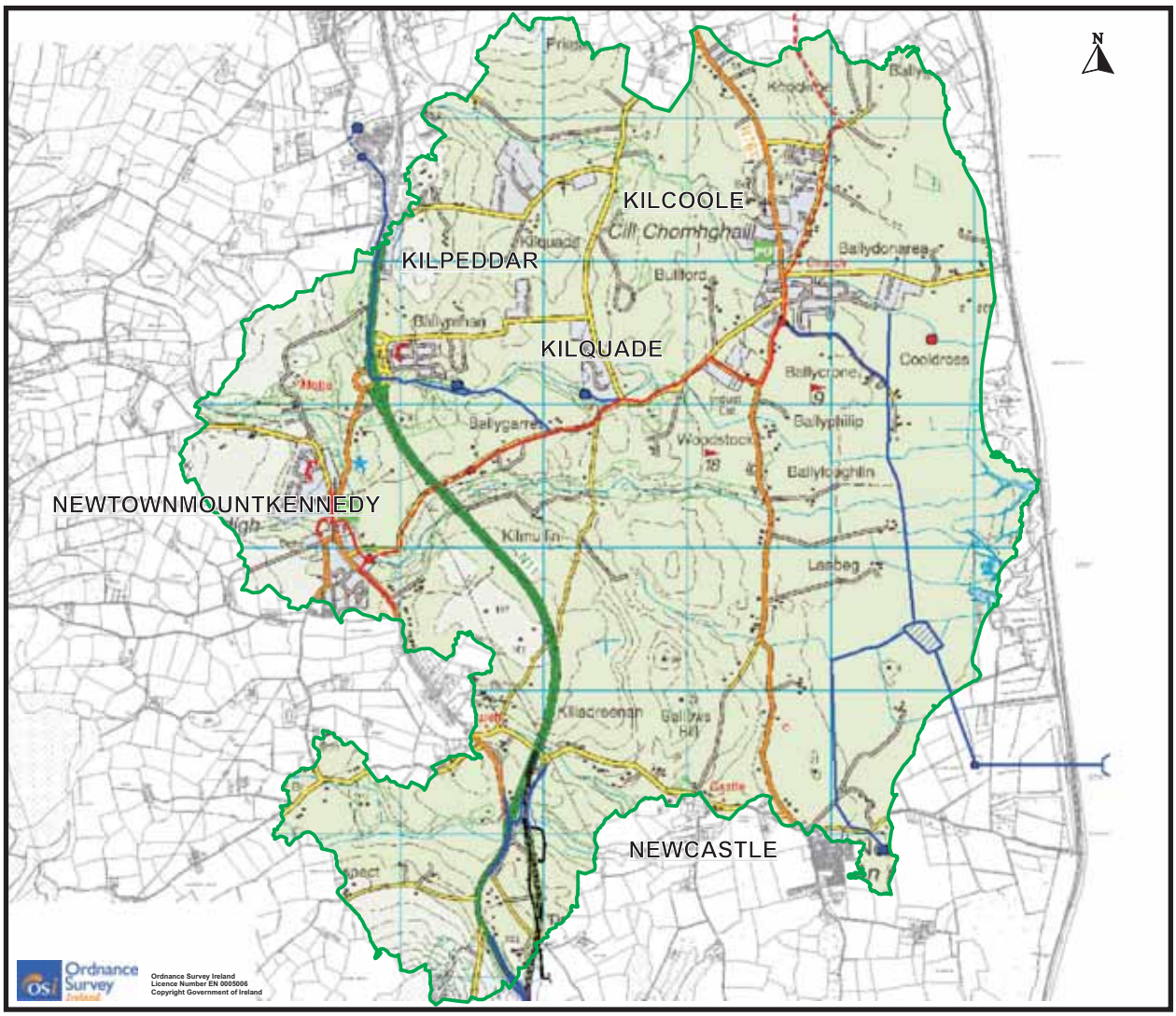
Wicklow County Council
Comhairle Chontae Chill Mhantáin

Newtownmountkennedy & Kilcoole Regional Sewerage Scheme



Environmental Impact Statement

Volume 1

MAIN REPORT

March 2006

RPS

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This Environmental Impact Statement has been prepared by RPS Consulting Engineers their Environmental Sub-consultants and with the assistance of staff from Wicklow County Council.

ENVIRONMENTAL SUB-CONSULTANTS

Air Quality	Odour Monitoring Ireland
Noise and Vibration	Enterprise Ireland
Terrestrial Ecology 1999	Eleanor Mayes
Marine Ecology	Ecoserve Irish Hydrodata
Archaeology, Architecture and Culture Heritage	Valerie Keeley

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1 INTRODUCTION

This Environmental Impact Statement (EIS) for Newtownmountkennedy and Kilcoole Sewerage Scheme has been prepared on behalf of Wicklow County Council by RPS Consulting Engineers and additional specialist environmental consultants.

