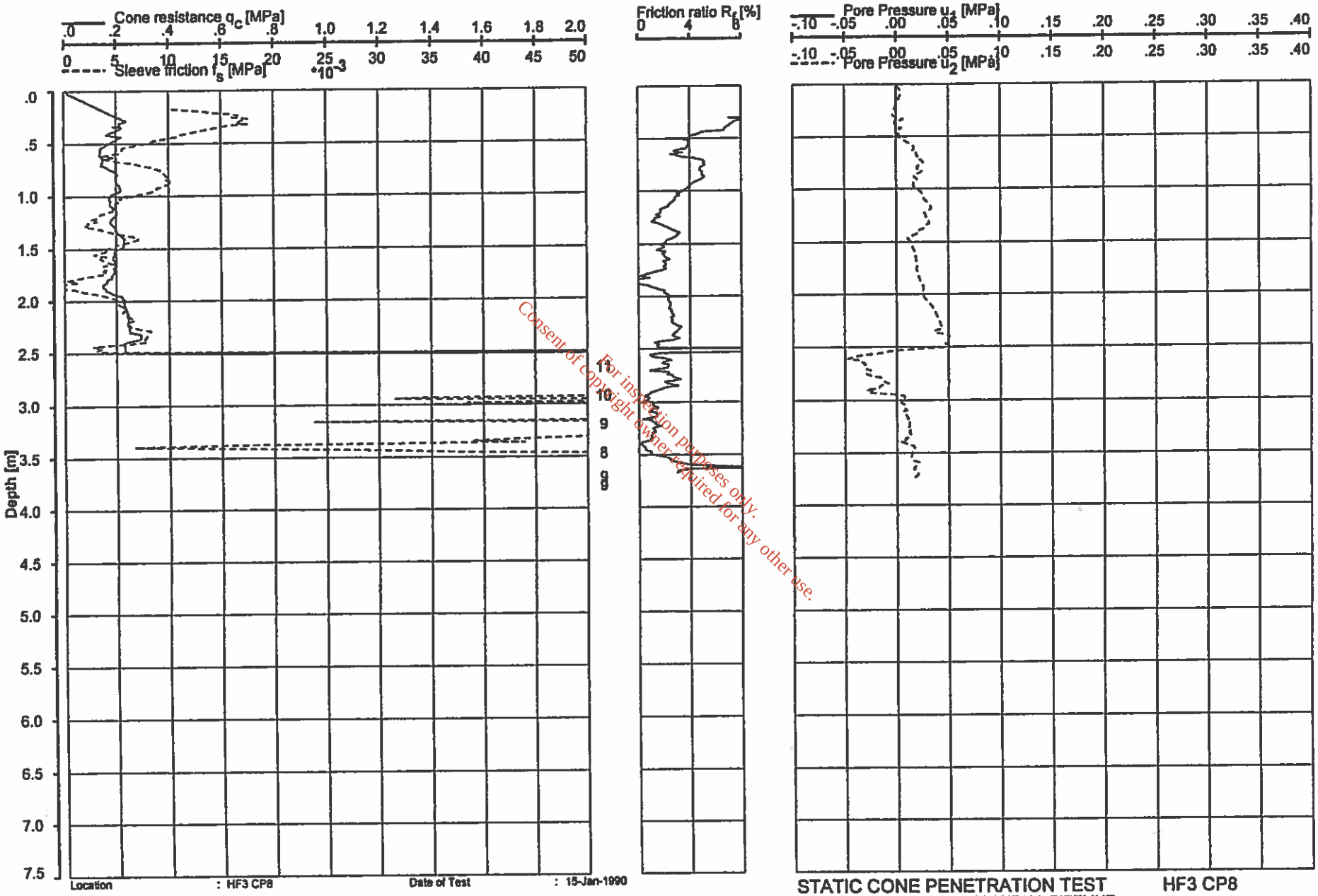
UNIPLOT 02.15.NL /16:48:43/02QCFSU1.CMD Made by: dd: 4-Dec-2003 Checked by:



Location : HF3 CP8
Coordinates :
Ground Level [m] :
Cone used : F7.5CKEW$_2$/V 1515

Date of Test : 15-Jan-1990
Date of Plot : 02-Dec-2003
File name : Hf3cp8.000
Interpretation Checked by : ...

31619-1 (01)

STATIC CONE PENETRATION TEST HF3 CP8
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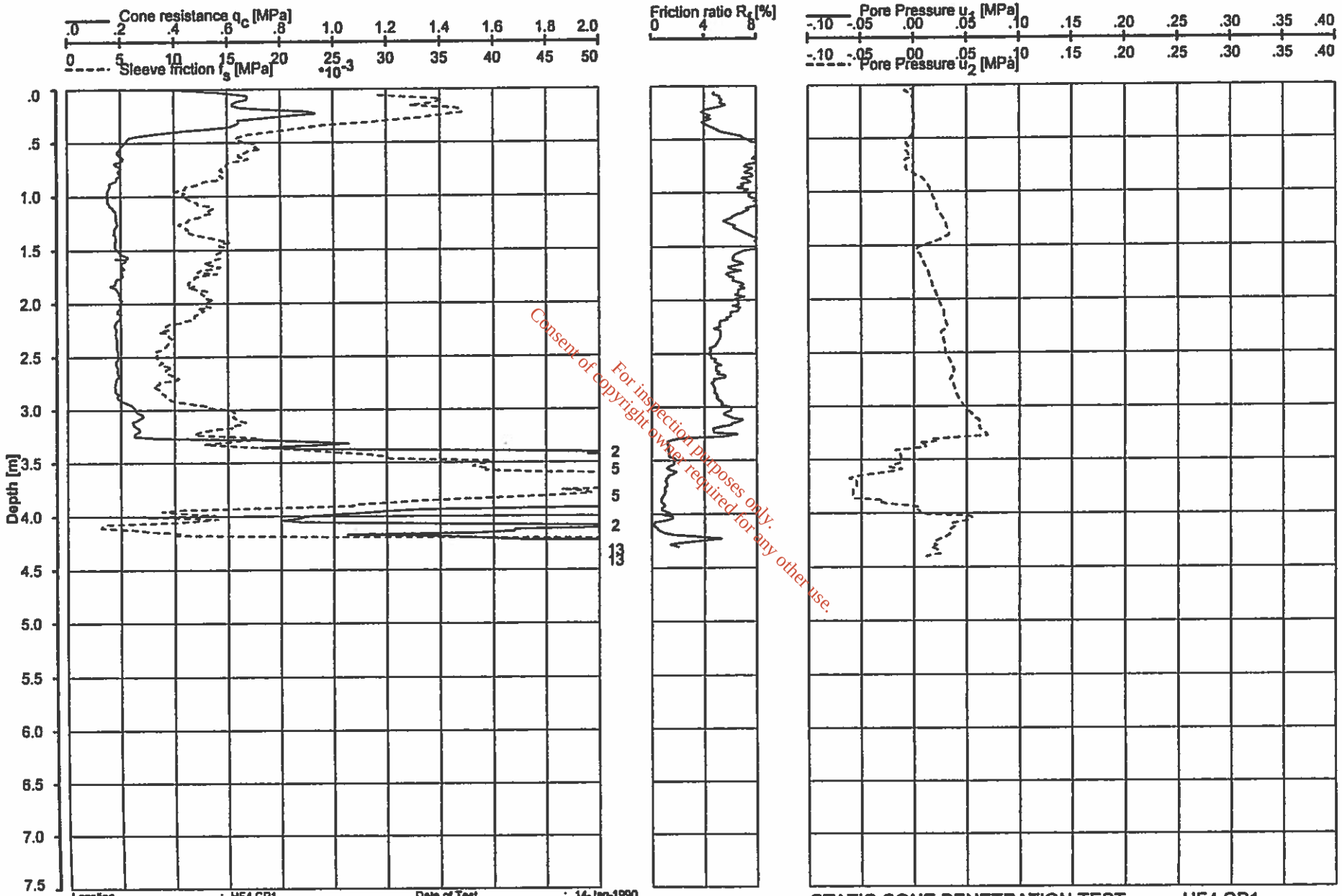
UNIPLOT 02.15.NL /16:48:43/02QCFSU1.CMD Made by: dd: 4-Dec-2003 Checked by:



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For inspection purposes only.

Location	: HF4 CP1	Date of Test	: 14-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Hf4cp1.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST HF4 CP1

EASINGTON LANFALL PIPELINE

STATOIL

FUGRO ENGINEERING SERVICES LIMITED

31619-1 (01)

EPA Export 08-07-2014:23:46:03

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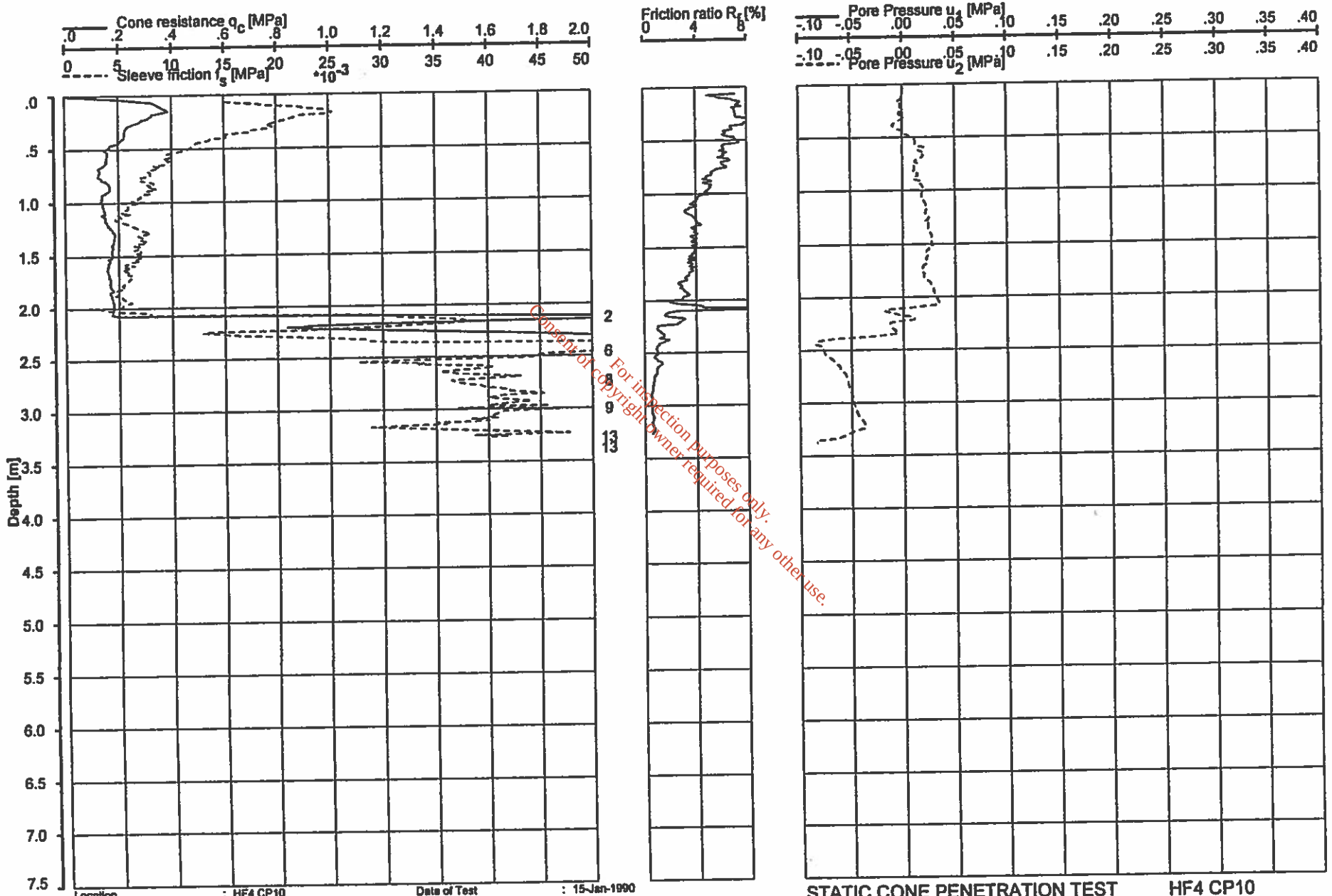

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Location	: HF4 CP10	Date of Test	: 15-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Hf4cp10.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST HF4 CP10

EASINGTON LANFALL PIPELINE

STATOIL

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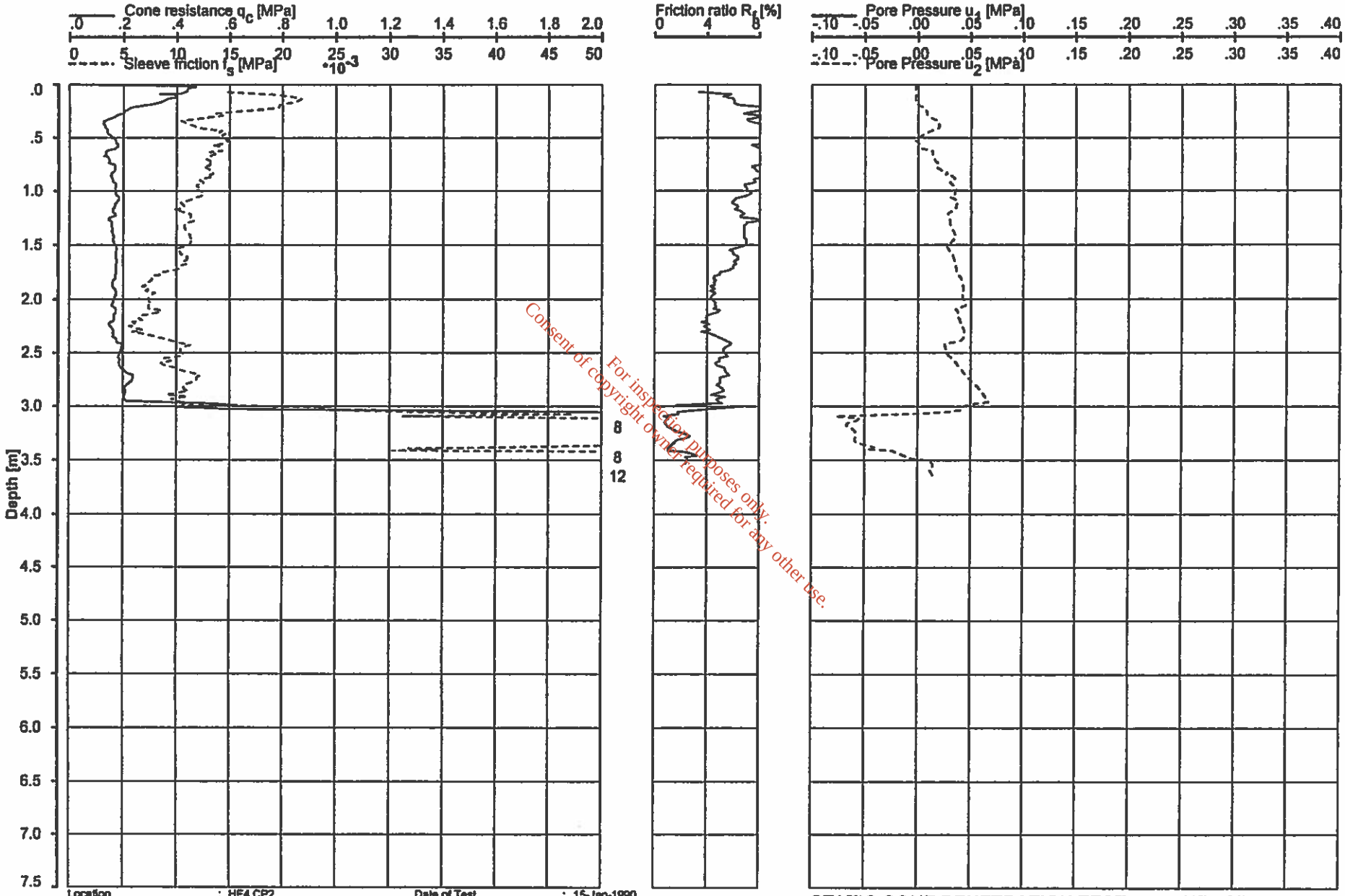

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Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Hf4cp2.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

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STATIC CONE PENETRATION TEST HF4 CP2
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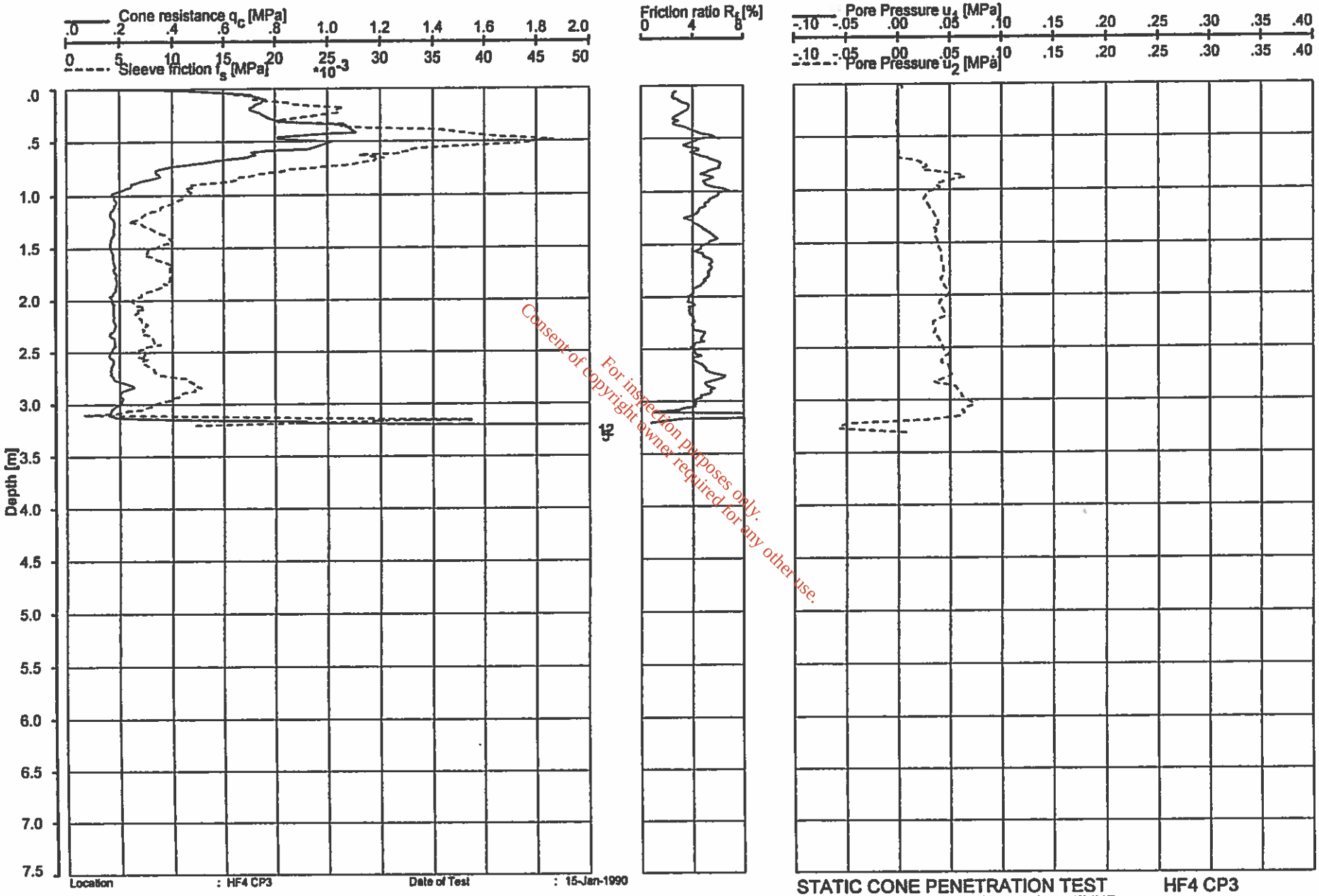

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Coordinates :
Ground Level [m] :
Cone used : F7.5CKEW$_2$/V 1515

Date of Test : 15-Jan-1990
Date of Plot : 02-Dec-2003
File name : Hf4cp3.000
Interpretation Checked by : ...