The scheme is to develop a new treatment plant at Leamore near Kilcoole which will provide secondary treatment capacity for 22,500 population equivalent (P.E.), with the facility to double the capacity of the scheme in the long term. This plant will discharge through a marine outfall to the Irish Sea. A sewer network will also be provided to transfer wastewater to the plant.

2 BACKGROUND TO THE SCHEME

The scheme concerns the provision of upgraded sewerage facilities for the communities of Newtownmountkennedy and Kilcoole in County Wicklow. Apart from these two villages, sewerage from two other residential developments (Garden Village and Kilquade Hill) currently served by private package treatment plants will be intercepted. Furthermore, the villages of Kilpedder, to the north of Newtownmountkennedy and Newcastle, to the south of Kilcoole, are also considered to be included in the future. At present wastewater from Newtownmountkennedy and part of Kilcoole is pumped to Greystones as an interim measure. However, by 2007 the capacity of the transfer pipeline will be reached and the capacity of the plant at Greystones will be exceeded.

3 DESCRIPTION OF THE SCHEME

The treatment plant at Leamore will comprise a variety of process options to satisfy the effluent standards required by the Urban Wastewater Treatment Directive for normal conditions, BOD_5 of 25mg/l and suspended solids of 35mg/l. The treatment plant will include the following elements:-

- **Preliminary treatment;** to comprise inlet pumping, stormwater balancing, removal of screenings to a 6mm maximum size, grit removal and flow measurement. This element of the works is generally common to all options, sized for the phase 1 flow of 22,500 population equivalent, but with civil works suitable for duplication of the equipment at ultimate capacity

- **Secondary treatment;** comprising a variety of options with conventional plant including primary settlement, activated sludge and final settlement tanks designed for carbonaceous BOD removal without nitrification or denitrification. This element of the works would be constructed as a modular two or four stream process, with initial development for 22,500 population equivalent and ultimately of double that capacity.
- **Sludge handling and treatment;** The Sludge Management Plan for County Wicklow recommends that sludge arisings from the Newtownmountkennedy/Kilcoole area be dewatered on site and transported to the proposed Wicklow Hub Centre for sludge treatment.

4 ALTERNATIVES CONSIDERED

The options considered for the scheme were as follows:-

- Transfer to Facility at Greystones
- Upgrade existing facilities
- New treatment plant

The transfer of wastewater to Greystones was considered as an alternative. However, the capacity of the plant at Greystones is limited to 27,000 PE and is expected to be exceeded by 2007. The plant at Greystones is therefore not a long term solution to the needs of the Newtowonmountkennedy Kilcoole area due to its limited capacity and the need to service the considerable amount of development underway and planned for Greystones.

The upgrading of the existing facilities is not a viable option as Garden Village and Kilpedder are only serviced by packaged plants which would have to be replaced by conventional type plants. The other plants at Newcastle and Kilcoole would also require considerable upgrading and the operational cost of running a number of small plants would be excessive. Furthermore, the existing plant capacity is limited by the assimilative capacity of the receiving waters.

A treatment plant to serve the medium to long term needs of the area was considered the best solution. In this regard, the expansion of the existing plants at Kilcoole or Newcastle were also considered. However an examination of these options concluded that a new plant at Leamore offered the best solution as the marine outfall could be located outside of the Special Protection Area on the Kilcoole marches. Furthermore the site has good natural screening and is well removed from the residential areas in Kilcoole and Newcastle.

5 ENVIRONMENTAL IMPACTS OF THE SCHEME

This section outlines the environmental impacts of the proposed scheme and gives an overall assessment of these impacts. Environmentally sensitive areas in the vicinity of the proposed scheme are identified and mitigation measures proposed to reduce any environmental impact.

HUMAN BEINGS

Human beings interact, to a greater or lesser extent, with all aspects of the receiving environment. Therefore, impacts on any aspect of the environment have the potential to impact on human beings. The impacts of the scheme specifically relating to human beings are covered under the headings, *Community*, *Air Quality*, *Noise and Vibration* and *Landscape and Visual Impacts*.

5.1 COMMUNITY

The scheme will have a positive impact on the social and economic development of the catchment as it will provide for new and existing residential and business developments as well as protecting the marine environment by improving the quality of discharges from existing facilities.

The site is located on farm land in private ownership and does not impact directly on community facilities. The site however, is located adjacent to important recreational and conservation areas. While there will be a temporary impact from the construction of the pipeline across a Natural Heritage Area, overall the receiving environment will benefit from the improved quality of the discharge. In the larger study area there are no community facilities impacted by the scheme.

Impacts related to air quality, noise and landscape are dealt with below.

5.2 AIR QUALITY

The impact on air quality is related to odour emissions from the operation of the plant. The potential of the plant to generate odours was examined using an odour dispersion model. A phased modelling approach ascertained the odour impact of the facility over its different operations, using measurements that were performed previously on similar operating WWTP's and local meteorological data. It was concluded that *no major odour impact* should be perceived

by residents in the vicinity of the proposed operating WWTP following the installation of odour abatement protocols/minimisation procedures.

5.3 NOISE AND VIBRATION

In general, noise is likely to provoke complaints when it exceeds the level of background noise by a certain margin or when certain absolute levels are attained. The criteria for industrial noise generally lie in the range 35-45 dB(A) at night and 45-55 dB(A) by day. The lower values are normally applicable to rural areas and zones of hospitals, and the higher values are sometimes applicable to city centre areas or special cases such as mining or quarrying. The most widely applied criteria for Industry are that of 40 - 45 dB(A) (night-time) and 50 – 55 dB(A) (daytime) but further controls may be specified if there are prominent discrete tones or impulses. Based on these criteria, limit values have been proposed for the operation of the plant.

Noise measurements were made at the nearest noise sensitive locations to establish background levels. Due to the continuous nature of the plant operation the night time operation is of major importance as this requires a lower limit than daytime. There are no statutory limits for environmental noise emissions for this type of plant, or industry in general, in this country.

As the plant will be some distance from the nearest sensitive receptors there will be no impact from the construction and operation of the plant. There will however be a slight impact from the construction and operation of the pumphouse. To mitigate any adverse impacts noise control measures will be incorporated into the design of the plant, with the enclosure of the main sources of noise, as appropriate to meet the above noise criteria.

5.4 LANDSCAPE AND VISUAL IMPACT

The landscape and visual aspects of the scheme were assessed taking into account the character of the site and surrounding landscape and the significance of visual impacts identified.

The sensitivity of the receiving environment can be classed as being moderate to high. This classification has mainly been derived from the sensitive nature of the landscape character, as well as the existing site usage and the rural context in which the proposed development is to be located. In principal the proposed development will contrast with the existing land use and landscape character of the area.

Site visibility will greatly depend on the vegetation cover and time of year. The site is exposed to long-range views to the northwest and short to medium range views from the north and south.

The impact of the development on the nearest sensitive receptors was examined. Eight potential sensitive receptors were identified within a one kilometre radius of the site. There will be a severe impact on one farmhouse to the north of the site as it has a direct view of the development and does not benefit from topography or existing screening to reduce the impact. The other receptors benefit from existing screening and topography. One property to the north of the site will experience a medium impact and the remaining properties will experience a low or negligible impact and in some cases no impact at all. These impacts were assessed without any mitigation measures in place.

A number of mitigation measures are proposed to ensure that the degree of visual intrusion posed by the proposed development is minimised and that the site achieves a high degree of visual integration into the existing fabric of the receiving environment. With these measures in place it was concluded that the proposed development does not pose a threat to the landscape character associated with this part of County Wicklow.

NATURAL ENVIRONMENT

This section covers the potential effects of the proposed scheme on the natural environment.

5.5 TERRESTRIAL ENVIRONMENT

The site is a relatively low-lying field which is liable to some waterlogging. The field is in agricultural production and ecological interest is confined to a wet woodland that lies along the eastern site boundary, and a hedgerow with mature ash trees and badger setts along the northern boundary. Potentially significant impacts from the development are damage to woodland and pollution of watercourses draining into Kilcoole Marshes through spillages during construction. The development of the facility will result in the replacement of cultivated land with buildings and paved surfaces. This is not a significant impact as cultivated agricultural crops are not significant from an ecological perspective.

The woodland and drainage ditch along the eastern boundary of the site at Leamore will be fenced off before construction work starts. Strict site management with regard to storage and handling of fuels, oils, cement and other potentially toxic and hazardous substances will minimise the risk of pollution.

The outfall pipeline which discharges to the sea passes through Kilcoole Marshes, a sensitive marine area which is designated as a Special Protection Area under the Birds Directive, and Special Area of Conservation and a Natural Heritage Area under Irish legislation. The route of the outfall pipeline has been chosen across the least sensitive area of these important habitats. The habitats in the area have been identified and the main impact of the pipeline resulting from the construction activities following mitigation will be short term displacement of improved grassland which is developing a more wet grassland character, and displacement of small numbers of breeding birds from the pipeline assembly area.

The associated development of the sewer network may cause some temporary impacts but these will be minimised by locating the routes on roads and away from sensitive areas where possible.

5.6 MARINE ENVIRONMENT

The proposed scheme will require the construction of an outfall pipe discharging to the sea between The Breaches and Six-Mile Point on the Wicklow coast. The area has been described as an important fishery for seed mussels (juvenile *Mytilus edulis*) and whelks (*Buccinum undatum*). The marine environment was surveyed and the habitats and species present were noted.

Furthermore numerical modelling of the marine environment was carried out to facilitate the assessment of effluent discharges from a variety of outfall lengths. The extent of the area considered in the modelling studies was sufficient to include the combined impacts of the existing outfalls serving Wicklow, Greystones and Bray. The modelling studies concluded that a 1000m long outfall will perform satisfactorily under calm and adverse wind conditions. Sewage treatment will be undertaken at a level which maintains EU water quality standards for bathing and shellfish directives, to minimise adverse future impacts to the marine environment. Long term monitoring will also be carried out to verify the plant's performance.