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STATIC CONE PENETRATION TEST HF4 CP3
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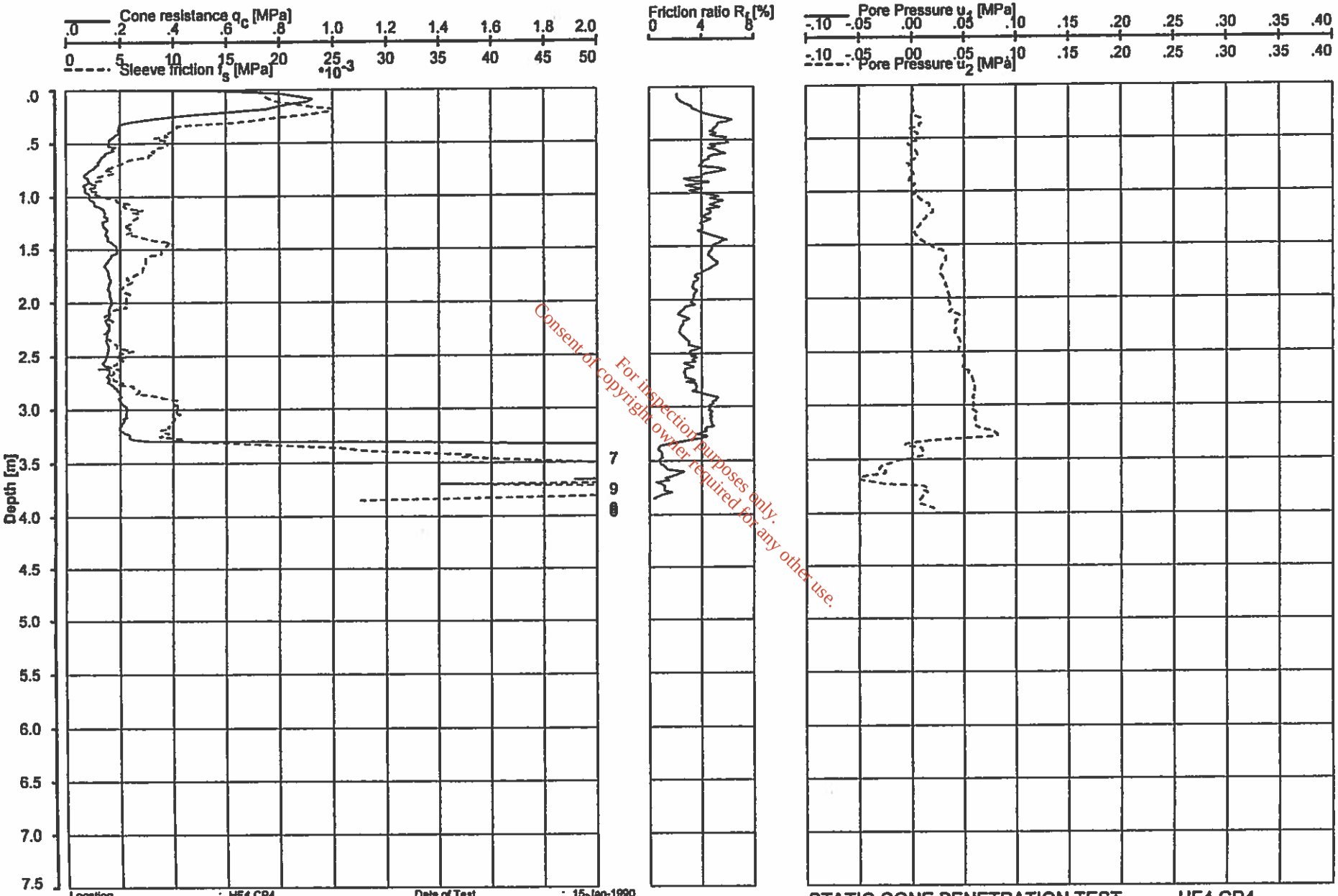

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Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Hf4cp4.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST HF4 CP4
EASINGTON LANFALL PIPELINE
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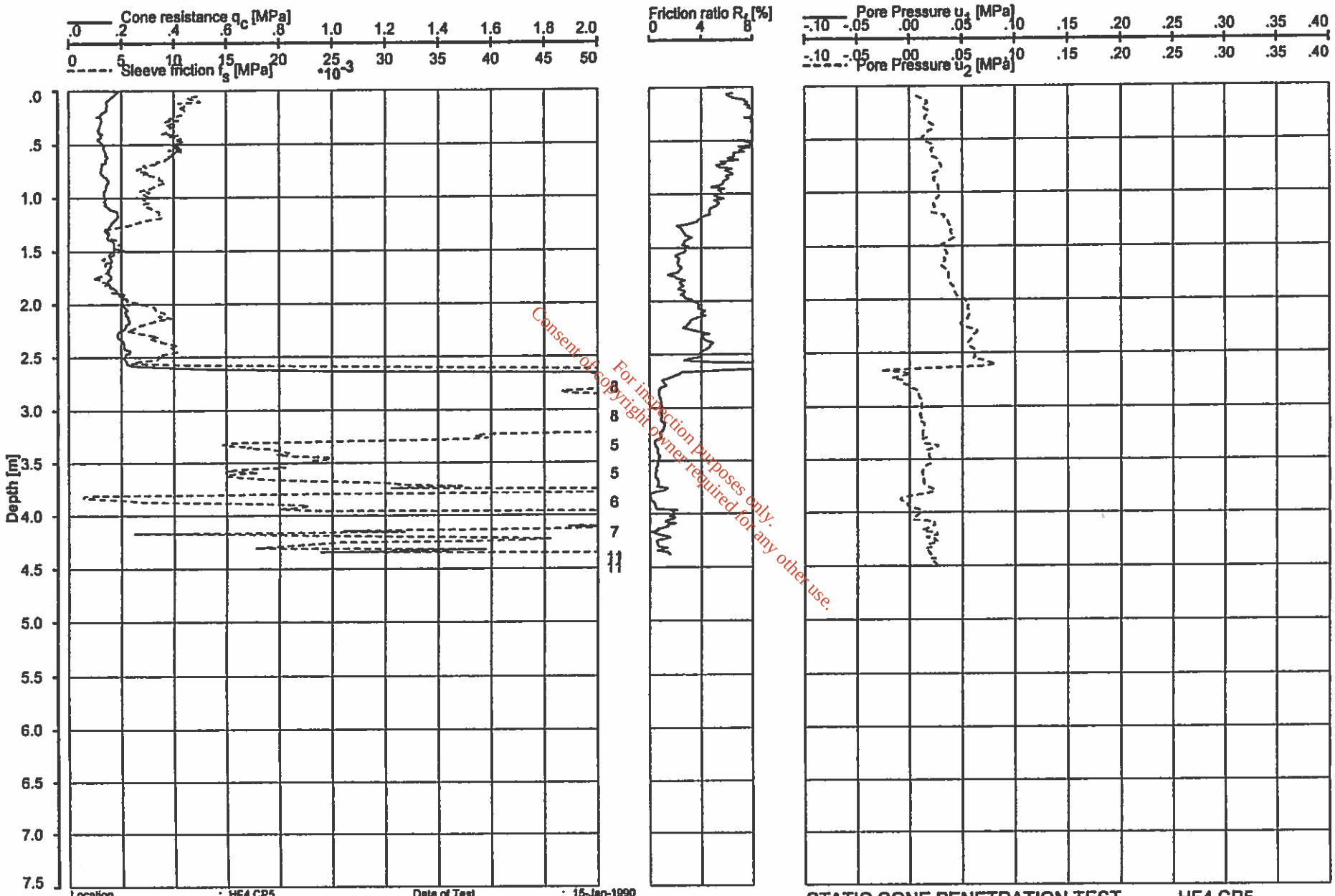

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Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: HF4CP5.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

31619-1 (01)

STATIC CONE PENETRATION TEST HF4 CP5
EASINGTON LANFALL PIPELINE
STATOIL

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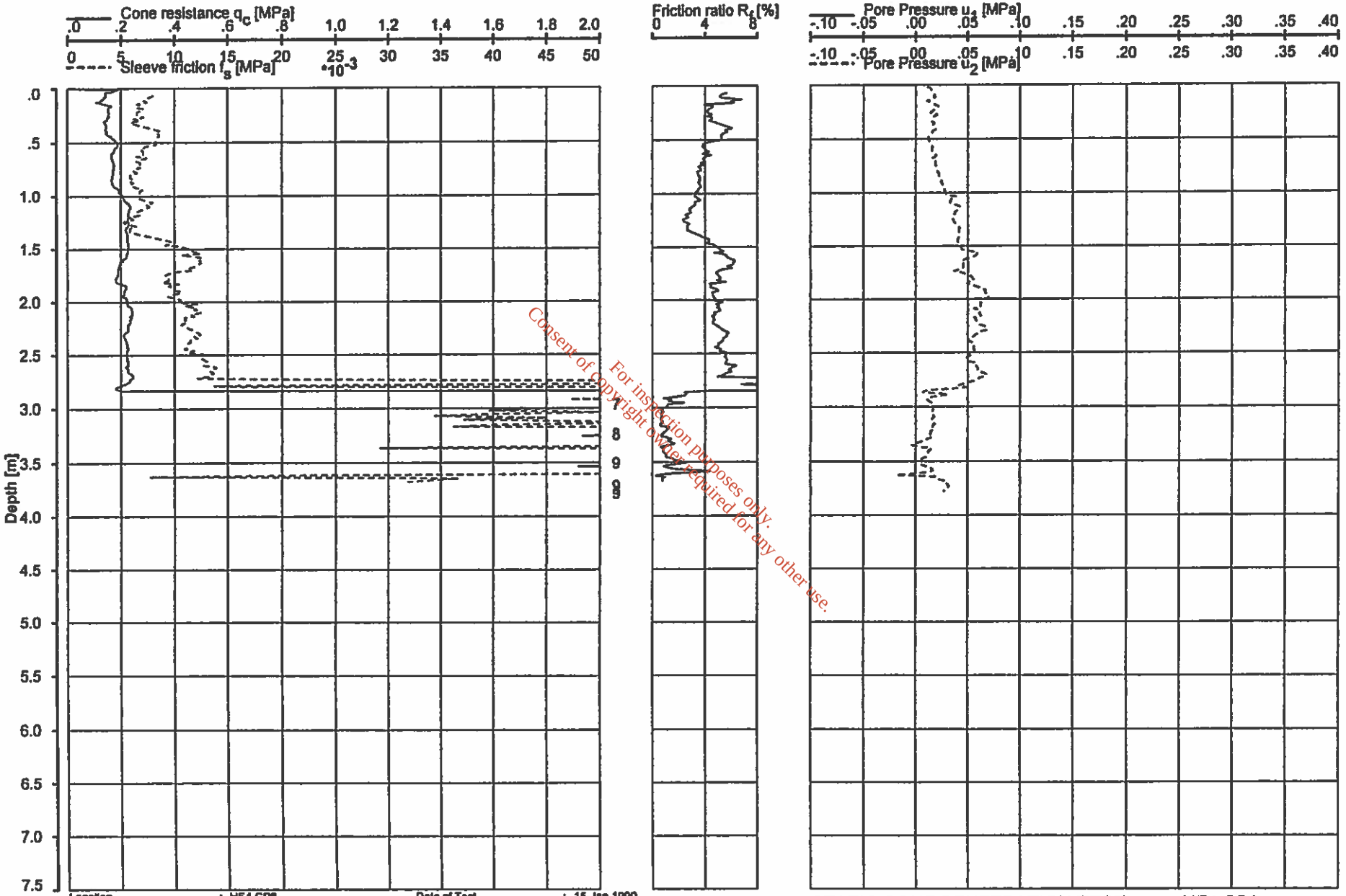

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Location	: HF4 CP6	Date of Test	: 15-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Hf4cp6.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST HF4 CP6
EASINGTON LANFALL PIPELINE
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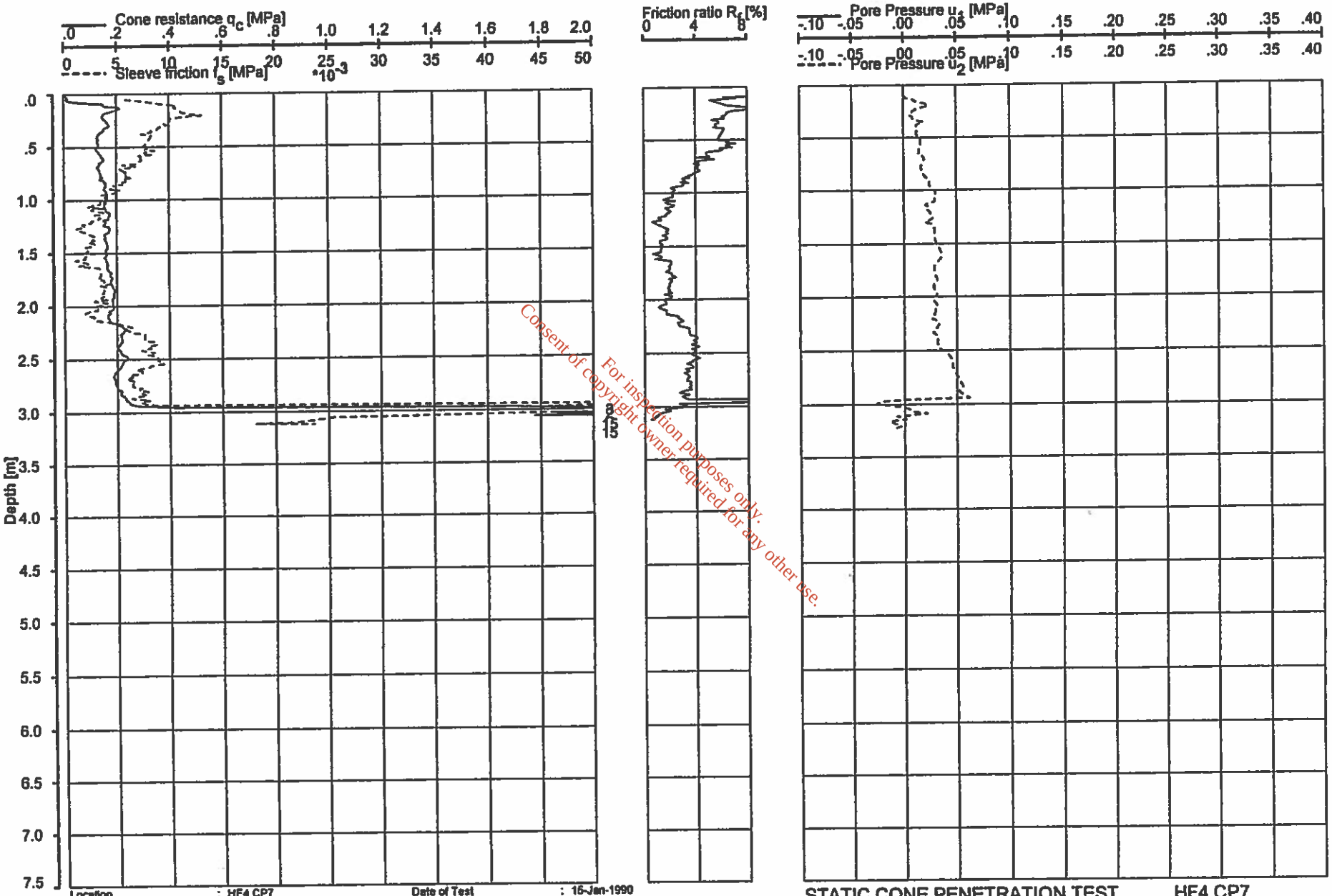

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For inspection purposes only.

Location	: HF4 CP7	Date of Test	: 16-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Hf4cp7.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST HF4 CP7
EASINGTON LANFALL PIPELINE
STATOIL

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EPA Export 08-07-2014:23:46:03

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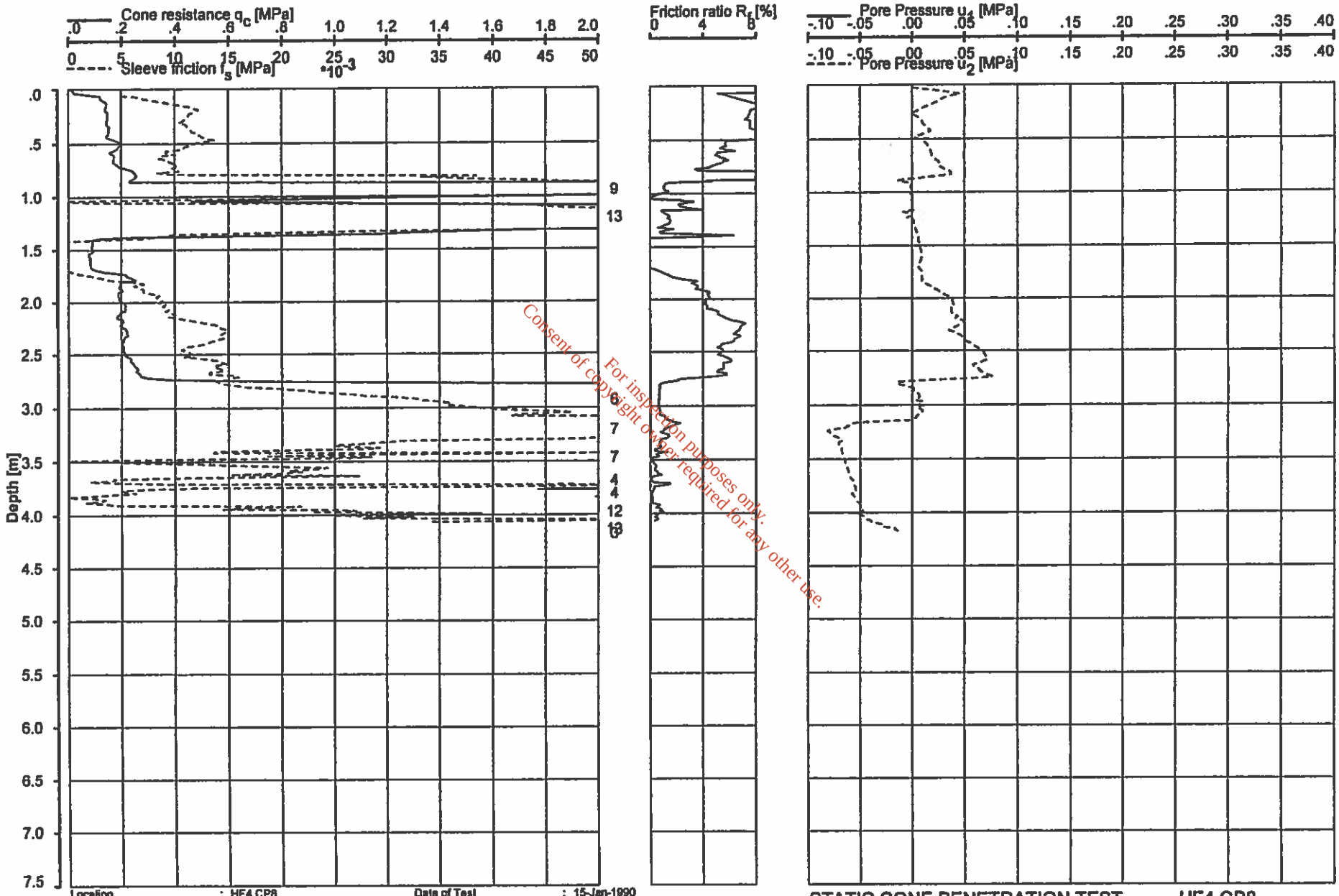

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Location	: HF4 CP8	Date of Test	: 15-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Hf4cp8.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST HF4 CP8
EASINGTON LANFALL PIPELINE
STATOIL

FUGRO ENGINEERING SERVICES LIMITED

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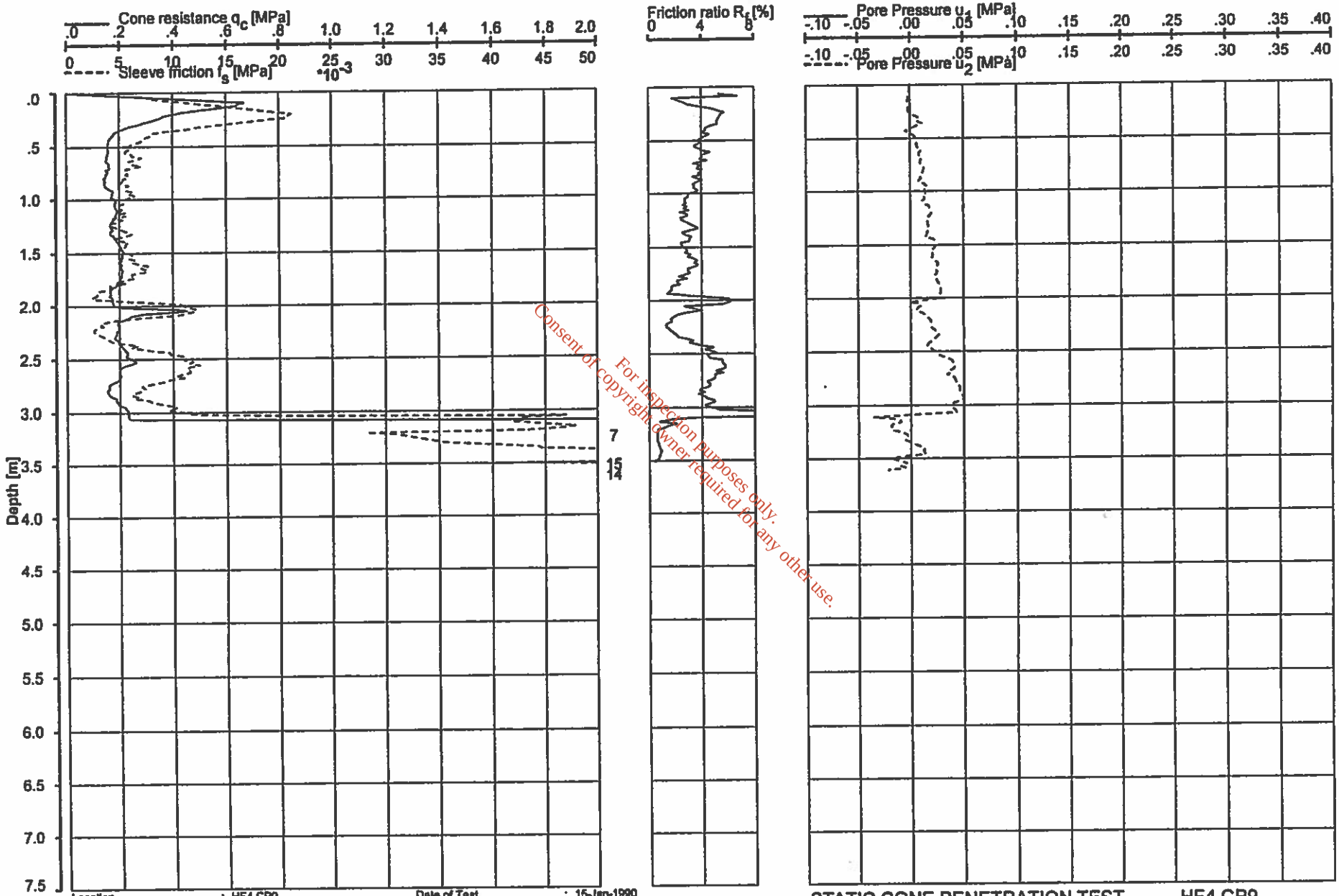