5.7 SOILS, GEOLOGY AND HYDROGEOLOGY

The soils, geology and hydrogeology of the area was examined including the seabed in the vicinity of the proposed outfall. Groundwater is widely used in the area as a source of supply and well yields are typically poor to good. The proposed works will involve slight impacts on soil and geology, primarily associated with construction. The construction of the outfall pipeline in tunnel under the railway line and inner shoreline area is expected to have a slight impact of short duration on beach mobility.

Long term permanent impacts will be negligible as regards the impact of the physical works and will be slight as regards the ultimate disposal of treated wastewater sludge from the plant. Disposal of the sludge will be in accordance with the Sludge Management Plan for Co. Wicklow. Monitoring of discharges will take place in strict compliance with all licence and planning conditions.

MATERIAL ASSETS

This section covers the potential effects of the proposed scheme on Material Assets including agricultural properties and non-agricultural properties (residential, commercial and recreational).

5.8 MATERIAL ASSETS: AGRICULTURAL PROPERTIES

The siting of the proposed treatment plant will affect one farm holding. A number of other farms will potentially be impacted by the sewer network although this will be a temporary construction impact. The potential impact from the landtake for the proposed facility however will be permanent. The actual field in which the proposed plant is to be located is in forage maize and is part of a mixed enterprise of dry stock and tillage. The field is located on the northern boundary of the farm away from the farm buildings and entrance and is therefore not affected by severance.

Land take will be dealt with by compensation. Compensatory measures for loss of land, buildings and any other injurious affects will be agreed with property owners affected as part of the Compulsory Purchase Order (CPO) procedures. This is outside the scope of the EIS.

5.9 MATERIAL ASSETS: NON AGRICULTURAL PROPERTIES

The only impact to non agricultural land/properties will be during the construction of the sewer network. This impact can be described as not significant and will not involve the demolition of any property. The impact on landowners will be minimised by confining landtake where possible to public lands.

ARCHITECTURAL, ARCHAEOLOGICAL AND CULTURAL HERITAGE

This section deals with the impacts on known and potential archaeological sites, features of cultural heritage value and buildings of architectural, artistic, cultural or historic interest.

5.10 ARCHITECTURAL, ARCHAEOLOGICAL AND CULTURAL HERITAGE

5.10.1 Buildings of Architectural Interest

An inspection of records of architectural sites identified five sites in the study area, three of which are protected in the Wicklow County Development Plan 2004- 2010. Of these, four sites are potentially impacted by the construction of the pipeline. Mitigation measures have been proposed to reduce any potential impact.

5.10.2 Archaeology

Twelve archaeological sites recorded in the Record of Monuments and Places are found within the environs of the proposed development route. None of these are directly impacted by the scheme but some are in close proximity to the scheme. The proposed sewer network may involve some river crossings which may have some archaeological potential as could the marine waters in the vicinity of the pipeline. The main mitigation will involve a walkover survey in advance of the construction works in addition to archaeological monitoring during the construction and the retention of an archaeologist during the earthworks.

5.11 POTENTIAL CONSTRUCTION IMPACTS

There are a number of impacts related to the construction of the scheme most of which are of a temporary nature. These impacts will be mitigated by good site practice and a mitigation plan being put in place by the contractor before commencing the works.

6 WHAT HAPPENS NEXT?

6.1 VIEWING AND PURCHASING THE EIS

Copies of the Environmental Impact Statement are available for examination at the locations detailed in the published newspaper notices.

The Environmental Impact Statement is also available for purchase in hardcopy or CD format from:

Wicklow County Council
County Buildings
Wicklow

Prices are as shown in the published newspaper notice.

6.2 NEXT STEPS

Construction of the scheme is dependent on approval from An Bord Pleanála.

Written submissions relating to the environmental effects of the proposals may be made to the Board prior to the date specified in the published newspaper notices. An Bord Pleanála, at its discretion, may hold an Oral Hearing.

The written submissions, together with any representations made at the Oral Hearing, will be considered by the Board before making their decision on whether or not to approve the scheme (with or without modifications).

The Board's decision shall be published in one or more newspapers circulating in the area; including, where appropriate, particulars of any modifications to the scheme.

1 INTRODUCTION

1.1 INTRODUCTION

In 1999, a Preliminary Report and EIS were prepared by RPS Consulting Engineers for the following development:

- Provision of a new sewerage network to collect all foul flows to a treatment plant sited at Leamore, near Kilcoole County Wicklow. Local sewers and a pumping station to be constructed at Newtownmountkennedy to transfer flows to Kilcoole, and intercept flows from Kilpedder, Garden Village and Kilquade, and to include a sewer to transfer wastewater from Newcastle to Leamore.

- The construction of a treatment plant at Leamore to discharge through a 600mm diameter marine outfall to the Irish Sea (1000m long). The plant capacity would be initially for 15,000 population equivalent (PE) as a minimum and by 2005 the plant would provide minimum secondary treatment capacity for 22,500 PE, with the facility to duplicate in the long term.

- Implementation of an interim scheme to transfer an existing sewerage load in the order of 5,000 – 6,000 PE from the whole of Newtownmountkennedy and the western area of Kilcoole to Greystones Waste Water Treatment Works (WWTW), and to facilitate new development in the order of 5,000 -7,000PE with additional development over time to include Garden Village, and Kilquade.

The full scheme did not go ahead although the interim scheme has been implemented and commissioned (January 2003) and currently transfers flows in the order of 3,200PE to Greystones WWTW. Wicklow County Council proposes to proceed with the full scheme and the EIS has been updated to account for developments since 1999. This Environmental Impact Statement (EIS) examines the potential significant impacts of the construction and operation of a central wastewater treatment plant at Leamore, near Kilcoole. It also examines the potential impacts of the long sea outfall associated with the development.

1.2 PURPOSE OF THE SCHEME

The purpose of the scheme is to provide a new central wastewater treatment works at Leamore, near Kilcoole, County Wicklow to serve the regional needs of the area. This plant will be capable of accommodating all of the existing developments plus residential and commercial development as indicated by the adopted settlement strategy for the area. The development should be advanced on a phased basis with an initial stage being construction to a design capacity of 22,500 P.E. with secondary treatment followed by final development to 45,000 P.E. as required.

1.3 DEVELOPMENT PLANS

The following publications are relevant to the study area:-

(i) County Development Plans for Co. Wicklow 1999 and 2004-2010

(ii) Census 2002 data

(iii) Strategic Planning Guidelines for the Greater Dublin area

(iv) Wicklow County Council Housing Strategy 2001 - 2005

(v) Local Area Plans for Newtownmountkennedy and Kilcoole

(vi) Greystones/Delgany Development Plan

(vii) Planning Permissions granted and awaiting decision

The Wicklow County Development Plan (CDP) sets out the overall strategy for the proper planning and sustainable development of the county and contains information on the likely effects on the environment of implementing the Plan. The Development Plan 2004 – 2010 was adopted in November 2004.

The CDP has been prepared within the context of the National Spatial Strategy and the Strategic Planning Guidelines for the Greater Dublin Area (SPG). The SPG's have particular relevance to this project as the Study Area is close to the boundary between the Metropolitan Area and Hinterland Area as defined within the SPG's. Within the Hinterland regional development is concentrated within "development centres", within County Wicklow the Primary Development Centre is Wicklow Town with Arklow being a Secondary Development Centre, both of these are outside the Study Area. The SPG's state that development within the Hinterland outside of the development centres should meet local and not regional need, however the SPG Review and Update April 2000 identified the need for a review of development plans for settlements close to the boundary of the Metropolitan Area and of those along transportation corridors. The Study Area considered for this scheme would qualify for such a review.

Within the Study Area the CDP designates Newtownmountkennedy as a Primary Local Growth Centre with Kilcoole and Newcastle designated as Secondary Local Growth Centres. These centres will have been selected to accommodate growth within the Strategic Green Belt, outside of the Primary and Secondary Development Centres (such as Greystones/Delgany). Kilpeddar has been designated as a Large Village, future development in this area is restricted to allow local growth only. **Table 1.1** details the population projections for these growth centres.

Table 1.1: Projected Domestic Populations within the Study Area

Area	No. of Persons 2002[1]	No. of Persons 2007	No. of Persons 2016	No. of Persons 2023[7]
Newtownmountkennedy	2,521	4,528[2]	6,000[2]	6,892
Kilcoole	2,826	3,694[3]	4,500[4]	5,169
Newcastle	851	1,083[5]	1,500[4]	1,783
Kilpeddar	517	675[5]	960[6]	1,141
Total Population	6,715	9,980	12,960	14,985

[1] Source: 2002 Census Data

[2] Source: Section 2.1.2 Newtownmountkennedy Local Area Plan 2002

[3] Source: Section 2.5 Kilcoole Local Area Plan 2002

[4] Source: Section 2.2.2 Wicklow County Development Plan 1999

[5] Calculated pro-rata from 2002 and 2016 data

[6] Calculated by applying an assumed growth rate, determined by proximity to growth centres (refer to Table 2.2 Wicklow Development Plan 1999)

[7] Calculated by applying assumed growth rates

The CDP provides estimates of population to 2016, but the design horizon for the scheme extends to 2023 and therefore the assessment of population growth needs to be extended further. Estimates of future population have been published by the Central Statistics Office for the period up until 2031, however these estimates are on a Regional basis (i.e. the Mid-East region which encompasses Kildare, Meath and Wicklow), the estimated growth rate cannot be applied to specific growth centres such as

Newtownmountkennedy, Kilcoole and Newcastle. The population forecasts beyond 2016 are therefore determined using nominal annual growth rates.

The development strategy for Newtownmountkennedy is detailed within the Newtownmountkennedy Local Area Plan 2002. The plan states that expansion of Newtownmountkennedy is hindered by the absence of a satisfactory sewerage system, the sanitary improvements will allow for growth to the local growth centre strategy level. Population growth is to be concentrated along the western edge of the village and will be expected to grow to around 6,892 persons by 2023.