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Location	: HF4 CP9	Date of Test	: 15-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level (m)	:	File name	: Hf4cp9.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

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STATIC CONE PENETRATION TEST HF4 CP9
EASINGTON LANFALL PIPELINE
STATOIL

FUGRO ENGINEERING SERVICES LIMITED

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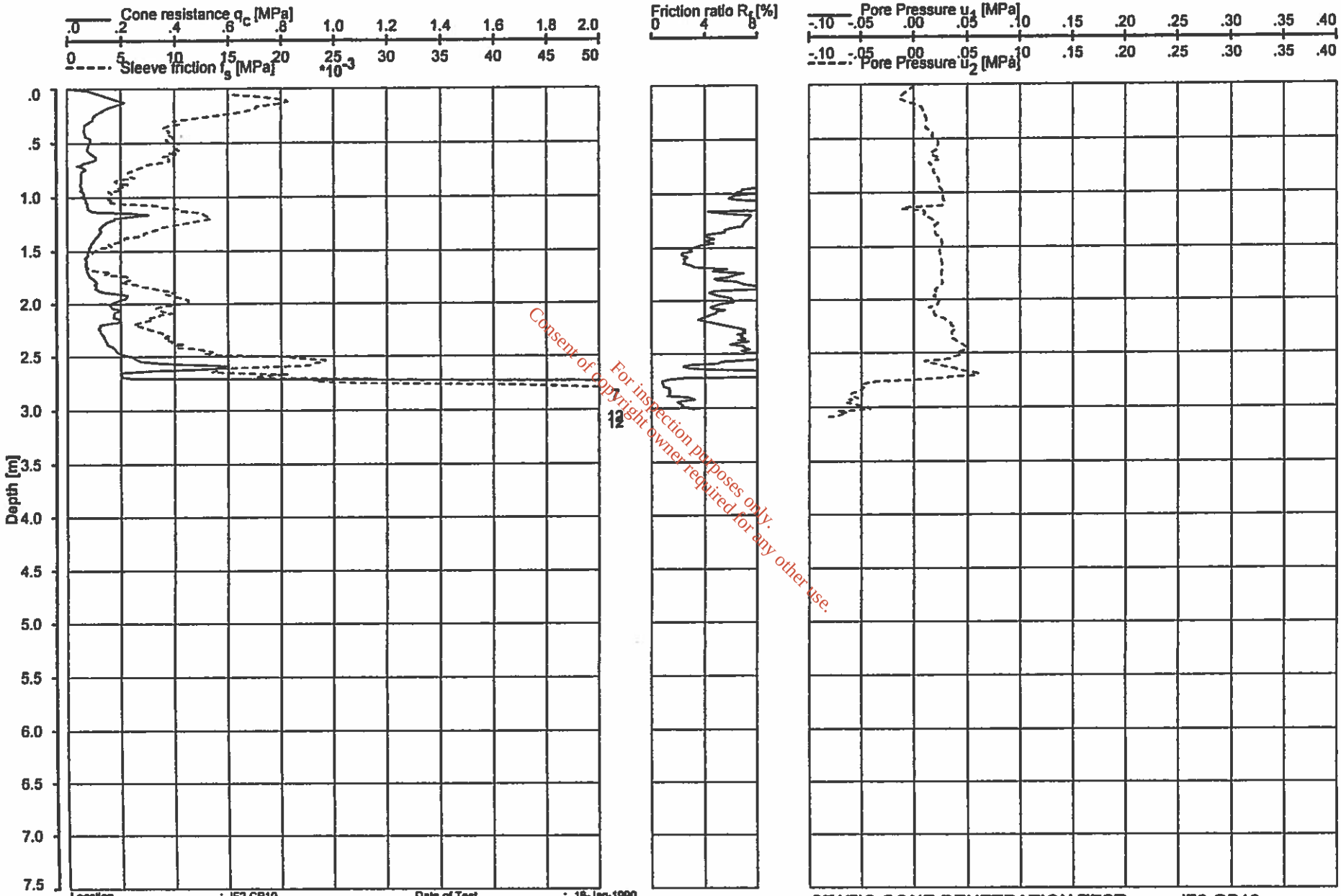

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Location	: IF2 CP10	Date of Test	: 16-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: LI2cp10.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST IF2 CP10
EASINGTON LANFALL PIPELINE
STATOIL

FUGRO ENGINEERING SERVICES LIMITED

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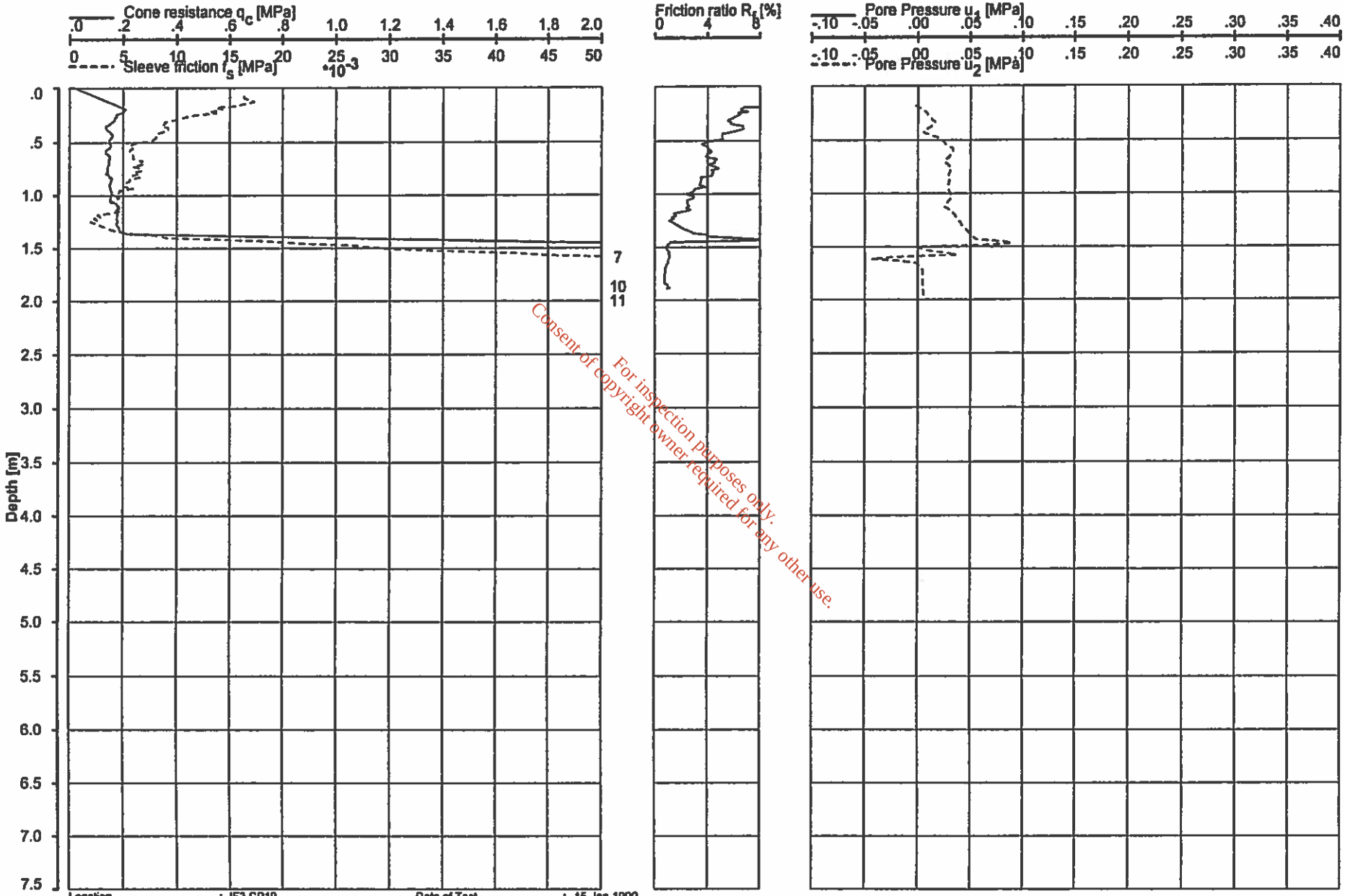

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Location	: IF3 CP10	Date of Test	: 15-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level (m)	:	File name	: Lf3cp10.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

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STATIC CONE PENETRATION TEST IF3 CP10
EASINGTON LANFALL PIPELINE
STATOIL

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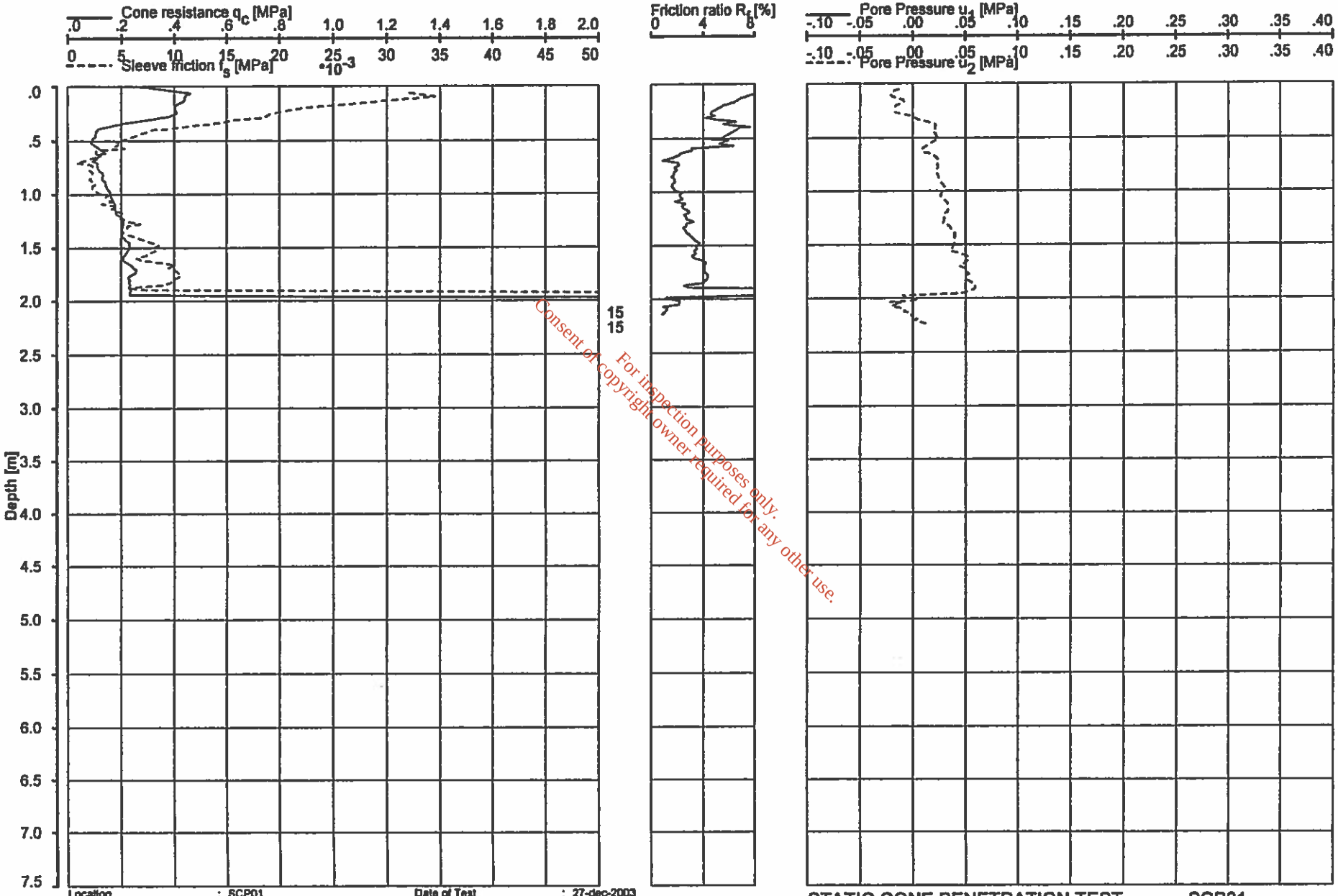

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Location	: SCP01	Date of Test	: 27-dec-2003
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Scp01.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST SCP01
EASINGTON LANFALL PIPELINE
STATOIL

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EPA Export 08-07-2014:23:46:03

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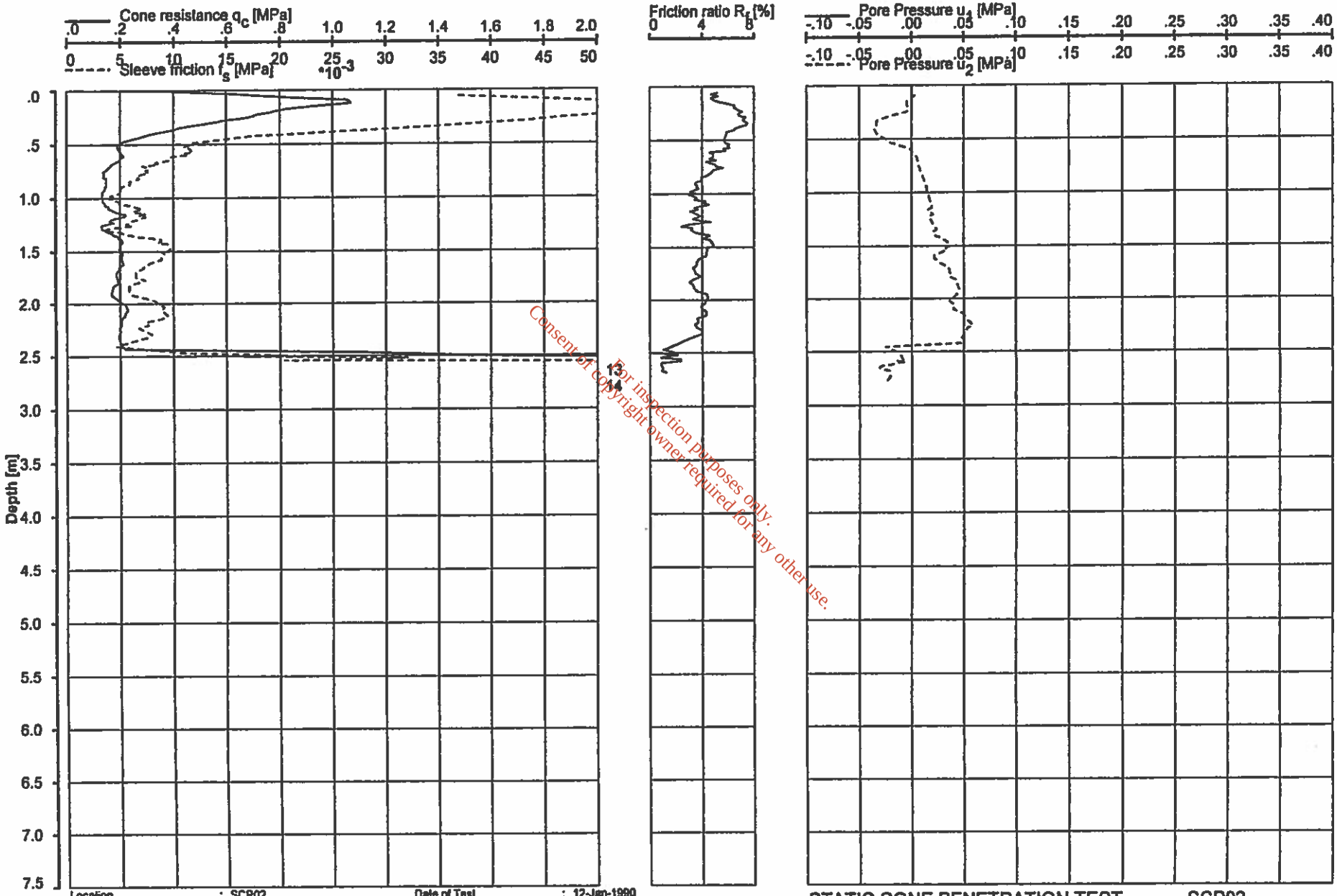

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Location	: SCP02	Date of Test	: 12-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Scp02.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

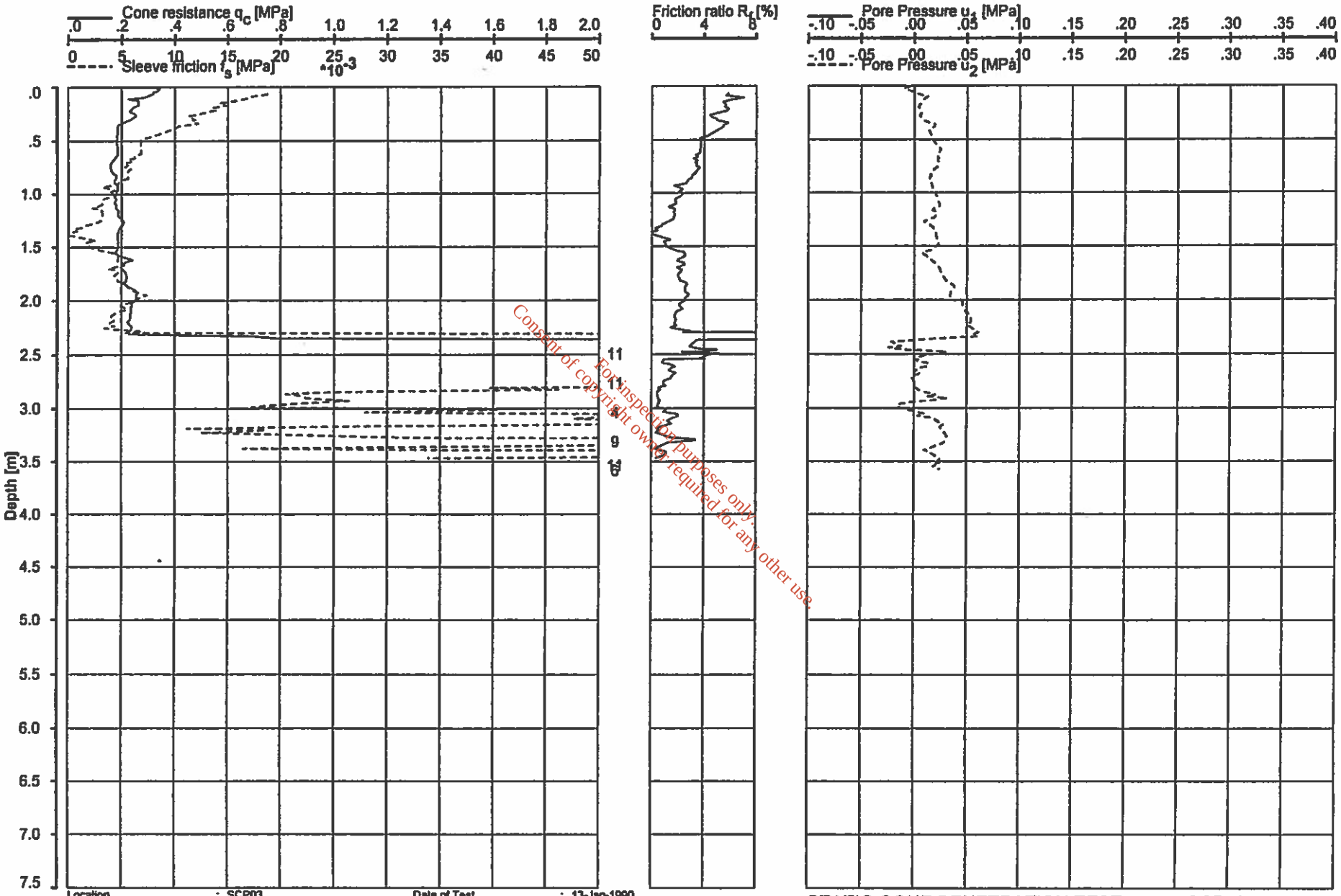
31619-1 (01)

STATIC CONE PENETRATION TEST SCP02
EASINGTON LANFALL PIPELINE
STATOIL

FUGRO ENGINEERING SERVICES LIMITED

EPA Export 08-07-2014:23:46:03

UNIPLOT 02.15.NL /16:48:51/02QCFSU1.CMD Made by: dd: 4-Dec-2003 Checked by:



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For inspection purposes only.

Location	: SCP03	Date of Test	: 13-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Scp03.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST SCP03
EASINGTON LANFALL PIPELINE
STATOIL

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EPA Export 08-07-2014:23:46:03

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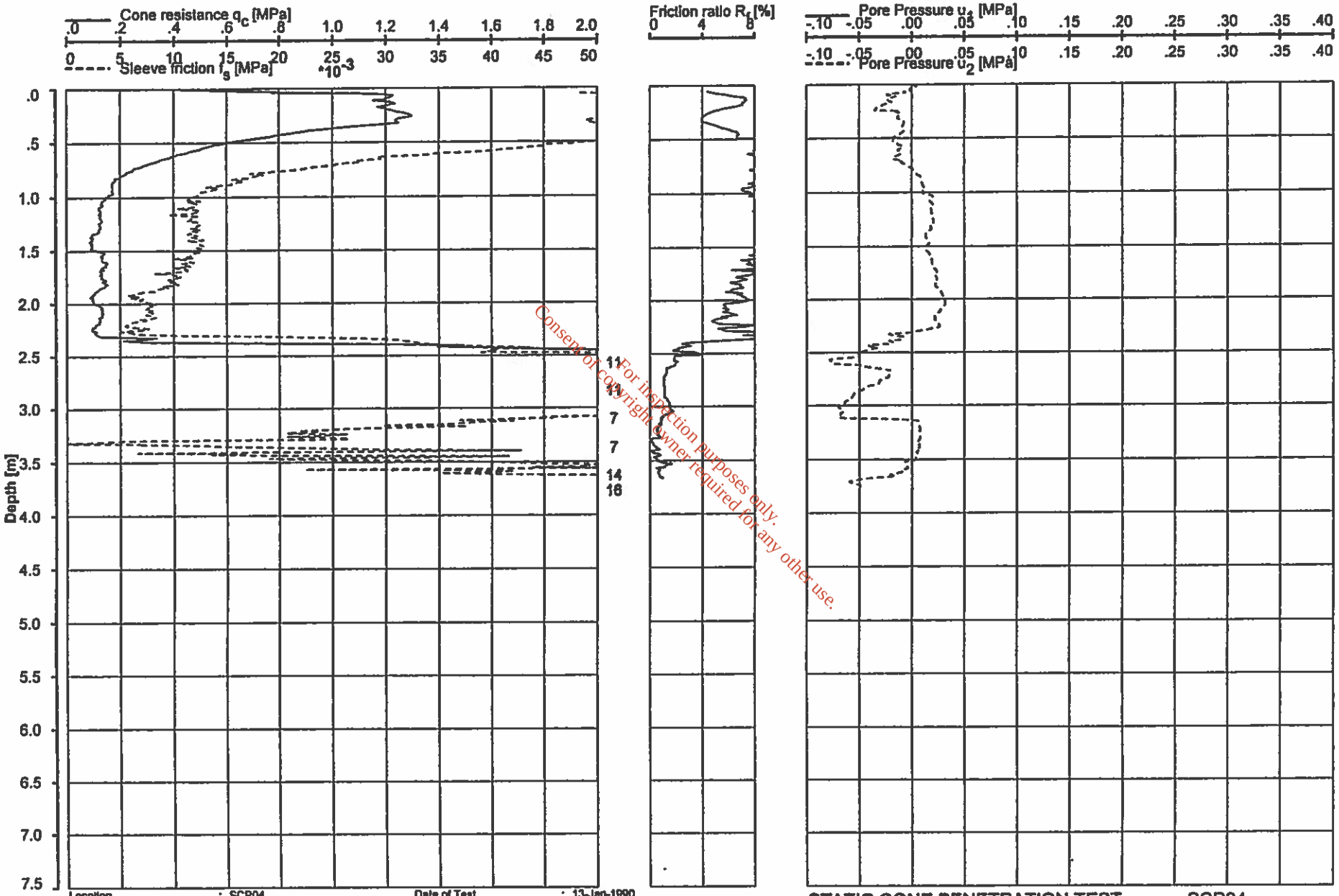

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Location	: SCP04	Date of Test	: 13-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level (m)	:	File name	: Scp04.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

STATIC CONE PENETRATION TEST SCP04
EASINGTON LANFALL PIPELINE
STATOIL

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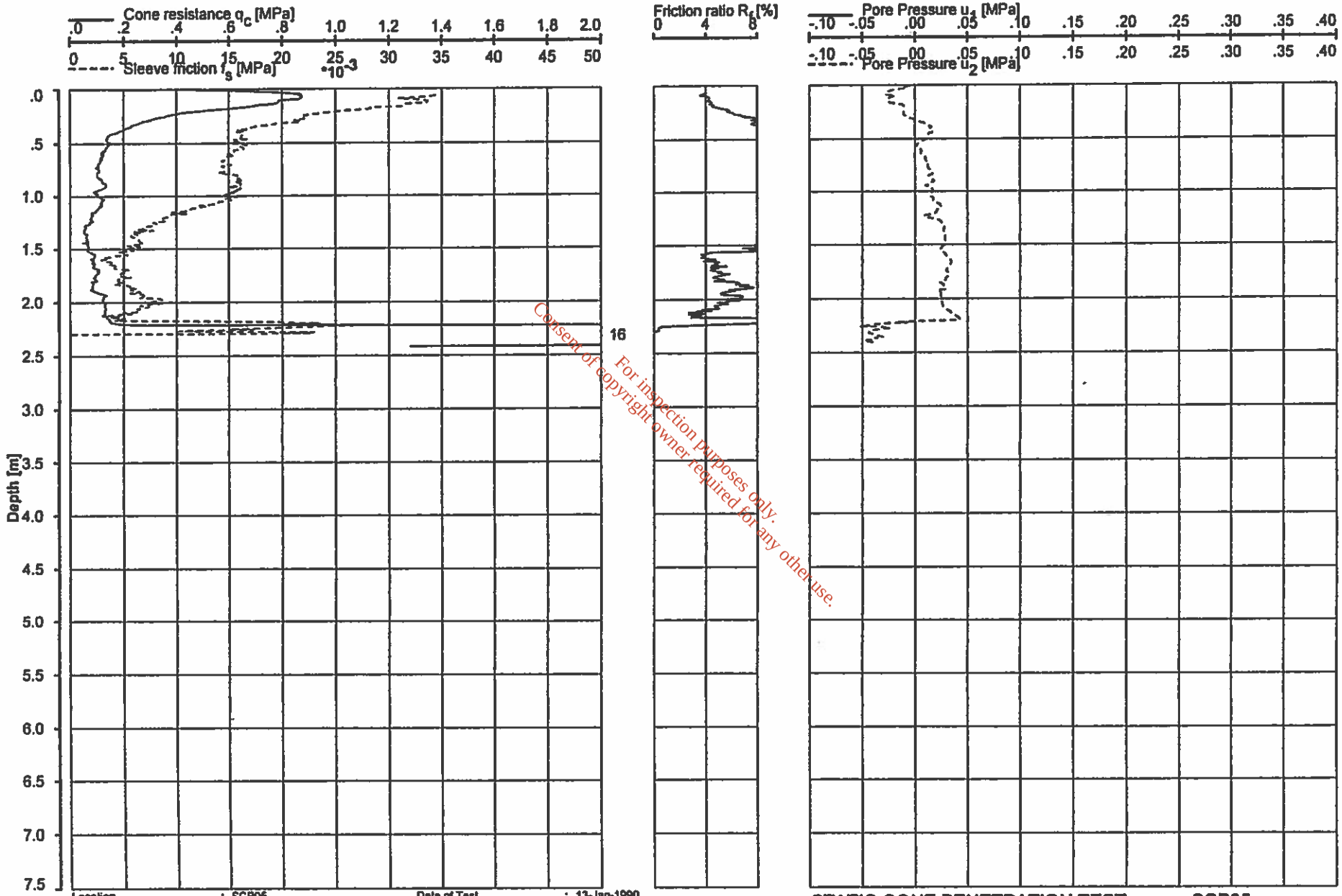

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Location	: SCP05	Date of Test	: 13-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Scp05.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: —

STATIC CONE PENETRATION TEST SCP05
EASINGTON LANFALL PIPELINE
STATOIL

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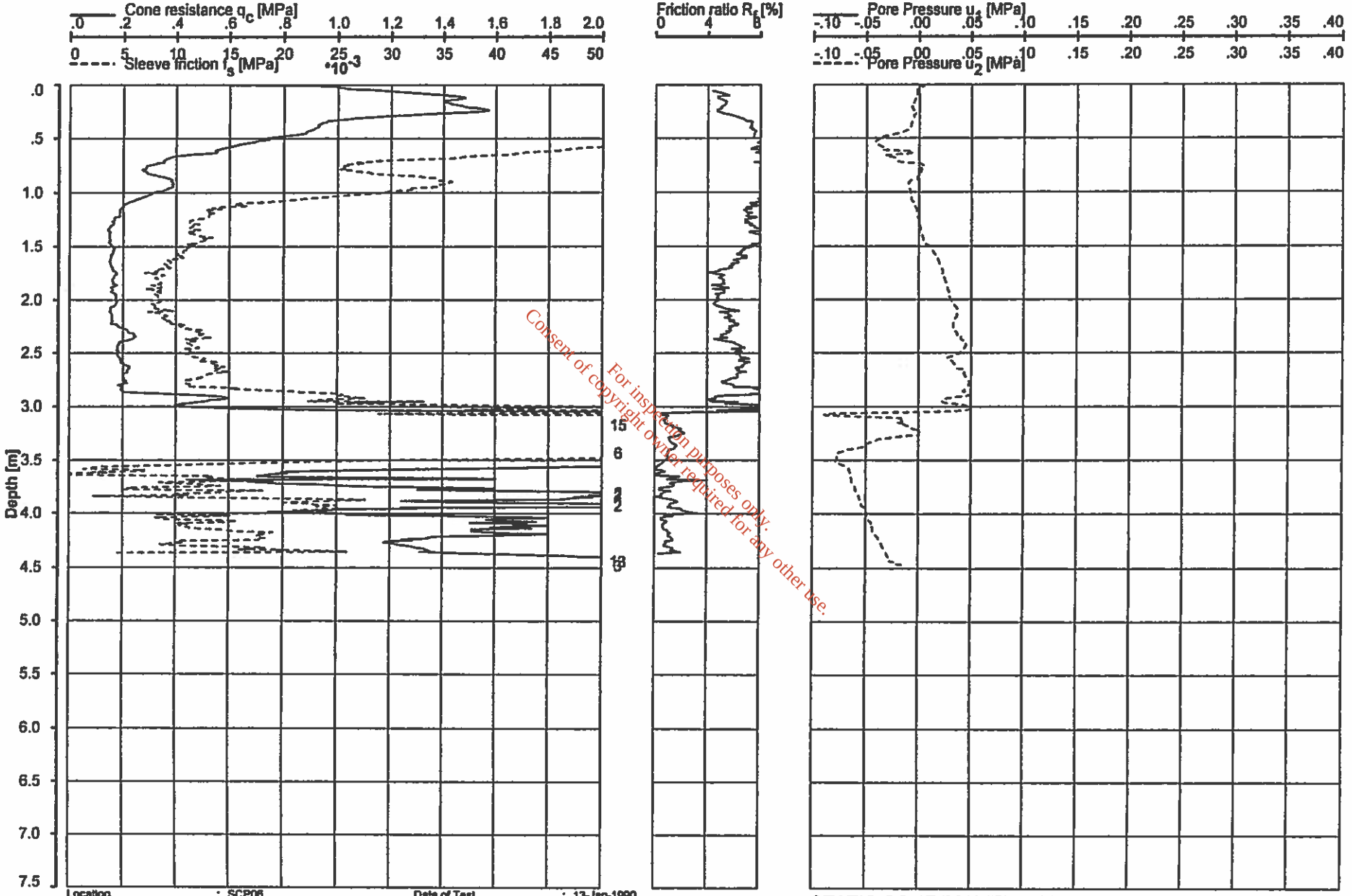

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Location	: SCP06	Date of Test	: 13-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Scp06.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

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STATIC CONE PENETRATION TEST SCP06
EASINGTON LANFALL PIPELINE
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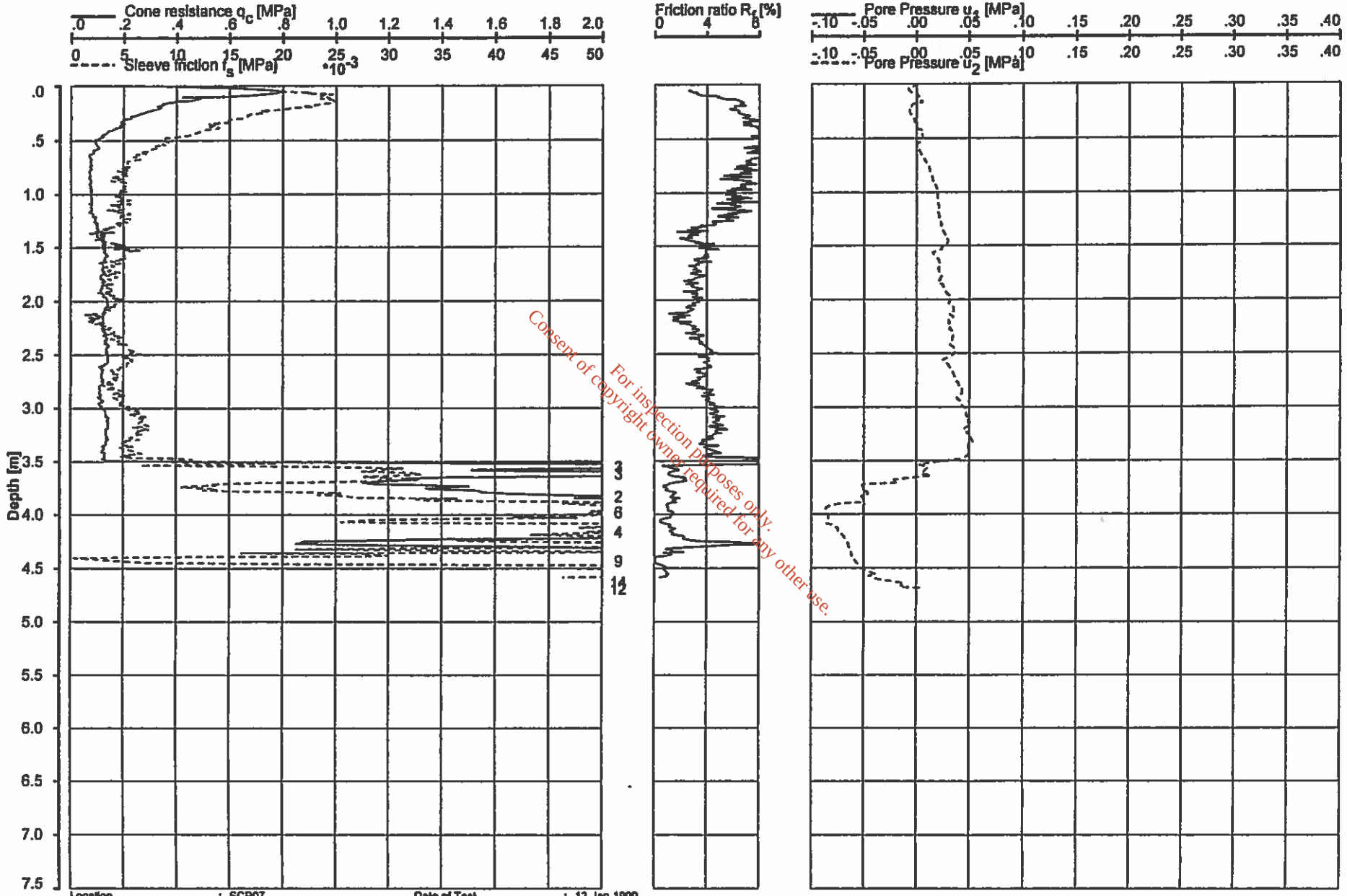

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Location	: SCP07	Date of Test	: 13-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: SCP07.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

31619-1 (01)

STATIC CONE PENETRATION TEST SCP07
EASINGTON LANFALL PIPELINE
STATOIL

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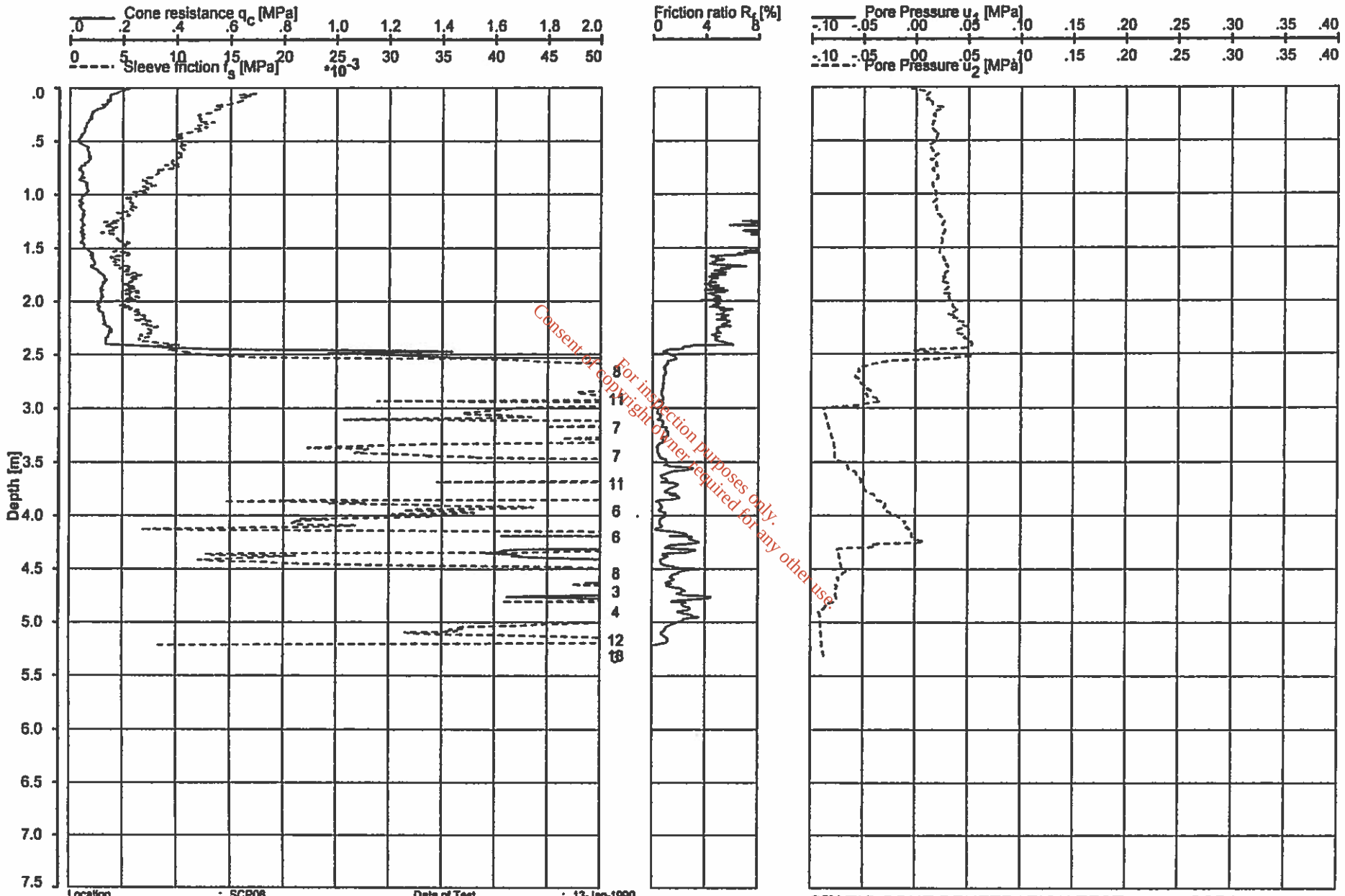
EPA Export 08-07-2014:23:46:03

UNIPLOT 02.15.NL /16:48:53/02QCFSU1.CMD Made by: dd: 4-Dec-2003 Checked by:



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Location	: SCP08	Date of Test	: 13-Jan-1990
Coordinates	:	Date of Plot	: 02-Dec-2003
Ground Level [m]	:	File name	: Scp08.000
Cone used	: F7.5CKEW$_2$/V 1515	Interpretation Checked by	: ...

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STATIC CONE PENETRATION TEST SCP08
EASINGTON LANFALL PIPELINE
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APPENDIX C REVIEW OF EFFECTIVE STRESS PARAMETERS FOR PEAT

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Reference	Cohesion, c' (kPa)	Friction angle, ϕ' (degs.)	Testing Apparatus/ Comments
Hanrahan et al (1967)	5 to 7	36 to 43	From triaxial apparatus
Rowe and Mylleville (1996)	2.5	28	From simple shear apparatus
Landva (1980)	2.4	27.1 to 32.5	Mainly ring shear apparatus for normal stress greater than 13kPa
	5 to 6	-	At zero normal stress
Farrell and Hebib (1998)	0	38	From ring shear and shear box apparatus
	0.61	31	From DSS apparatus. Result considered too low therefore DSS not considered appropriate
Rowe, Maclean and Soderman (1984)	1.1	26	From simple shear apparatus
	3	27	From DSS apparatus
Sandorini et al (1984)	4.5	28	From triaxial apparatus
McGreever and Farrell (1988)	6	38	From triaxial apparatus using soil with 20% organic content
	6	31	From shear box apparatus using soil with 20% organic content
Hungr and Evans (1985)	3.3	-	Back-analysed from failure
Madison et al (1996)	10	23	-

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Table: Review of Effective Stress Parameters for Peat

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APPENDIX D RISK REGISTER

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D.1 Geotechnical Risk Register

A Geotechnical Risk Register has been compiled to show the degree of risk attached to various elements of the design. The purpose of the register is to provide an outline description of the hazard, identify the potential likely cause, describe the consequence or impact of the hazard and identify the design and construction controls to be implemented in order to reduce the probability to a tolerable level. The overall application of the risk register will allow the management of geotechnical risk.

Whilst probability of a hazard occurring can be reduced to a minimum by geotechnical design, the probability cannot be reduced below Negligible. The likelihood of a hazard occurring has been judged on a qualitative scale. The scale has been derived from Clayton (2001) as follows:

Scale	Probability	Chance, per section of Works
>1	Negligible	< 10 %
2	Unlikely	10 – 30 %
3	Likely	30 – 50 %
4	Probable	50 – 70 %
5	Very Likely	> 70 %

Table of Qualitative Probability Scales

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The severity of the risk is also assessed qualitatively and depends on the risk tolerance. The risk results from the combination of the hazard and the impact/consequence. A similar qualitative scale has been derived for the impact of the hazard as follows:

Scale	Impact
5	Very High
4	High
3	Medium
2	Low
1	Very Low

Table of Qualitative Impact Scales

The impact of a hazard manifesting itself can be either financial, health & safety or environmental or combinations of all three.