As a Secondary Local Growth Centre, Kilcoole is not planned to develop to the scale envisaged for Newtownmountkennedy. Currently, the two towns have similar populations, however by 2023 Kilcoole is expected to be much smaller in size compared to Newtownmountkennedy. However, it is a policy of the Council to promote the expansion of Kilcoole's employment base. The settlement strategy would envisage that the population of Kilcoole is likely to increase from an estimated 2,826 in 2002 to 5,169 in 2023.

The development strategy envisaged that Newcastle could expand to approximately double its present size, giving an indicative population in 2023 of 1,783 persons. This would obviously require significant new residential development in the area and a corresponding increase in treatment plant capacity.

The foregoing summarises the planning context for the consideration of future sewerage needs in the area. For design purposes, however, it is also necessary to consider potential long-term development in order that sewerage infra-structure can cater for all reasonable foreseeable requirements. Therefore, potential development indicated by planning applications and other criteria has been taken into account, together with a design factor for contingency development. The ultimate scope of the project is taken to include Kilpedder and the existing developments at Garden Village and Kilquade Hill.

Further information on development needs in the area is provided in the Preliminary Report for the scheme dated 2004.

1.4 LEGAL REQUIREMENTS

The EIS has been prepared in accordance with the following:-

- The EU Directives on Environmental Impact Assessment (85/337/EEC) and (97/11/EEC) and associated national regulations referred to as the European Communities (Environmental Impact Assessment) Regulations, 1989-2000.
- The Local Government Planning and Development Act 2000 and the Local Government Planning and Development Regulations, 2001.
- Advice Notes on Current Practice and Guidelines on Information to be Contained in Environmental Impact Statements (EIS) (2002, 2003 respectively).

The EC Directives on the assessment of the effects of certain public and private projects on the environment have been transposed into Irish legislation by the European Communities (Environmental Impact Assessment) Regulations 1989 – 2001 and the Local Government Planning and Development Regulations, 2001.

The Planning and Development Regulations, 2001 under Schedule 5 requires that the Authority prepare a statement on the likely effects on the environment for waste water treatment plants with a capacity greater than 10,000 population equivalent. Therefore the current scheme requires an EIS.

The requirements for the content of an EIS under the Planning and Development Regulations, 2001 and the EIA Regulations are the same and are listed below:

Information to be contained in an Environmental Impact Statement (Article 94, Planning and Development Regulations, 2001):

(a) A description of the proposed development comprising information on the site, design and size of the proposed development.

(b) A description of the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse affects.

(c) The data required to identify and assess the main effects, which the proposed development is likely to have on the environment.

(d) An outline of the main alternatives studied by the developer concerned and an indication of the main reasons for its choice, taking into account the effects on the environment.

The Planning and Development Act, 2000 imposes a general obligation on a person developing land to gain permission.

The Act differentiates between applications made by a private developer and an application made by a local authority (including development on the authority's behalf).

Section 175 of the Act requires that where a local authority (or any other person on their behalf) proposes to carry out development within the functional area of the local authority concerned the local authority shall prepare an environmental impact statement. Section 175 also states that where a local authority is required to prepare an EIS they shall apply to An Bord Pleanála for approval.

The procedure of gaining approval for local authority own development (under the Planning and Development Act, 2000) is as follows:

- Publish notice indicating nature and location of proposed development in newspapers, specifying where EIS may be viewed & inviting submissions to An Bord Pleanála (The Board)
- Send a copy of the application and EIS to 'prescribed authorities' & invite submissions to the Board
- Apply to Board for approval for development
- Board may request further information
- Where an oral hearing is being held for CPO related to the development the Board may also hear evidence in relation to the impacts on the environment and the proper planning and sustainable development.
- The Board makes their decision (with or without conditions) considering EIS, effects on the environment & consequences for proper planning and sustainable development

1.5 STRUCTURE OF EIS

The EIS is comprised of 2 volumes:

Volume 1 is the main EIS report. A non – technical summary of the information contained in the EIS is also contained in this volume.

Volume 2 Technical Appendices containing supporting information to that contained in the main EIS

1.6 PUBLIC CONSULTATION

1.6.1 Public

A preliminary public consultation process was carried out in 1999 when the scheme was first proposed involving public displays over 2 afternoons each in Kilcoole and Newtownmountkennedy. At each session members of the study team and Wicklow County Council were available to discuss the project. Over 200 persons attended and the overwhelming response was in support of the early implementation of the scheme, based on a central plant. The following is a summary of contributions from the public received at and after the exhibitions:

- *Some 9 respondents made written submission in relation to the scheme*
- *Generally the public favoured the implementation of the proposed scheme with central treatment. There was no support for local treatment*
- *The option of integrating the region to the Greystones scheme was generally not supported, but there was some support for this option*
- *There were a number of responses opposing the scheme on grounds of facilitating new development (outflow from Dublin)*
- *There were some objections to the siting of the proposed wastewater treatment works at Leamore and to the proposed outfall*
- *There was one written response requesting secondary treatment at a minimum from Leamore on the grounds of Water Quality.*

Dúchas, the National Parks & Wildlife Service (now part of the Department of Environment, Heritage and Local Government) have been consulted regarding the scheme, particularly the outfall, which is located in a sensitive area of coastline. The scheme, as proposed, is regarded by Dúchas as acceptable.