The degree of risk is determined by combining the probability and impact assessments and has been judged against a third qualitative scale, the Risk Rating which includes a descriptive response as follows:

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Risk	Risk Rating	Response
1 to 4	Trivial	Monitor
5 to 8	Tolerable	Regular Attention
9 to 12	Substantial	Early Attention
13 to 25	Intolerable	Unacceptable

Table of Qualitative Risk Scales

The probability of a hazard manifesting itself can be reduced by geotechnical design but the impact cannot be influenced. Whilst a high impact event with low probability may have a similar risk rating as a low impact event with a high probability, the net effect of these separate hypothetical events may be viewed differently by the different parties involved with the project.

During construction, the ground conditions will be observed, monitored and recorded as appropriate. This will allow methods of construction and revision in design to be appropriately amended whilst the risks highlighted in the Geotechnical Risk Register are continuously monitored.

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HAZARD	CAUSE	IMPACT	Design Controls	Construction Controls	AFTER CONTROL			CONTINGENCY MEASURES
					P	I	R	
1. Rutting of haul road from transfer area to deposition area.	Over trafficking of previously unknown weaker surface areas.	Impede operations and/or loss of ground.	Incorporate geotextile with drainage layer material where required. Design appropriate geotechnical instrumentation for monitoring.	Place geotextile and drainage layer material where necessary.	0.5	1.5	0.75	Install additional geotextile, increase thickness of haul road, import selected granular material, switch to lighter construction plant, reduce trafficking.
2. Movement of placed peat over the top of highfield	Overestimating the geotechnical properties of the ex-situ peat and/or allowing the peat to be reworked to low shear strenghts. Drainage not provided or impeded.	Overtopping could allow movement of peat within depostion area blocking construction traffic. Loss of strength of placed material.	Review the site investigation of ex-situ peat and use conservative values for geotechnical parameters. Ensure no overfilling of placed peat.	Adopt construction measures to minimise disturbance of ex-situ peat. Provide adequate drainage and also maintain existing drainage. Adopt observational approach	0.75	2	1.5	Peat must be allowed to regain sufficient strength either by ceasing operations or some artificial means. Increased windrowing time for ex-situ peat prior to transport from gas terminal site.
3. Failure of internal highfield	Inadequate shear strength. Overloading of wagons. Too close spacing of wagons. Piling fill materials too high. Severe dynamic effects, e.g., imposing speed limits and requiring fills to be spread as trucks are emptied.	Loss of plant, closure of access, danger to operatives	Undertake conservative ground investigation & adopt conservative design strength.	Limit plant weight & spacing of plant. Limit loading on roadway. Adopt observational approach	1	2	2	Import selected granular material for improved strength & drainage, relocate access road.
4. Bog slide	Insufficient understanding of the mechanisms of failure and inadequate design. Presnce of weak peat.	Movement of placed and in-situ peat form depostion area. Cessation of works. Loss of ground. Existing and proposed drainage inundated.	Understand mechanisms of a 'bog slide' and assess the site for sliding potential, based on published information and site investigation data. Undertake stabilty analysis of the site.	Adopt observational approach	0.25	5	1.25	Cease operations, remove displaced material, provide check barriers to impede/contain slide.
5. Failure of perimeter highfield	Ground too weak.	Movement of placed and in-situ peat form depostion area. Cessation of works. Loss of ground. Existing and proposed drainage inundated.	Undertake comprehensive ground investigation, adopt conservative design parameters. Undertake stability analysis for design proposal.	Adopt observational approach	1	1	1	Import selected granular fill, flatten slope, use granular haunch.
6. Bearing failure of access road from R313	Inadequate strength in ground. Excess water in retained peat and access track. Inadequate drainage provisions.	Movement of ground below access road with loss of ground strength.	Undertake comprehensive ground investigation, interpret and adopt conservative design parameters. Provide design that avoids weak founding material.	Install geotechnical instrumentation prior to construction where road is o peat. Establish threshold/trigger values and engage appropriate personnel to monitor and interpret geotechnical instrumentation during and post construction. Where road is not founded on peat/weak material then no requirement for instrumentation and monitoring	1	4	4	Cease traffic operations. Excavate failed area and replace with selected granular fill.

Table: Preliminary Geotechnical Design for Srahmore Peat Deposition Site - Geotechnical Risk Register

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DRAWINGS

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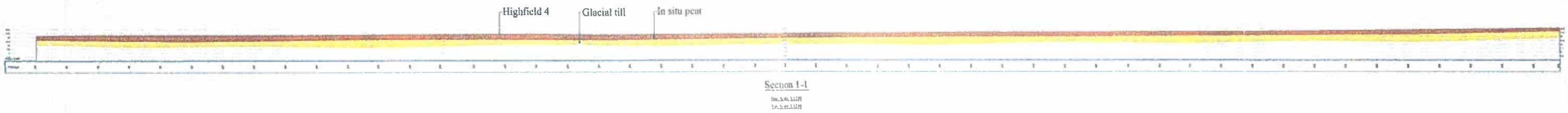
HF2 — Location of Highfield 2

CPXXX — Static Cone Penetration Location, depth to bottom of peat shown by line.

HFXXXX — Location of borehole with descriptions

OH no recovery 5.8 — Open hole to 5.8 mbgl
PT 2.0 — Peat to 5.8 mbgl
SA 1.5 — Sand to 5.8 mbgl
GR 2.4 — Gravel to 5.8 mbgl

TPXXXX — Location of trialpit, depth reached shown by line.



Section 1-1

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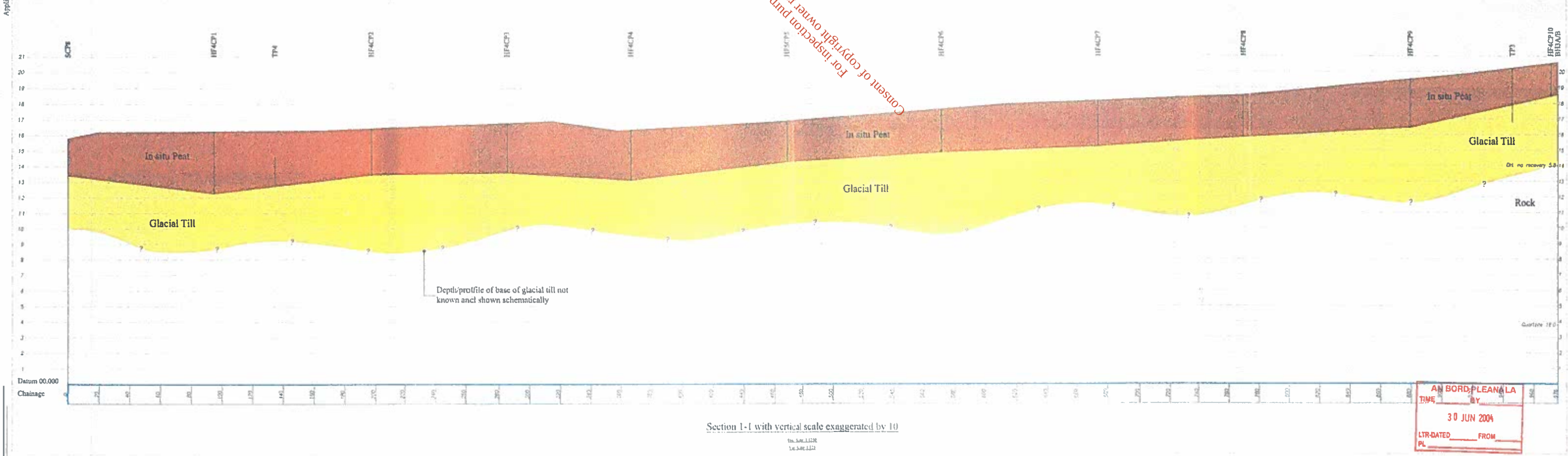

Section 1-1 with vertical scale exaggerated by 10

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TIME BY
30 JUN 2004
LTR-DATED FROM
PL

Further notes

Notes:

Scale: See Above | Checked: P.J.
Date: 10/12/03 | Revision: A
Drawn: P.O'R | Issued on: 18/12/03

Client: Shell E&P Ireland Limited

Job: Preliminary Geotechnical Design for Srahmore Peat Deposition Site

Drg. No. - 382_001

Title: Preliminary Design Ground Profile for Areas 5 & 6 Section 1-1

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Applied Ground Engineering Consultants Limited

Legend:

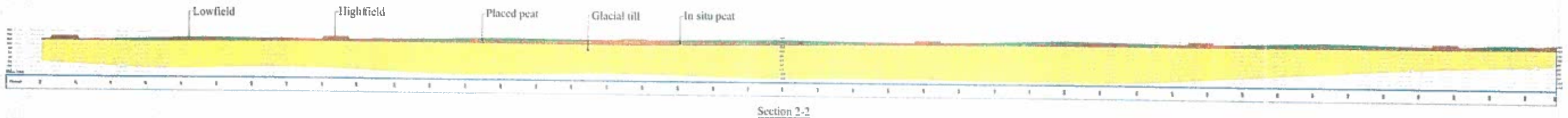
HF2 — Location of Highfield 2

CPXXX — Static Cone Penetration Location, depth to bottom of peat shown by line.

BHXXX — Location of borehole with descripsons

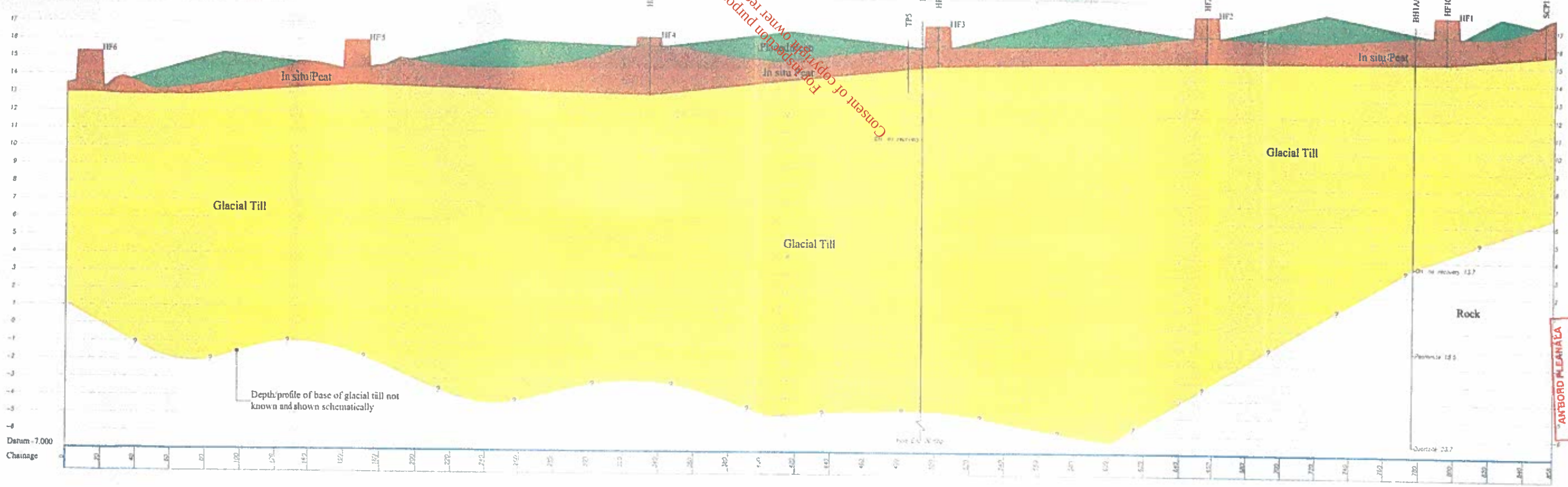
CH 20 recovery 5.8 — Open hole to 5.8 mbgl
PT 2.0 — Peat to 5.8 mbgl
SA 1.5 — Sand to 5.8 mbgl
GR 2.9 — Gravel to 5.8 mbgl

TPXXX — Location of trialpit, depth reached shown by line.



Section 2-2

Hor. Scale 1:1250
Ver. Scale 1:125



Section 2-2 with vertical scale exaggerated by 10

Hor. Scale 1:1250
Ver. Scale 1:125

Further notes:

Notes:

Scale: See Above
Date: 10/12/03
Drawn: P.O.R

Client: Shell E&P Ireland Limited

Job: Preliminary Geotechnical Design for Srahmore Peat Deposition Site

Drg. No. - 382_002

Title: Preliminary Design Ground Profile for Areas 5 & 6 Section 2-2

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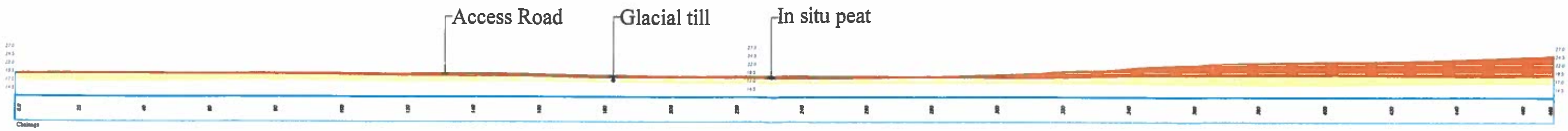
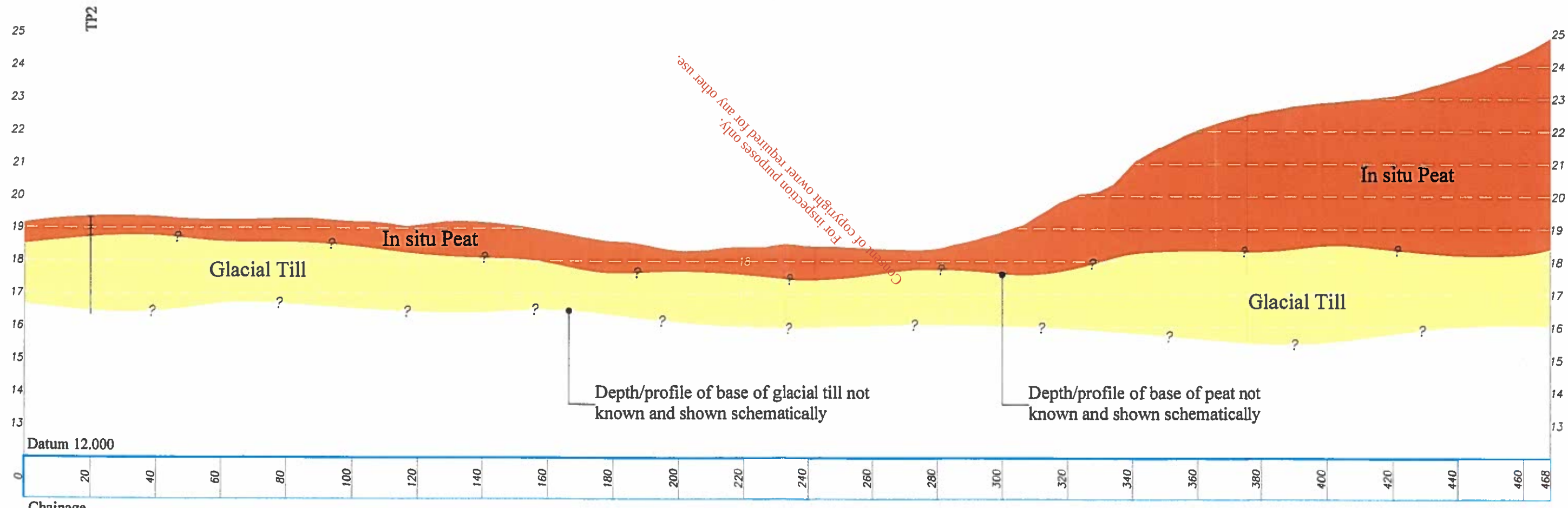
Legend:

- HF2 — Location of Highfield 2
- CPXXX — Static Cone Penetration Location, depth to bottom of peat shown by line.
- BHXXX — Location of borehole with descriptions
- OH no recovery 5.8 — Open hole to 5.8 mbgl
- PT 2.0 — Peat to 5.8 mbgl
- SA 1.5 — Sand to 5.8 mbgl
- GR 2.4 — Gravel to 5.8 mbgl
- TPXXX — Location of trialpit, depth reached shown by line.



Section 3-3

Hor. Scale: 1:1250
Ver. Scale: 1:1250



Section 3-3 with vertical scale exaggerated by 10

Hor. Scale: 1:1250
Ver. Scale: 1:125

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Notes:	Client: Shell E&P Ireland Limited	Job: Preliminary Geotechnical Design for Srahmore Peat Deposition Site	Drg. No. - 382_003 Title: Preliminary Design Ground Profile for Areas 5 & 6 Section 3-3	AGEC Ltd 5 Kilcarrig Street Bagenalstown Carlow Ireland Tel: +353 503 23800 Fax: +353 503 23793 www.agec.ie info@agec.ie
Scale: See Above / Checked: P.J. Date: 10/12/03 / Revision: A Drawn: P.O.R. / Based on: 382_018				

Appendix 10

Archaeological Published Sources

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Appendix 10

Publications consulted in the course of the study

1. General reference works

1 AUTHOR	Date	Title
Flanagan, D. & Flanagan, L.	1994	*Irish Place Names*. Dublin. Gill & Macmillan Ltd.
Mitchell, F. & Ryan, M.	1993	*Reading the Irish Landscape*. Town House
O'Kelly, M.J.	2001	*Early Ireland, an introduction to Irish Prehistory*. Cambridge University Press
Whitaker, J.	2002	*Collation and Evaluation of Archaeological Data from Bord na Móna Bogs*. Unpublished report commissioned by Dúchas
Whitaker, J.	*forthcoming*	*Archaeological Survey Report: Oweninny II, Bangor Bogs, Co. Mayo*

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Archaeology.

Local histories

Author	Date	Title
Knox, Hubert T.	1908	*The History of the County of Mayo*. De Burca, Dublin
Noone, Fr. Sean	1991	*Where the Sun Sets, Balycroy, Kilcommon & Kiltane, Co. Mayo*. Leinster Leader, Naas.
Quinn, J.F.	2002	History of Mayo (Vols 2 & 5). Ballina.

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Archaeological artefact corpora

Author	Date	Title
Bourke, E,	1994	Glass vessels of the first nine centuries AD in Ireland, *J Roy Soc Antiq Ir*, **124**, 163-209
Clarke, DL,	1970	*Beaker pottery of Great Britain and Ireland.* Cambridge: University Press
Collins, AEP,	1994	The flint javelin heads of Ireland, in D Ó Corráin (ed.) *Irish antiquity*, 111-33. Dublin: Four Courts Press
Dunleavy, M,	1988	A classification of early Irish combs, *Proc Roy Ir Acad*, **88C.11**, 341-422.
Eames, E & T Fanning	1988	*Irish medieval tiles*. Dublin: Royal Iris Academy
Earwood, C,	1994	*Domestic wooden artefacts in Britain and Ireland from Neolithic to Viking times*. Exeter: University of Exeter Press
Eogan, G,	1965	*Catalogue of Irish bronze swords*. Dublin: The Stationary Office
Eogan, G,	1983	*The hoards of the Irish Later Bronze Age*. Dublin: University College Dublin
Eogan, G,	1994	*The accomplished art. Gold and gold working in Britain and Ireland during the Bronze Age (c. 2,300-650 BC).* Oxford: Oxbow Books Ltd.
Harbison, P,	1969a	The axes of the Early Bronze Age in Ireland. *Praehistorische Bronzefunde*, **IX.1**. Muenchen: CH Beck
Harbison, P,	1969b	The daggers and the halberds of the Early Bronze Age in Ireland. *Praehistorische Bronzefunde*, **VI.1**. Muenchen: CH Beck
Harbison, P,	1976	Bracers and V-perforated buttons in the Beaker and Food Vessel Cultures of Ireland, *Archaeologia Atlantica Research Report*, **1**
Herity, M,	1982	Irish decorated neolithic pottery, *Proc Roy Ir Acad*, **82C.10**, 248-404.

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Author	Date	Title
Kavanagh, RM,	1973	The encrusted urn in Ireland, *Proc Roy Ir Acad*, **73C**, 507-617
Kavanagh, RM,	1976	Collared and cordoned cinerary urns in Ireland, *Proc Roy Ir Acad*, **76C**, 293-381
Kavanagh, RM,	1991	A reconsideration of razors in the Irish Early Bronze Age, *J Roy Soc Antiq Ir*, **121**, 77-104
Longworth, IH,	1984	*Collared urns of the Bronze Age in Great Britain and Ireland.* Cambridge: Cambridge University Press
O'Connor, L,	1991	Irish Iron Age and Early Christian whetstones, *J Roy Soc Antiq Ir*, **121**, 45-76
O'Meadhra, U,	1984	Early Christian, Viking and Romanesque art motif-pieces from Ireland. *Theses & papers in North European archaeology*, 7. Stockholm: Almquist & Wiksell International
Raftery, B,	1983	A catalogue of Irish Iron Age Antiquities. *Veroeffentlichung des Vorgeschichtlichen Seminars Marburg, Sonderband*, **1**.
Somerville, O,	1993	Kite-shaped brooches, *J Roy Soc Antiq Ir*, **123**, 59-101
Waddell, J,	n.d. [1990]	*The Bronze Age burials of Ireland.* Galway: University Press
Waddell, J, & O'Riordain	AB 1995	*Funerary bowls and vases of the Early Irish Bronze Age*. Galway: University Press

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Appendix 11

Archaeological Recorded Monuments

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Appendix 11

Sites & Monuments Record, Archaeological Survey, Department of the Environment, Heritage and Local Government (Fig 2)

SMR No.: 018-006
Townland: Rathmorgan
County: Mayo
NGR: 8081 / 32700
Description: Holy Well, Cairn & Standing Stone.
Visited 27/07/95 by PO'D/MW
On 1837 and 1921 maps.
Situated on the ESE slope of a steep mountainous hill. Poor mountainous pasture.

1) Holy Well – natural spring (local information) covered by a massive subrectangular boulder (L 2.69m, dims. 1.3m x 0.27m) which is supported by 3 much smaller stones. There is a small pile of while marble stone on top of the covering stone.
2) Cairn – immediately SSE of the well is a partially peat-covered low circular cairn of small and medium sized white marble stones (diam. 4.3m; max. H 0.5m) tapering to a point. Protruding from the centre of the cairn is a small irregularly shaped apparently uninscribed stone.
3) Standing Stone – immediately WNW of the well is an approx. rectangular upright block (H 1.14m, dims. 0.8m x 0.43m).

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SMR No.: 018-007
Townland: Rathmorgan
County: Mayo
NGR: 8087 / 32671
Description: Rath / Enclosure
Visited 27/07/95 by PO'D/MW
On 1837 and 1921 maps.
Situated on the S slope of a steep mountainous hill on poor pastureland. Raised circular area (diam 29.3m) defined by a low irregular scarp (H 0.6m). At foot of scarp is a berm (W 4m). At the outer edge of the berm is a wide shallow fosse (W 4.2m, max. D 0.4m) with traces of a possible counterscarp bank at its outer lip. From NW=N-S-SW the berm, fosse and counterscarp bank have been levelled. Here, the scarp has been

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modified and incorporated into the field boundary. Original entrance not recognisable.

Sources: Westropp, T.J., 1912 & 1914, *The Promontory Forts and Early Remains of the Coasts of County Mayo,* JRSAI, vol. 42 & 44, p. 148 – 159.

"… low earthen fort, yellow with moss, standing out against the green fields. Old people say that it is the Real Place, i.e. the Rathmorgan fromwhich the townland is named. The local pronunciation is 'Rah Murrigan' – one would like to fancy it a memory of the great queen, Medb of the Cattle Forays, but the Glenmassan manuscript confirms the map form as early, before 1238 at the least. The Rath is greatly defaced; a steep bank rises 6ft over the field to the S, but hardly 2ft to the N, being terraced up on the slope. In parts, rude facing masonry of large blocks occurs, and all round the edge a slight depression, over 1ft deep and 8-10ft wide, probably marks where a dry stone rampart capped the revetted earthen bank. The garth is somewhat oval, and is 86ft across N & S, and 69ft E & W. This leaves only a small enclosure if a thick stone rampart girt it, barely 66ft by 49ft at most.

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SMR No.: 018-008
Townland: Cloontakilla
County: Mayo
NGR: 8582/32482
Description: Children's Burial Ground.
Visited 24/04/96 by PO'D/MW
On 1837 and 1921 maps.
Situated atop a hillock on a generally NNW facing hillside. From NW-N-E, where the hillock is bordered by a fast flowing stream, the hillock is high and steep sided. Low grass covered mound of earth and large & medium sized stones (dims. 6.7m NNW-SSE, 4.6m ENE-WSW) ranging in height between 0.5m at SSE and 1.65m at NNW. There are 4 graves to the ENE & SE of the mound. The best preserved of these, at the SE is stone lined (dims. 1m WNW-ESE, 0.7m NNE-SSW).

Source: O'Donovan, J., 1838, p. 161.
Letters Containing Information Relative to the Antiquities of the County of Mayo, Collected During the Progress of the Ordnance Survey. In Bray, 1927, Reproduced by Rev. Michael O'Flanagan, Vol. I.
"In this parish are several old grave yards, some of which

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contain the ruins of small rude churches of whose history nothing is known or ever will be discovered. One of these is situated in the townland of Cluainte Cille (the Cloons of the Kill or Church) about 11 miles SE of Belmullet... Those little churches are not ancient, as the architectural antiquary will at once pronounce but they are curious monuments to show that the mountainous parts of Erros were inhabited some centuries back."

SMR No.: 018-010
Townland: Rathmorgan
County: Mayo
NGR: 8212 / 32755
Source: Per. Comm., Noel Dunne, 1991.
Description: Cairn.

SMR No.: 018-011
Townland: Dereens Island
County: Mayo
NGR: -
Source: Per. Comm., R. Chapple, September 1993.
Noone, 1991, p.108, *"Where the Sun Sets"*, The Leinster Leader.
Description: Ecclesiastical Remains.
"At the NE end of the island are the ruins of about 6 dwellings of stone and mortar which contained 2 apartments of equal size. At the SW end of the island are ruins of an old church 45ft x 21ft, which had gabled facing E & W. Nearby, approximately 60ft S of the church is a small dwelling, probably for a priest or a religious community."

SMR No.: 018-013
Townland: Gortmore / Attavally
County: Mayo
NGR: 8379 / 32524
Source: Pers. Comm., R. Chapple, September 1993.

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Visited 29/05/96 by PO'D/DS

Description: Architectural Fragments.
The 'dressed stones' may originally have been in the church (018-011) or dwellings (018-012).

SMR No.: 018-014
Townland: Carrowmore Lake
County: Mayo
NGR: 8427 / 32573 & 8422 / 32569
Source: Pers. Comm., R. Chapple, September 1993.
"Report on the Possible Crannog Sites in Carrowmore Lake, County Mayo", Robert Chapple, Erris Survey Office.

Description: Lake Carrowmore is the largest lake in the barony, 1000 hectares in area. By tradition it is one of the oldest in Ireland. There are 27 sites listed by the SMR as possible crannogs. Three in N Carrowmore lake look most archaeologically promising. They were inspected on the 30th July – 2nd August, 1993.

Site A – 100m to the W of Derreens Island and 350m from the lake shore. Small, lightly overgrown, roughly oval island. C. 40m NW-SE, c. 26m NE-SW. The edges of the island slope gently under water. No archaeological remains.

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Site B – Above Muingerroon Island, c. 450m to NW of Derreens Island, and c. 280m S of the lake shore. Small circular island. Surface is marshy, heavily overgrown with small trees and dense scrub-bushes, therefore it could not be inspected internally. The surface is composed of natural limestone bedrock. Sides dropped away steeply but no signs of human intervention. Aerial photos showed possible causeway associated with it, but it could not be relocated.

Site C – Muingerroon Island. Small, roughly shaped, c. 50m NE-SW, c. 32m NW-SE, lies c. 320m to NE of Dereens Island. The surface is made of sand and gravel like the bottom of the lake. Interior is lightly wooded with low, weather-beaten trees. Completely natural.

Site D – Gortmore Island. It was decided that this site was too big to be used as a crannog, therefore it was not surveyed.

Site E – Attavally Island. Small, oval shaped island, c. 118m

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NE-SW, c. 50m NW-SE, lies c. 612m to SE of Gortmore Island, and c. 176m from the lake shore. Interior is flat, except for a small mound or cairn that dominates the centre, measuring c. 3m in height and c. 4-5m in diameter. Constructed from stone and earth. Now grassed over. It is the remains of a trigonometrical station (33ft OD) as shown on the 3rd ed. 1921 OS 6" sheet. Not ancient. Island slopes gently under water. On the SE side the bottom is thick marl mud. 5 – 10m from the shore there are 5 – 10 partially decayed tree-branches imbedded horizontally in the mud. Cannot tell if they are worked in any way. Not placed in any defined order nor do they have a structural function. Aerial photos show a possible causeway, extending from the SSW corner of the island, heading to the nearest part of the shore for approx. 60-80m in SW direction, turning slightly WSW before disappearing from view. On inspection it could be traced for 70m and is 0.7m – 1.5m in width, 0.25 – 0.5m in height, and the sides possess an angle of repose of roughly 45 degrees. Constructed of sand and gravel, like the bottom of the lake. Couldn't see where it joined the land, but hampered by poor visibility and density of rushes. Existence of the causeway attested locally. Known as the "Roadeen" and was visible just below the lake surface in exceptionally dry summers before the local dam was erected. Chert scraper found 8m S of the island, between the causeway and submerged timbers. 0.75m under water. 40.5mm long x 31mm wide, 6mm thick.

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SMR No.: 025-00101 (church) & 00102 (midden)
Townland: Bunawillin
County: Mayo
NGR: 7364 / 32482 (church), 7363 / 32477 (midden)
Source: Noone, Fr. Sean, 1991, *"Where the Sun Sets"*, NAAS, p. 127.
Description: Church and Midden.
Visited 25/04/96 by PO'D/MW
There was an old chapel by the sea shore at the end of Joseph Scanlon's property. The ruins were plainly visible at the end of the last century. Since then the sea has washed away much of the land, so all that is left… are a few stones and the remains of a kitchen midden with an assortment of seashells. A circular stone cup dating from the period prior to 1600AD was found in the sand near the site. Now in National Museum, Dublin. Named "Doocreeghan" in early maps.

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SMR No.: 025-00201 (enclosure) & 00202 (house)
Townland: Muingmore
County: Mayo
NGR: 7557 / 32456
Description: Enclosure.
Situated 7.7m from Muingmor house. Circular area (diam. 12.4m) defined by a low narrow earthen bank (H 0.5m, W 1.6m). No fosse. Original entrance (W 2.5m) at ESE. Interior largely occupied by irregular shaped mound of earth and stone. Otherwise, internal ground level is lower than that of the ground outside. Probably modern structure.
House.
Situated on a prominent rise within an extensive area of peatland. Rectangular house (dims 13.7NNE-SSW, 6.2m WNW-ESE). Outlined by lower portions of walls of drystone masonry (wall thickness 1.1m). The remaining stones are mostly large and medium sized. Entrance (W 1.3m) is at the NNE end of the ESE wall. House divided internally into 2 rooms of unequal size by a WNW-ESE dividing wall. Probably relatively modern.

SMR No.: 025-003
Townland: Muingmore
County: Mayo
NGR: 7588 / 32292
Description: Possible crannog. On 1921 map.

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SMR No.: 025-004
Townland: Doolough
County: Mayo
NGR: 7683 / 32194
Description: Possible crannog. On 1921 map.

SMR No.: 025-005
Townland: Doolough
County: Mayo
NGR: 7737 / 32157
Description: Possible crannog. On 1838 and 1921 maps.

SMR No.: 026-00101 (burial ground) & 00102 (cist)
Townland: Tristia
County: Mayo
NGR: 7894 / 32309
Sources: Aldridge, 1969, p. 86, *"Notes on Children's Burial Grounds in Mayo"*, JRSAI, Vol. 99, Part 1, pp. 83 – 87.

Description: Burial Ground.
Visited 29/05/96 by PO'D/DS
Situated on SW facing slope. Poor mountainous terrain. Ill defined on ground. Comprised of a series of natural occurring boulders following no particular pattern. Max diam. 16.8m NNE-SSW. NE possible cist burial.
Cist Burial.
Situated NE portion of Tristia Children's Burial Ground. Large irregularly shaped boulder aligned NNW-SSE (max. L 2.05m, W 1.3m, D 0.3m) split into 2 roughly equal portions and resting on number of small stones.

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SMR No.: 026-00201
Townland: Tristia
County: Mayo
NGR: 7904 / 32279
Description: Megalithic Court Tomb.
Visited 25/04/96 by PO'D/MW

SMR No.: 026-00202
Townland: Tristia
County: Mayo
NGR: 7893 / 32273

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Source: Per. Comm., P.Walsh, 1990.
Description: Pre-Bog Walls.

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SMR No.: 026-00301 (church)
026-00302 (graveyard)
026-00303 (abbey)

Townland: Kilteany

County: Mayo

NGR: 8222 / 32300

Description: O'Donovan, J., 1838, *"Letters Containing Information Relative to the Antiquities of the County of Mayo, Collected During the Progress of the Ordnance Survey"*, in Bray, 1927, Reproduced by Rev. Michael O'Flanagan, vol. I, pp. 161 – 162.
"In the mountains the ruins of the chapels of Kilcummin, Kiltena, and Fahey in Ballycroy show little architectural ornament in their construction, but serve as marks to show that inhabitants existed in their era in these parts, sufficient to support and fill them, though at this day they cannot boast so many houses."

Erris, *"The Irish Highlands"*, 1836, p.13.
"In this parish are several old grave yards, some of which contain ruins of small rude churches of whose history nothing is known or will ever be discovered... and a third which contains a rude old church in the townland of Cill Teine, about 9 miles SE of Belmullet."

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Rev. Neary, 1913-14, *"Some Notes on Killala Diocese"*, Galway Archaeological and Historical Society Journal, vol. VIII, pp. 12 – 38.
"An old church exists at Killteany, west of Bangor, and it may be the Insula Dori."

Lewis, Samuel, 1837, *"A Topographical Dictionary of Ireland"*, London, Vol. 2, p.67.
"At Kiltairn, on the banks of the Owenmore, are remains of an ancient abbey, and also of the old parish church."

Site Visit 29/06/96 by PO'D/DS.
Kilteany Church in Ruins.
Situated on low lying ground, adjacent to stream. Late medieval parish church (ext. dim. 13.95m NE-SW, 6.1m NW-SE, wall thickness 0.9m). Single light round headed NE window, round headed rear arch, wall presses at ground floor level at either end of the E wall. Plain flat headed single light window at NE end of SE wall. Rounded headed doorway with

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pointed segmental arch at SW end of SE wall. Most of dressed stone is missing but 2 portions of chamfered jambs are in situ. 2 opposing joist holes in SW end of NW and SE walls and third close to WNW angle. Its counterpart in the SE wall has collapsed. Remains of N-S wall to E of building represents remains of further buildings.

SMR No.: 026-004
Townland: Bangor
County: Mayo
NGR: 8008 / 32328
Source: Per. Comm., P. Walsh, 1990.
Description: Megalithic Tomb, unclassified.
Visited 23/10/97 by PO'D/MW.

SMR No.: 026-005
Townland: Bangor
County: Mayo
NGR: -
Description: Neary, 1913-14, p.24, "*Some Notes on Killala Diocese*", Glaway Archaeological and Historical Society Journal, Vol. VIII, pp. 12 – 38. "Old churches also exist at Bangor."

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Appendix 12

Archaeological Stray finds

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Appendix 12

Topographic Files, Irish Antiquities Division, National Museum of Ireland

The Topographical Files were searched for references to Srahmore, Attavally, Bangor and the surrounding townlands. The following references were found:

Townland: Attavally
Parish: Kilcommon
Barony: Erris
County: Mayo
Reg. No.: 1964:68
OS Map: 18, 26
Description: Plough Share of Ard.
Wooden share, long handle, triangular head. Handle rectangular in cross-section where it joins the head. 75cm from that it becomes circular in cross-section to the end. Handle is broken in 2 parts. Triangular end is flat on one surface, the 2 sides are slightly convex. Found in bog, 6ft deep.

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Townland: Attavally
Parish: Kilcommon
Barony: Erris
County: Mayo
Reg. No.: 1997:10 (IA/42/94)
OS Map: 89
Description: Chert Scraper.
Complete end and side of a scraper made from chert. Removed from a platform core with the striking platform and bulb of percussion intact.

Townland: Bangor
Parish: Kilcommon
Barony: Erris
County: Mayo
Reg. No: 1938:8574-5
OS Map: 26
Description: Two wooden vessels found in a bog. One incomplete.

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Appendix 13

Archaeological Drawings

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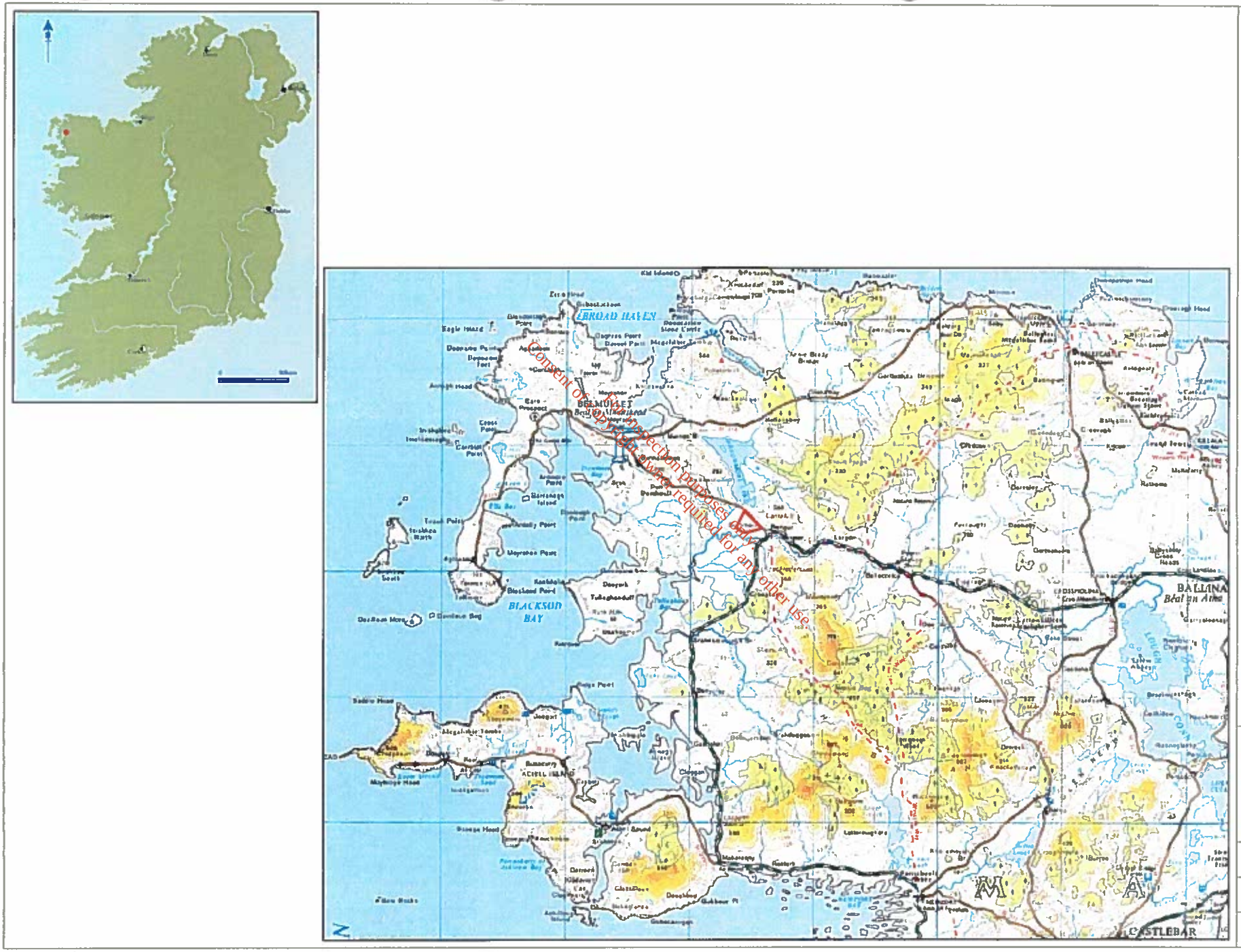

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Fig. 1 Location map.

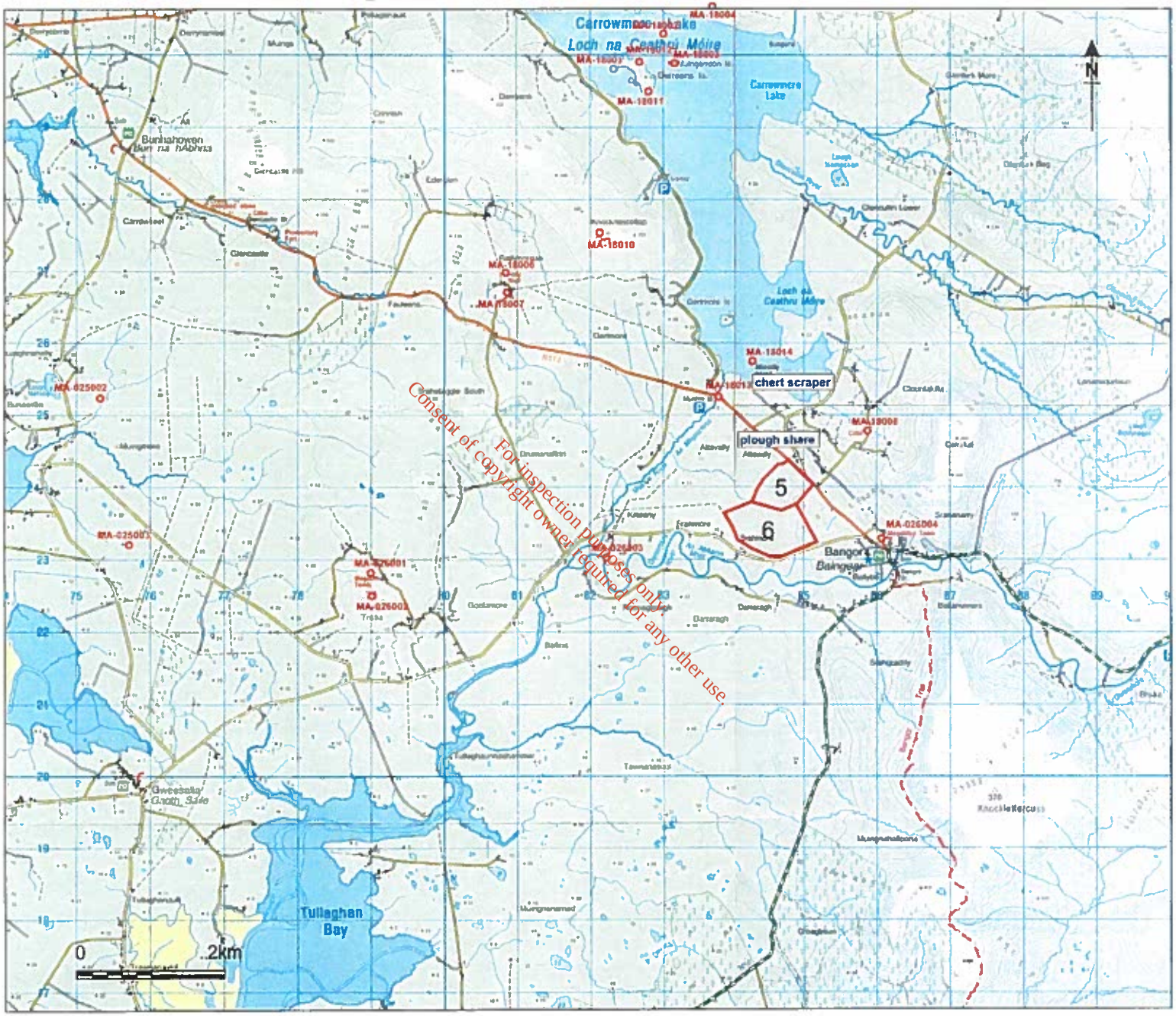

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Fig. 2 Site location map.