1.6.2 Statutory Bodies

A list of the statutory bodies, government agencies and non-government organisations (NGO's) consulted is given below. These bodes were informed by letter of the intention to implement the scheme originally proposed in 1999 and to inform them that the EIS was being updated to account for developments since 1999.

- Eastern Regional Fisheries Board
- An Taisce
- Birdwatch Ireland
- Bord Failte
- Coastwatch Ireland
- DEHLG - Parks and Wildlife
- DEHLG - Heritage Section
- Eastern Health Board
- Environmental Protection Agency
- Geological Survey of Ireland

- Health and Safety Authority
- Irish Underwater Council
- Bord Iascaigh Mhara
- CIE

1.6.3 Second Public Consultation

A second public information evening was held on the scheme on 10th November, 2005 in the Council offices in Greystones between 7 and 9 pm. The purpose of the event was to update the local community on the progress on the scheme which was first proposed in 1999. The evening was well attended and representatives from Wicklow County Council and the study team were there to answer questions. The scheme was well received and as with last time there was overwhelming response to the early implementation of the scheme. The issues raised were as follows:-

- When will the scheme be built
- Can my home to connected to the scheme
- How much of the scheme has already been built
- Will the scheme affect the birds at Kilcoole marches
- Will there be any odour associated with the plant

2 BACKGROUND

2.1 GENERAL

This study concerns the provision of a wastewater treatment works to serve the communities of Newtownmountkennedy and Kilcoole in County Wicklow. Apart from these two villages, two other residential developments (Garden Village and Kilquade Hill) currently served by private package treatment plants would be intercepted. The plant can also facilitate the inclusion of the villages of Kilpedder, to the north of Newtownmountkennedy and Newcastle, to the south of Kilcoole, in the future **(Figure 2.1)**.

The catchment containing these dispersed communities is drained by four small rivers, denoted A, B, C, D. These streams are characterised by very low summer flows, making them relatively unsuitable for effluent disposal. Furthermore, all four discharge to the Kilcoole inter-tidal marshes and from there, under the railway line at "The Breaches," to the sea. Effluent discharge to the streams, therefore, results in the risk of pollution to the inter-tidal waters at the marshes and possible bacterial contamination of the marine bathing and recreational waters.