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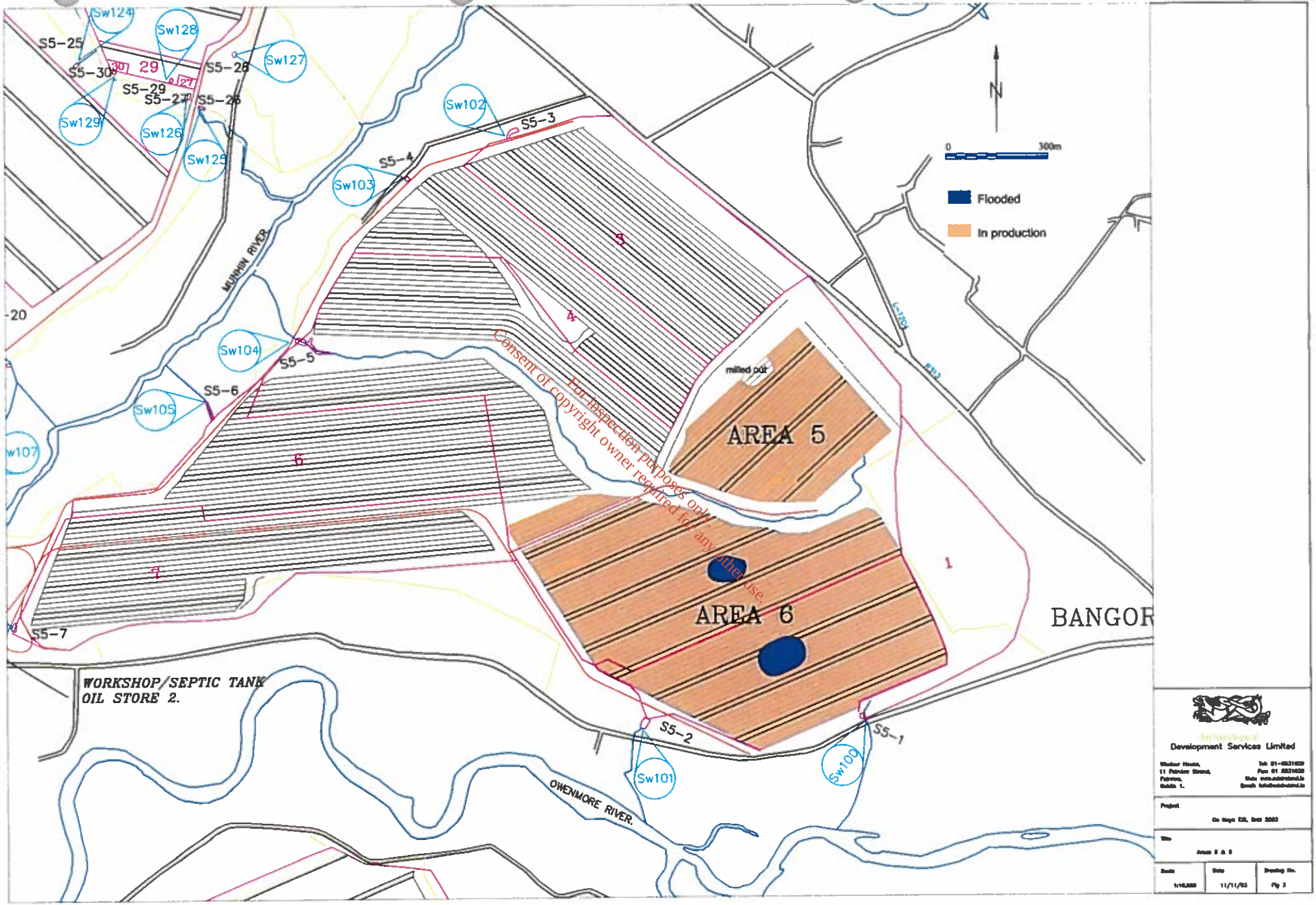

Fig. 3 Areas 5 & 6. Scale 1/10,000

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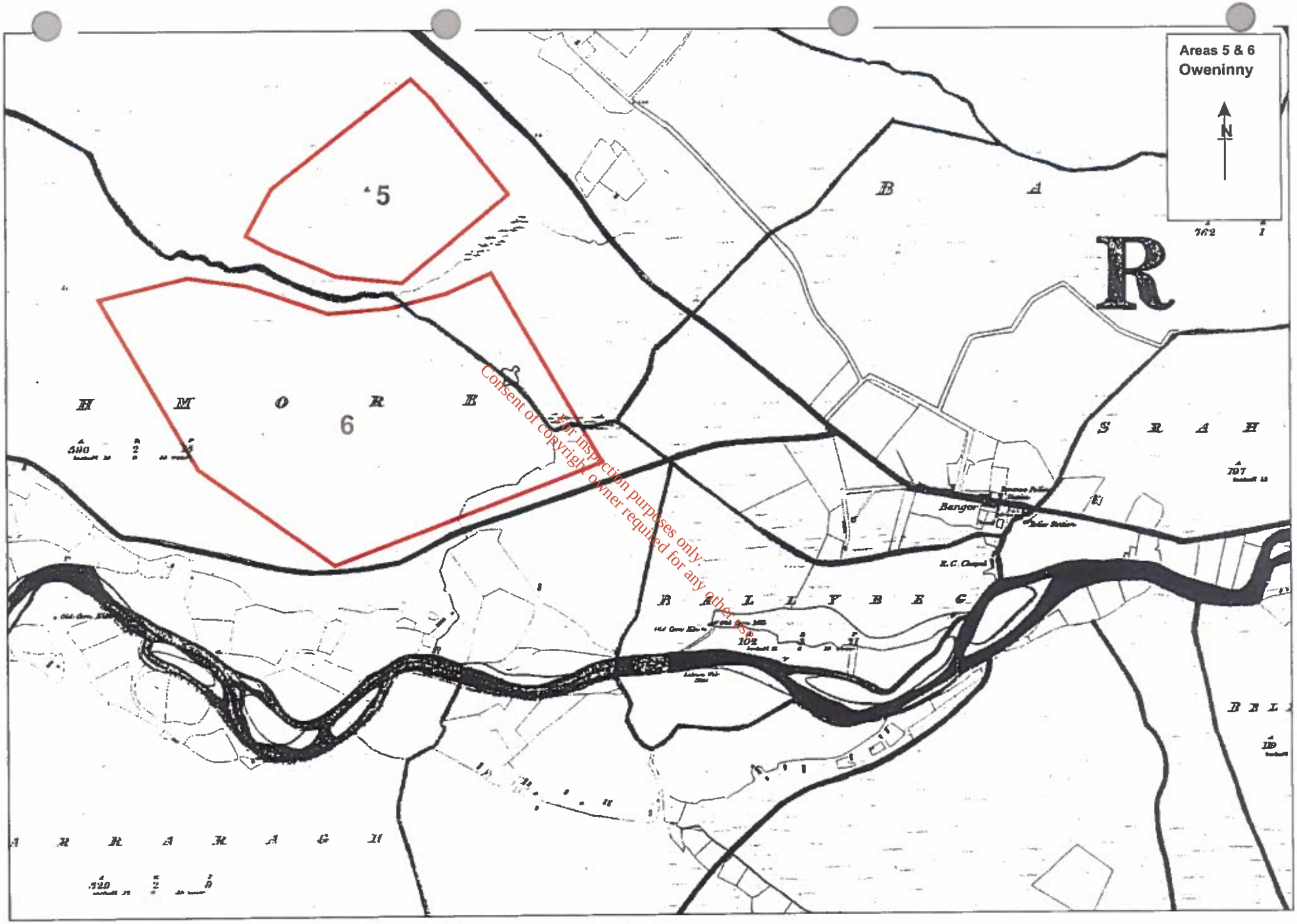

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Fig. 4 Ordnance survey map of Co. Mayo. 1st edition. Sheet 26, published 1839. Scale 1:10,560 reduced by 15%.

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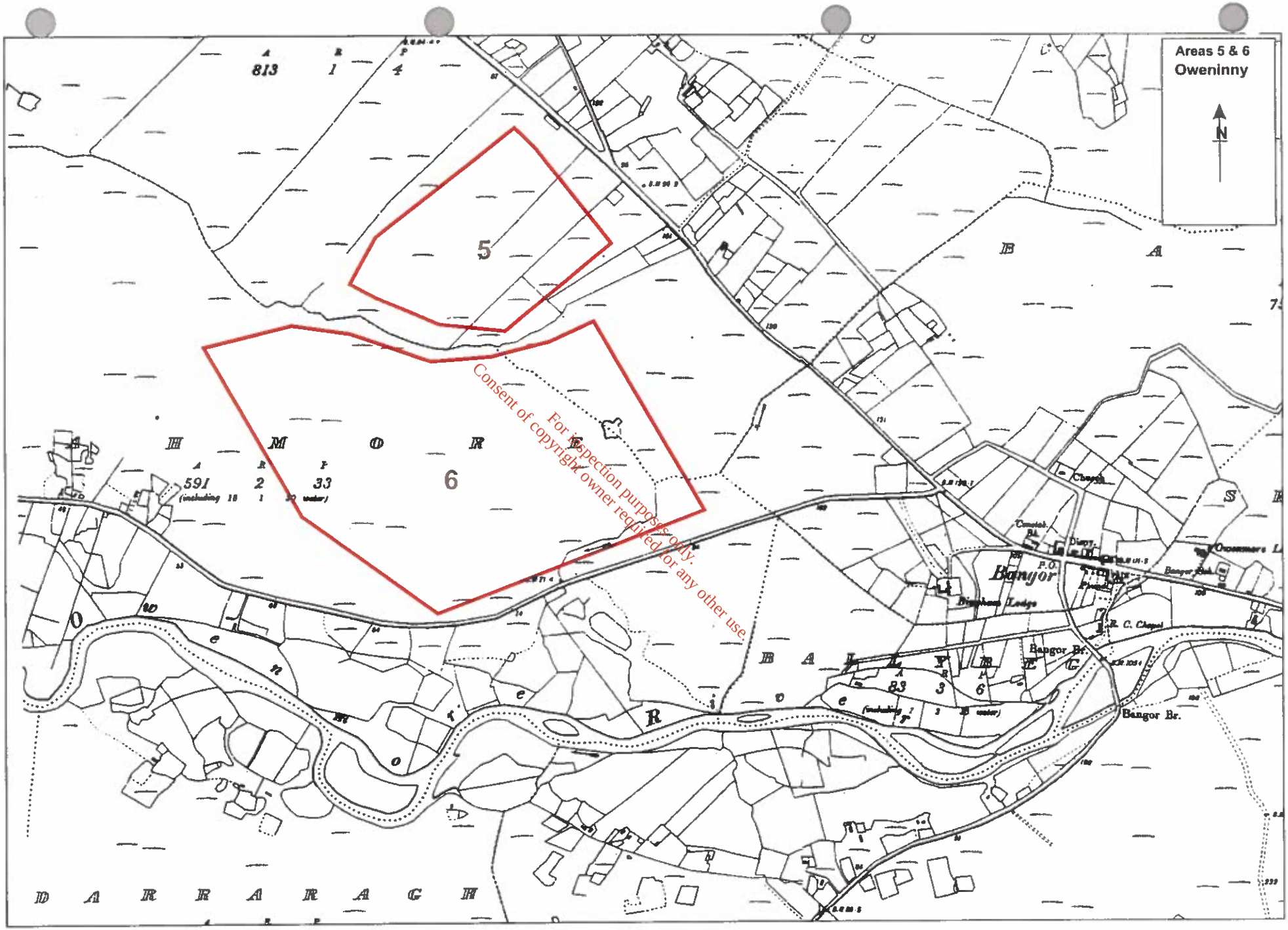

Fig. 5 Ordnance survey map of Co. Mayo. 2nd edition. Sheet 26, published 1900. Scale 1:10,560 reduced by 15%.

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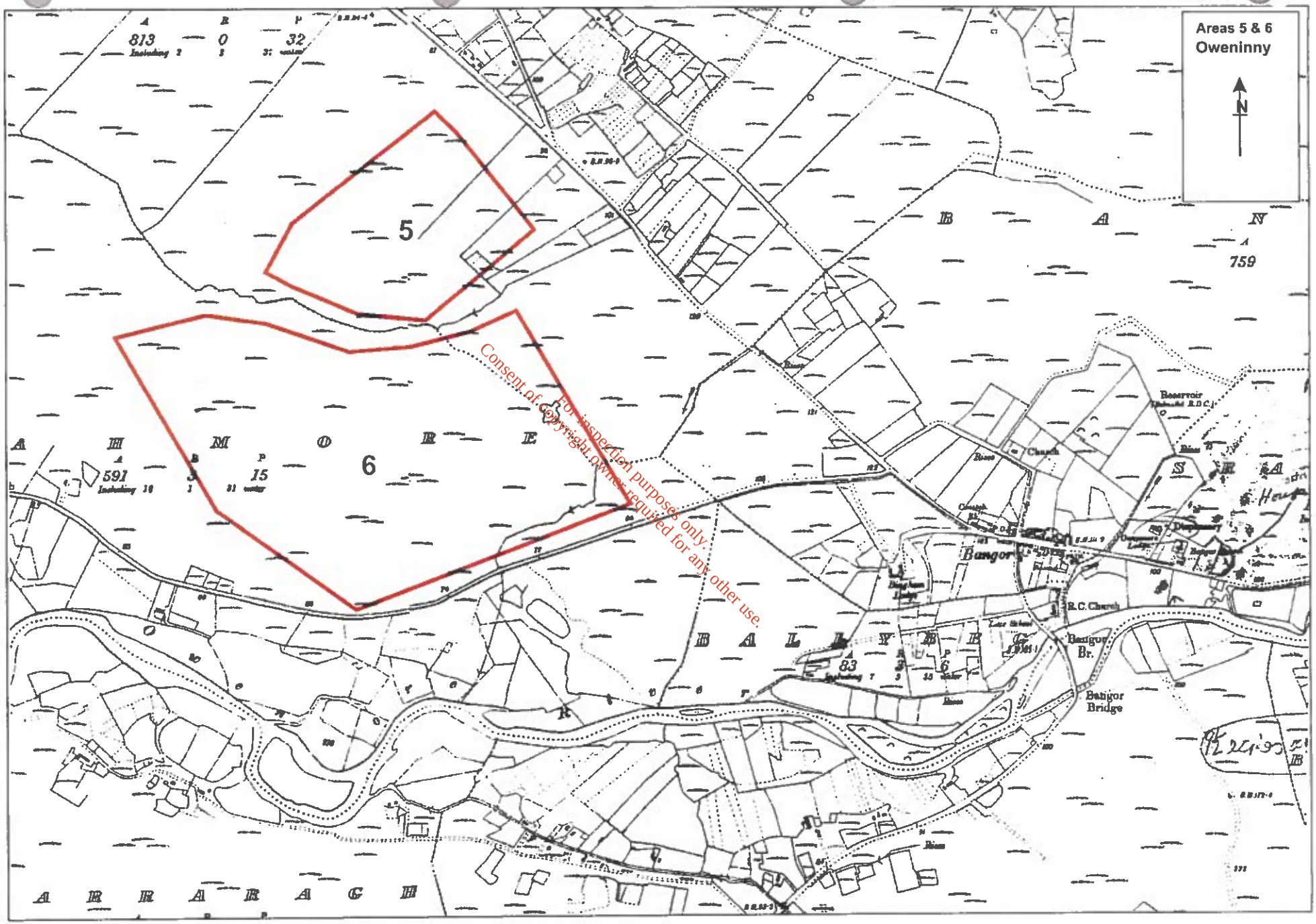

Fig. 6 Ordnance survey map of Co. Mayo. 3rd edition. Sheet 26, published 1921. Scale 1:10,560 reduced by 15%.

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Appendix 14

Draft EMS

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BORD NA MÓNA

BORD NA MÓNA ENERGY LIMITED

Peat Depository

Waste Licence No.?

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Environmental Management System

Draft

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Contents:

Document No.	Description	Revision
1.0 ERP	Emergency Response Procedure	0
1.1 ERP	Oil Spill Clean-up Procedure	0
1.2 ERP	General Fire/Explosion Procedure	0
2.0 SCP	Silt Control Procedure	0
3.0 SPIP	Silt Pond-Outfall-River Inspection Procedure.	0
4.0 SPMP	Silt Pond Maintenance Procedure.	0
5.0 ODLP	Oil/Diesel Loading Procedure	0
6.0 DHP	Dust Handling Procedure	0
7.0 RNCP	Road Network Cleaning Procedure	0
8.0 EMP	Environmental Monitoring Procedure	0
9.0 WDP	Waste Disposal Procedure	0
10.0 CSSP	Composite Sampler Service Procedure	0

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BORD NA MÓNA

BORD NA MÓNA ENERGY LIMITED

Site Manager

Environmental Co-ordinator

Procedure:

Page: 1 of 2

Rev:

Emergency Response Procedure (ERP 1.0)

Purpose:

The purpose of this programme is to define appropriate procedures in response to potential emergency situations occurring at the site including Environmental accidents and/or emergencies.

Definitions:

Environmental Emergency Response Team: Site Manager, Environmental Co-ordinator, and any other person or persons co-opted by the aforementioned individuals for the specific emergency.

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References:

Document No. No.	Description	Revision
ERP 1.1	Oil Spill Clean Up Procedure	0
ERP 1.2	General Fire/Explosion Procedure	0

Procedure:

1. Should an emergency situation occur, appropriate Environmental Emergency Response Procedures, ERP 2.0 to ERP 3.0, which detail each emergency situation and the proposed response should this emergency occur are prepared.

2. Each Environmental Response Procedure is completed with reference to potential emergency situations. The response documented within the Environmental Emergency Response Procedure reflects the likelihood of the situation occurring and the associated potential environmental impacts of this occurrence.

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3. On a Monthly basis the appointed member of the Environmental Emergency Response Team checks all emergency response equipment to ensure that it is provided in agreed quantities and in suitable working order. Any discrepancies shall be reported at once to the General Manager and his/her environmental deputy.

5. Following an emergency, details of the incident shall be recorded on the Environmental Incident Investigation Form (EPF3.1) located within the Environmental Incident Investigation and Reporting Procedure (Environmental Procedure EP 3.0). Following this the Environmental Corrective and Preventive Action Procedure (EP 2.0) shall be implemented accordingly, to introduce a corrective and preventive action.

6. In the event of the following incidents occuring, records shall be maintained and the EPA shall be notified by telephone and facsimile as soon as possible and not later than 10.00am the following working day after the occurrence of the incident. Local Authority, Duchas and the North Eastern Regional Fisheries Board shall also be notified in the event of any incident which relates to discharges to surface water.

- any emission which results in the contravention of any relevant standard, including any standard for any environmental medium, or any relevant emission limit value, prescribed under any relevant enactment,
- any emissions that does not meet with the requirements of Waste Licence No. ?
- any occurrence with the potential for environmental pollution,
- any emergency.

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The written record shall be submitted to the Agency as soon as practicable and in any case within five working days after the occurrence of any incident.

Should any further actions be taken after the date of written notification, as a result of any incident occurring, a written report shall be forwarded of those actions to the Agency as soon as practicable and no later than ten days after the initiation of those actions.

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BORD NA MÓNA

BORD NA MÓNA ENERGY LIMITED

Site Manager

Procedure:

Page: 1 of 4

Environmental Co-ordinator

Rev:

Emergency Response Procedure (ERP 2.0)
(Oil, Diesel & Petrol Spillages)

Purpose:

This procedure details the steps to be taken when dealing with an oil/diesel/petrol substance spill on site. It is required in order to:

- Protect Employees
- Protect the Environment
- Prevent Fugitive Emissions

This procedure should be followed for all large and massive spills, which may occur.

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Definitions:

Small Spill: Greater than 5 litres and less than 250 litres

Large Spill: Greater than 250 litres.

Responsibility:

General staff and contractors of Bord na Móna, Energy Limited, are responsible for being aware of the procedure and their responsibilities/requirements/obligations.

Procedure:

1. Ensure all diesel/oils are handled (loaded, unloaded and moved) by a competent person using the correct procedure. Appropriate precautions should be taken at all times to minimise the risk of accidental spillage.
2. In the event of a spillage occurring the Site Manager or his/her environmental deputy in consultation with the Bog Foreman shall initially:
   - Investigate the length of time since the incident occurred.

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- Consult the relevant data sheets (Material Safety Data Sheets or otherwise) for the method of spill containment and fire control of the affected material.

3. The spill must be assessed immediately by the Env. Coordinator/Site Foreman for potential risks to health and safety of employees, and the potential Environmental consequences.

4. If there is a risk of explosion, all personnel in the area must be evacuated from the area.

5. The spill should be sourced, isolated, and contained with polystyrene booms or dry peat (moisture content of 10%)

6. All effort should be made to prevent the spill from entering a storm drain or the nearest outfall.

7. If the spillage emanated from a drum, it is positioned so that the ruptured section is in upwards direction, thereby preventing further leakage.

8. Use shovels, brushes or a machine to sweep the spilled material in to drums.

9. Start on the outside and work in towards the centre of the spill.

10. Do not mix different types of waste.

11. Drum the waste and seal the container or bag and double bag

12. Label the waste with the destination name, appropriate hazard label and name of waste, giving as much information as possible on contents, plus concentrations of constituents if applicable etc.

13. If the spill occurred due to a damaged drum, place the ruptured drum into a salvage drum container, until disposal is arranged.

14. Once the spill has been contained, a suitable absorbent, (dry peat), to soak the spillage must be applied.

15. All possible ignition sources such as electrical equipment, naked lights, machinery etc should be removed from the area. Any combustibles in the spill area should be removed.

15. Follow-up action measures taken must include the implementation of appropriate remedial work to prevent such a spillage incident reoccurring in future.

16. The Environmental Protection Agency, Regional Fisheries Board, and Local

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Authority Personnel are contacted by the General Manager or his/her environmental deputy, in the event of any incident occurring, paying due regard to Conditions 4 and using the Environmental Notification Form (EF3.2). Following an emergency, details of the incident shall be recorded on the Environmental Incident Investigation Form (EPF3.1) located within the Environmental Incident Investigation and Reporting Procedure (Environmental Procedure EP 3.0). Following the environmental incident investigation appropriate procedures shall be implemented accordingly i.e. Environmental Non-Compliance Procedure (EP 1.0) and the Environmental Corrective Action Procedure (EP 2.0)

A shortened version for posting at the Site is attached on the following page.

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BORD NA MÓNA

BORD NA MÓNA ENERGY LIMITED

EMERGENCY PROCEDURE IN THE EVENT OF OIL SPILLAGE

Inform Site Manager

General Manager to inform EPA & Local Authority

Block outfall at nearest point

Establish cause and prevent further leakage

Inspect outfall downstream

Inspect receiving water (River/Stream/Lake)

Establish limit of spillage

Install booms in the outfall

Use dry peat (preferably 10% M.C.) to clean up

Arrange remedial work to prevent future occurrences

Requirements: Map of drainage system
Stock of polystyrene booms
Stock of dry peat (10% M.C.)

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Site Manager

Environmental Co-ordinator

Emergency Response Procedure (ERP 3.0)
(General Fire/Explosion Procedure)

Purpose:

A procedure to deal with fire/explosion emergencies is required for the following reasons:

- To protect Employees.
- To protect the Environment.
- To prevent Fugitive emissions.

Responsibility:

General staff and contractors of Bord na Móna, Energy Limited, are responsible for being aware of the procedure and their responsibilities/requirements/obligations.

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GENERAL

1. The Site Manager will delegate a member of his staff to be responsible for all aspects of fire safety.
2. All fire equipment not deployed should be stored in a warm dry fire depot.
3. The Manager should specify certain persons who would be contacted in the event of a fire.
4. A formal report on fires involving people, stocks, buildings or equipment should be reported to the Safety Officer via form (Appendix III).
5. Formal records of all inspections and test of fire equipment should be maintained.

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6. There should be a system of re-charging of extinguishers after usage. This system should include a method of delivering extinguishers to re-charge point.

7. A reserve water supply capable of dealing with any fire emergency on site, shall be maintained.

8. Fire wagon or fire depot contents should be listed in (Appendix IV).

9. A suitable vehicle capable of transporting all fire equipment during a fire emergency should be available and well maintained at all times.

10. Smoking should only be allowed in designated areas.

11. Fire Equipment should not be used for any other purposes and should be serviceable at all times.

12. As a matter of urgency all fire alarm systems should be completed and maintained to comply with Section 27B of the Safety, Health and Welfare at Work Act 1989.

13. Storage or usage of all flammable oil solvents or gases should be in accordance with I.S. 644 1983 and I.S. 3213 1987.

14. Warning notices should be kept in good condition and must be strictly observed at all times.

15. All electrical appliances and welding plants should be switched off when not in use. Gas bottles should be turned off when not used.

16. Where there is a clearly recognised fire danger, extinguishers shall be deployed as a first means of defence.

17. All lorries, vans, locos and other machines working in a dusty environment should have a suitable fire extinguisher(s) mounted in a convenient position. (Appendix V).

18. Details of all local fire authorities should be displayed at various points throughout the Works.

19. The annual service contract for all fire equipment should be continued.

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BOG AREAS

1. Roadside signs should be erected in prominent positions and be maintained. They should only be erected during the months of fire dangers.

2. Notices of fire prevention should be located at strategic points to be decided by local management. See Appendix (I and II).

3. All machines must be washed down and cabs cleaned out on a regular basis to minimise the risk of fire. Particular care should be taken with production and loading machinery.

4. Cylinders of gas should be mounted outside of machine cabs and tea centres at all times.

5. A 4.5 kg. powder extinguisher should be mounted in all tea centres.

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WORKSHOPS, STORES

1. Petrol and other oils (unless they are stored in non-flammable containers to BS 3475) should only be stored in designated oil stores.

2. Batteries should not be charged in working areas unless suitable protection in provided.

3. Flash-back arrestors should be fitted to all oxy-acetylene equipment.

   a) Oxygen cylinders should be stored separately to fuel gas cylinders.

   b) Oxygen and fuel gas cylinders, if stored out of doors, should be protected from sunlight.

   b) All cylinder heads should be kept free of oil and grease.

4. Flame retardant overalls should be worn by all personnel exposed to heat or sparks.

5. Clearways to fire exits and means of escape should be unobstructed at all times.

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OFFICES AND CANTEENS

1. Each canteen should be equipped with a fire blanket and fire extinguisher.

2. There should be at least one fire point in all office premises.

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TRAINING

All personnel working on the Site shall be given training in the following areas for fires:

- The correct use of fire extinguishers. This training will be carried out on an annual basis.
- The correct use of the fire tractor and its equipment.
- The fire emergency plan.
- Precautionary measures to minimise the risk of fire.

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APPENDIX (I)

BORD NA MONA

INSTRUCTION TO EMPLOYEES REGARDING FIRE DANGERS

There is always danger of disastrous fires occurring on the bog unless great care is taken by everybody. This danger is very great during fine weather. You can do your part by obeying these few simple rules:-

DO NOT throw away burning matches or cigarette ends. Make sure that they are properly extinguished first.

DO remember that big fires have small beginnings.

DO put out fires yourself if you can.

DO report them immediately to your supervisor if you can not

DO remember that big fires can be prevented and that you can play a big part in their prevention.

Follow these instructions carefully.

Remember that fires may cause personal injury.

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APPENDIX (II)

BORD NA MONA

FIRE WARNING

1. Do not leave unattended fires.

2. Ensure that all fires are extinguished before leaving bog.

3. Do not burn gorse or heather in this area during the period beginning on the 15th day of April and ending on the 31st day of August in any year. (Ref: Wildlife Act 1976, Ch. 4 Sect. 40).

4. Do not throw away lighting cigarette ends or matches.

5. Report any fires immediately to local fire authority.

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APPENDIX (III)

FIRE REPORT FORM

Works: _____ Date:_____

Date of Fire:_____

Day: _____ Time:_____

Location: _____

Machine No. and Type:_____

Description of Fire:_____

_____

_____

_____

Fire Equipment Available:_____

_____

_____

Injury to Personnel: _____

Estimated Cost of Damage: _____

Was Fire Brigade Called? _____Which Brigade? _____

Who Called Brigade? _____ Time: _____

Was Fire Crew Called? _____

Was Hot Work permit Used? _____

Cause of Fire (Suspected): _____

Recommendations to Prevent Re-occurrence:_____

_____

_____

_____

COPY TO BE SENT TO SAFETY OFFICER

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APPENDIX (IV)

FIRE WAGON CONTENTS

Quantity	Items
2	4 Gal. Petrol Drum's of Petrol
34	Hoses (75' Lengths)
3	Hose Nozzles
10	Shovels
8	Helmets
1	Hose Junction
1	5 Gal. Diesel Drum
2	Suction Hose
1	Blank Cap
1	Hydrant Key
4	Baskets
2	Spanners
1	Hose Adapter
1	9 Hole Bar
2	Stand Pipes
7	Flash Lamps
7	Goggles
2	Breathing Apparatus
4	Beacons
1	Stretcher
6	Extinguisher's
1	First Aid Kit
1	Foam Making Machine
1	Manually Mobile Angus Fire Pump
5	Drums of Foam

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Location	Machine Type	Size of Ext.	No. of Exts.	Type of Ext.
	Tractors up to 100 HP	4.5 Kg.	1	ABC Dry Powder or Foam
	Tractors over 100 HP	9 Kg.	1	ABC Dry Powder or Foam
	Double Ridger	9 Kg.	1	ABC Dry Powder or Foam
	Harvester Types 6,7	4.5 Kg.	2	ABC Dry Powder or Foam
	Bulldozers	4.5 Kg.	1	ABC Dry Powder or Foam
	Excavators	4.5 Kg.	2	ABC Dry Powder or Foam
	Locomotives	4.5 Kg.	1	ABC Dry Powder or Foam
	Canteens	1.5 Kg. or Fire Blanket	1	BCF

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BORD NA MÓNA

BORD NA MÓNA ENERGY LIMITED

Procedure:

Sitel Manager

Page: 1 of 1

Environmental Co-ordinator

Rev: SCP

Silt Control Procedure

1. **Purpose**
   The purpose of this procedure is to provide for the protection of the environment by way of control, limitation, treatment and monitoring of emissions.

2. **Scope**
   The scope of this procedure covers all of the Peat Depository Site.

3. **Responsibility**

   The implementation of the Silt Control Procedure is the responsibility of the Site Foreman.

4. **Procedure**

   1. Agree detailed drainage plan with Site Foreman and put plan on paper.

   2. Silt ponds and associated bypasses will be properly maintained and cleaned, as inspections dictate. Ensure bypass is open and silt pond isolated during cleaning operation.

   3. If no bypass is possible, close off silt pond and clean, preferably during dry period.

   4. Inform Site Foreman of silt pond cleaning and ensure recording of same.

   5. Clean outfalls starting upstream.

   6. Review drainage plan with Area Bog Foreman a minimum of once per month.

   7. Ensure that all machines are properly guarded and safe working procedures are followed at all times.

   8. .The silt pond will be cleaned in accordance with the attached Silt Pond Maintenance Procedure.

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BORD NA MÓNA ENERGY LIMITED

Procedure:SPIP

Site Manager

Page: 1 of 1

Environmental Co-ordinator

Rev:

Silt Pond/Outfall/River Inspection Procedure

1. **Purpose**
   The purpose of this procedure is to provide for visual inspection of all the ponds, outfalls and rivers draining the site, on a weekly basis. From this, the de-silting roster will be planned.

2. **Scope**
   The scope of this procedure covers all silt ponds on the site.

3. **Responsibility**
   It is the responsibility of the Site Foreman to ensure all silt ponds are inspected on a weekly basis and that these inspections are returned and filed in the works office.

4. **Procedure**

   1. Record the Silt Pond identification number on the Inspection Log (see attached)
   2. Inspect the full length of the Silt Pond including inlets and outlet.
   3. Tick the appropriate box on the Inspection Log to indicate the condition of the pond.
   4. For ponds in series, the final pond will be clean at all times.
   5. If the pond requires cleaning in the following fortnight, contact Site Manager and arrange for cleaning.
   6. Record the date of cleaning on the inspection form.
   7. Inspect the Outfall from the silt pond to the receiving water (River) and record any observations.
   8. Inspect the River, at least 100 metres upstream and downstream of the discharge point and record any observations.

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BORD NA MÓNA

BORD NA MÓNA ENERGY LIMITED

Silt Pond- Outfall -River (SPI)
Weekly Inspection (Monthly Record Sheet)

Site: _____ Waste Licence no.: _____

Silt Pond								
Silt Pond no.	Checked By	Date	Full				Comments	Date Cleaned
			1/4	1/2	3/4	full		

Outfall Inspection		
Date	Comments	Date Cleaned

River Inspection	
Date	Comments

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SILT POND MAINTENANCE PROCEDURE

1. If the silt pond system has a by-pass channel or a stand-by pond then the drainage should be diverted through these. If not then the inlet to the pond should be blocked for the duration of the maintenance, while protecting stocks.

2. If the outlet from the pond has a weir then the level should be lowered so as to de-water the silt. If not, then the outlet pipe should be blocked.

3. The pond should be cleaned from the inlet to the outlet either from one side if the width allows or from both sides, if not.

4. The silt should be deposited as far back from the silt pond as possible with the excavator, or additionally with the aid of a dozer if space is limited.

5. A Peat Bund should be left between the pond and the excavated siltso as to stop particularly wet peat from flowing back into the pond.

6. When the pond has been cleaned the inlet should be unblocked and the pond allowed to fill before removing the outlet blockage.

7. If the drainage was diverted during the maintenance, thenit should be redirected back into the pond.

8. If there are signs of peat silt deposited upstream or downstream of the pond, in the outfall, then they should also be cleaned, starting up-stream. A barrier should be installed during this operation.

9. Records should be kept of all pond maintenance.

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Oil/Diesel Loading Procedure

1. **Purpose**
   The purpose of this procedure is to ensure that the company will take all the necessary steps to protect the environment from accidental spillages arising from refuelling of machines on site.

2. **Scope**
   The scope of this procedure covers the following diesel and oil loading/unloading operations

   - External delivery of oil/diesel from the supplier to a mobile, double skinned tank on site.
   - Internal refuelling of machines from the mobile double skinned oil/diesel tanks.

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3. **Responsibility**
   It is the responsibility of the Site Manager to ensure all personnel and contractors associated with and involved in handling oil/diesels are made aware of this procedure and adhere to it in their day to day operations

4. **Procedure**

External delivery from oil/diesel supplier.

1. The oil/diesel supplier must have an adequate spill clean-up kit on board the tanker in the event of a spillage.
2. The operator of the tanker must be present at all times while the delivery of the oil/diesel takes place.
3. A Bord na Mona employee must be present to supervise the delivery of the fuel.
4. The operator must be made aware of the location of Bord na Mona's spill kits/dry peat.

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Internal refuelling of machines from fixed oil/diesel tanks.

1. The operator of the machine, should be present at the re-fuelling nozzle at all times during the re-fuelling.

2. The re-fuelling hose should be returned to the correct position on the tank once finished

3. All barrels on their sides, should contain a drip-tray.

4. The tank shall contain a spill kit/dry peat, in the event of an oil/diesel spill.

5. The Site Manager/Foreman/Environmental Co-ordinator should be notified at once of any accidental oil/diesel spillage's during re-fuelling.

6. All empty barrels, being returned to the works, should be returned to the area labelled as empties.

7. All leaks, wear and tear and mechanical difficulties should be reported to the Site Foreman.

8. Any incidents involving oil/diesel spillages shall be reported to the EPA within ten days. A Corrective Action Report Form will be included.

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Procedure: DHP

Site Manager

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Environmental Co-ordinator

Rev:

Dust Handling Procedure

1. **Purpose**
   The purpose of this procedure is to provide for the protection of the environment by reducing dust blow during transport operations at the site. This will be achieved by adopting a Dust Handling Procedure.

2. **Scope**
   The scope of this procedure covers the entire road and bog transport network within the site and any roads servicing the site being used for peat transport.

3. **Responsibility**
   The implementation of the Dust Handling Procedure is the responsibility of the Site Foreman

Procedure

1. Meteorological Records are maintained at the Oweninny Works Office.

2. If during any particular day, it is felt that the weather conditions are such that they may cause dust blow off the internal road/bog network or that the wind speed is approaching 39 Kilometres/Hr, the daily meteorological records are checked at the Oweninny Office.

3. If the wind speed observations at Oweninny or those from Met Eireann show that the wind speed may exceed the Trigger Level (39 Kilometre's/Hr), a tractor and bouser will be deployed to dampen down all road surfaces.

4. Other than this, if dust is observed blowing off the roads from traffic, and is causing a nuisance, the bouser will be deployed to maintain a wet surface.

5. All other public roads used for peat transport will be monitored and the same procedure put in-place if required.

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BORD NA MÓNA ENERGY LIMITED

Site Manager

Environmental Co-ordinator

Procedure: DHP

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Road Network Cleaning Procedure

1. **Purpose**
   The purpose of this procedure is to provide for the maintenance of the road network in and around the site, which is used for peat delivery.
2. **Scope**
   The scope of this procedure covers all roads as highlighted on the attached site map.
3. **Responsibility**
   The implementation of the Road Network Cleaning Procedure is the responsibility of the Site Foreman

Procedure

1. A tractor and road sweeper will be on standby, on-site for all road sweeping Operations.

2. All roads used in connection with peat delivery operations will be inspected on a daily basis for peat debris, which may cause a nuisance to other road users.

3. Any road haulage operators will report any spillage's to the Site Foreman.

4. Where a road requires cleaning, the tractor and sweeper will be deployed to remove any debris to the roadside.

5. In addition to this, where dry conditions occur, causing problems with dust from road haulage of the peat, the dust dampening bouser will be used as per the Dust Handling Procedure (7.0 DHP).

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Site Manager

Environmental Co-ordinator

Procedure: EMP

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Environmental Monitoring Procedure

1. **Purpose**
   The purpose of this procedure is to provide for the protection of the environment by inspecting all potential and actual surface water discharges from the site. Discharges from the peat deposition area are dealt with under the Silt Pond/Outfall/River Inspection Procedure (3.0 SPIP)

2. **Scope**
   The scope of this procedure covers all run-off from the peat reception, oil refuelling tank, carpark, and canteen/office areas.

3. **Responsibility**
   The implementation of the Environmental Monitoring Procedure is the responsibility of the Site Foreman

Procedure.

1. All oil-traps/interceptors will be inspected on a weekly basis using the attached log.

2. Discharges from the Oil-traps/Interceptors will be sampled on a monthly basis and samples sent to Bord na Mona Environmental Ltd for analysis for COD (mg/l).

3. Based on the weekly visual inspection and COD results from the lab, the interceptor will be cleaned using an appropriate contractor.

4. The oil refuelling area will also be checked for oil/diesel spillages and any faults with equipment will be reported using the Corrective Action Report Form.

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Surface & Groundwater Protection (YIL)
Weekly Inspections – Monthly Record Sheet

Works : **Waste Licence no.:**

Oil Traps/Interceptors

DESCRIPTION	*CHECKED BY*	*DATE*	*COMMENT*

Surface Water Discharges

DESCRIPTION	*CHECKED BY*	*DATE*	*COMMENT*

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Site Manager

Procedure: WDP

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Environmental Co-ordinator

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Waste Disposal Procedure

1. **Purpose**
   The purpose of this procedure is to provide for the protection of the environment by providing for the documented on-site classification, labelling, segregation, storage and control of Hazardous & Non-hazardous waste generated on site by Bord na Mona Energy Ltd.

2. **Scope**
   The scope of this procedure covers all of the Srahmore Peat Deposition site.

3. **Responsibility**
   The implementation of the Waste Disposal Procedure is the responsibility of the Site Manager and/or the Environmental Co-ordinator.

4. **Relevant Documentation**

   Waste Management Regulations 1998
   Waste Management (Transfrontier Shipment of Waste) Regulations, 1998
   European Waste Catalogue and Hazardous Waste List January 2002

5. **Procedure**

   1. All wastes generated on site will be collected in appropriate containers for recycling or disposal.

   2. A full inventory of all wastes generated will be maintained, with receipts from contractors.

   3. Only Licensed Contractors will be engaged to handle the waste.

   4. It is proposed to handle the waste as follows:

      Waste Oil – Atlas Oil/suitably licensed contractor via Oweninny Works

      Waste Oil Filters - Atlas Oil/suitably licensed contractor via Oweninny Works.

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Batteries – Returnbatt/suitable licensed contractor via Oweninny Works.

Canteen/Office Waste – Local Licensed Contractor

Barrels/Drums – Return to supplier/Metal recycler via Oweninny Works.

5. All wastes will be designated either Hazardous of Non-hazardous and assigned the appropriate EWC code.

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Composite Sampler Service Procedure

1. Purpose

The purpose of this procedure is to provide for the efficient, uniform and representative weekly servicing of the Composite Sampler in accordance with the requirements of Waste Licence No. ??

2. Scope

The scope of this procedure covers all Composite Samplers on-site

3. Responsibility

The servicing of the Composite Sampler is the responsibility of the Environmental Coordinator or an individual appointed by the Site Manager

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4. Procedure

4.1 The sampler is visited once a week to remove samples and replace with clean empty bottles.

4.2 The sampler cover is removed and the programme is stopped.

4.3 The top of the sampler is removed, the securing ring removed, and the 7 x 2 litre composite samples are extracted from the sampler. The 8 bottle ie. the one being filled on the day of servicing, is placed in position 1.

4.4 A cap is placed on the composite sample and it is gently agitated to provide a representative sample. The plastic sample bottle is rinsed before filling from the 2litre composite bottle. Where a sample volume is below the required volumes as set out below, the flow should be reduced so as to provide sufficient volumes in the next week.

- A minimum of 500mls in a plastic container is required for the daily composite samples for Total Solids and Total Suspended Solids analysis.
- A minimum of 1 litre of sample in a plastic container is required for the full suite of analysis on the composite samples. **If no sample has been**

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collected for the day receiving the full suite of analysis, then a grab sample should be taken.

4.5 All of the 2 litre composite sample bottles are rinsed/cleaned and returned to the sampler, the securing ring and sampler cover replaced.

4.6 Each sample bottle for transportation to the Lab, is labeled with the following information provided:
Waste License No:
Sample ID: (Composite sample SW?)
Client: (Bord na Mona Energy Ltd)
Sampling Date & Time: Date the composite sample was taken

4.7 In addition to this a chain of Custody must be filled in. This will give the details of the sample, the analysis required, the sampler, transporter, and will be signed in by personnel from the lab.
A copy is attached.

4.8 The sampler must then be restarted, by running the programme.

4.9 Before leaving the site, the velocity probe in the pipe should be checked for debris & scum build up, as this reduces the performance of the flow meter. The suction head should also be checked for accumulated dirt/peat.

4.10 Samples must be delivered to the laboratory ASAP after sampling, at least, 24 hrs. after taking the samples.

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