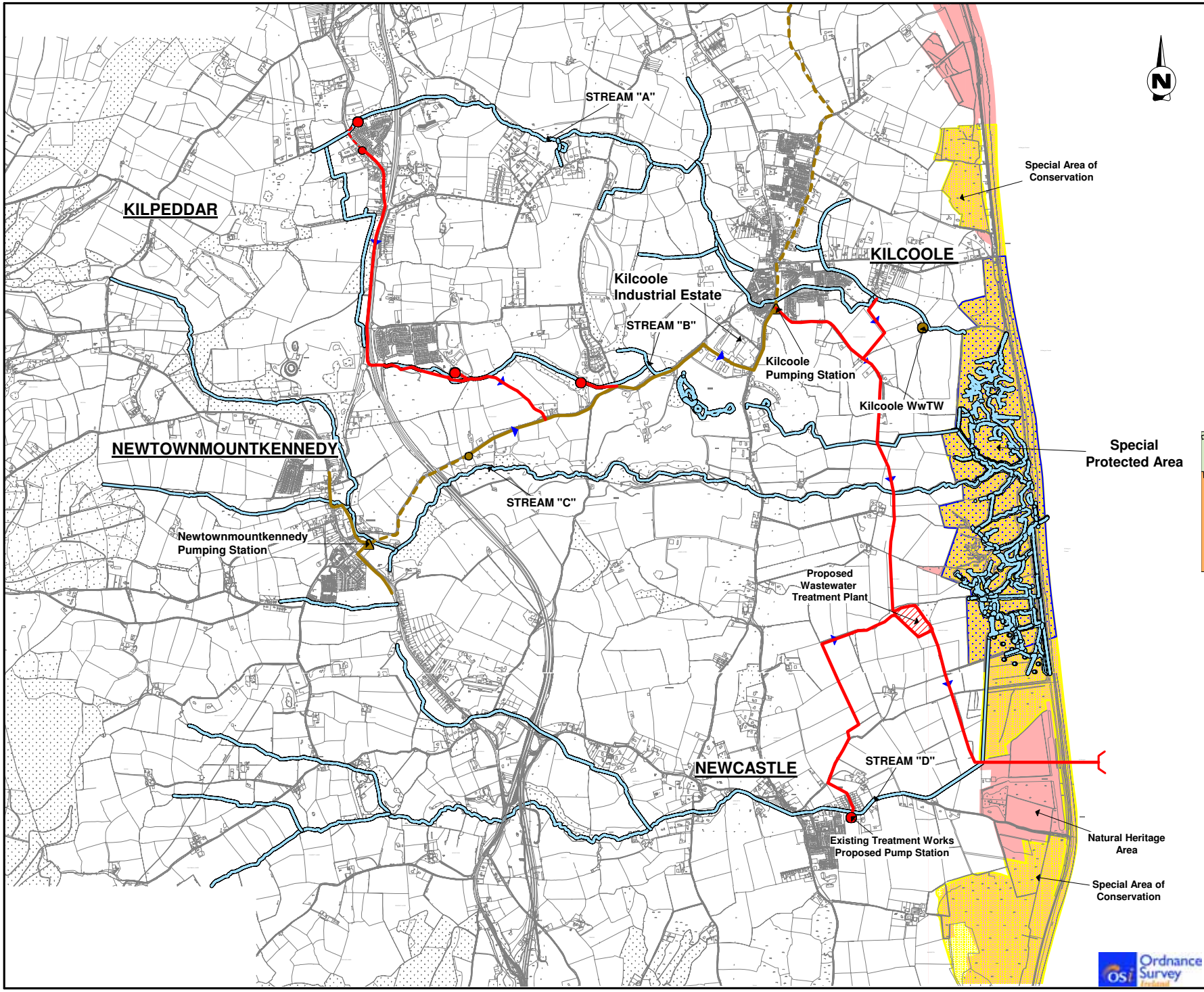
2.2 EXISTING ENVIRONMENT

The area under study borders the Irish Sea east coast. The shoreline is separated from the land area by the Dublin-Wexford railway line. The beach area is an important amenity and conservation area with a narrow strip of sand dunes, a rich dunes ecology and, in particular, a habitat for protected "Little Tern" populations, which reside there in season.

The four small rivers draining the catchment area, **(Figure 2.1)** are characterised as follows:

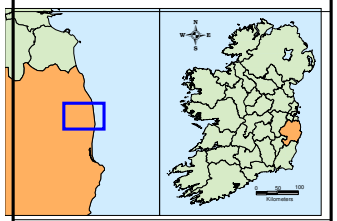
- **Stream A** is the most northerly stream, which drains the Kilpedder and Kilcoole areas. This receives the treated effluent discharge from the Kilpedder package type treatment works, immediately west of the N11, and also receives the discharge from the Kilcoole treatment works to the east of the town. Because of the low base flows in the stream, it is significantly polluted at these locations
- **Stream B** flows through Newtownmountkennedy Demesne and via Garden Village, Kilquade, Druids Glen and Kilcoole Golf Clubs, to the Kilcoole marshes. It receives effluent at Garden Village and Kilquade Hill.
- **Stream C** is a larger stream which drains a hilly catchment to the west of Newtownmountkennedy with two significant branches converging near the town before flowing under the N11 and through a steeply sloping wooded valley to the Kilcoole marshes. It receives the effluent from Newtownmountkennedy, with minimal treatment, resulting in significant pollution at this point
- **Stream D** drains the catchment to the south of Newtownmountkennedy including Killadreenan, before flowing easterly through Newcastle, to the Kilcoole marshes, receiving the effluent from Newcastle wastewater treatment works to the east of the village.

In 1992 and 1993, there was extensive sampling of these streams and further sampling was carried out in 1999 and 2005. The results confirmed that the treatment plants of Kilpedder, Kilcoole and Newtownmountkennedy cause significant pollution of the receiving waters. The Kilpedder and Kilcoole plants, which provide extended aeration treatment, were not operating satisfactorily, with only limited reduction in BOD_5, ammonia and phosphate. The Newtownmountkennedy plant has since been decommissioned and flows are transferred to Greystones WWTW via Kilcoole under the Interim Scheme.



Legend

- NTMK Interim Gravity Sewer
- Interim Scheme Rising Main
- Proposed Scheme Gravity Sewer (indicative)
- Area Stream Locations
- Special Areas for Conservation (SAC)
- Special Protection Areas (SPA)
- Natural Heritage Areas (NHA)



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Project
Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title

Location Plan

Figure 2.1

RPS mcos
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie

Issue Details			
Drawn:	DB/SK	Project No.	MDW0135
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In 1999 the river water quality reflected the discharges from these plants and was highly polluted downstream in each case (see **Appendix A**). Flow and chemical parameter measurement at the outfalls to the marsh suggested average daily loadings of 120kgs of BOD_5 per day (population equivalent = 2,000), 21kgs of ammonia (as N) and 11.7kgs of phosphate (as P). These results are something of an underestimation, since the package plants to stream B were not discharging, when the samples were taken. Water quality results for 2005 are presented in Chapter 11 and **Appendix A**.

2.3 KILCOOLE MARSHES AND BEACH ENVIRONMENT

The Kilcoole Marshes comprise an inter-tidal area, which is cut off from the sea by the railway line. It is subjected to normal tidal exchange when the outlet at "The Breaches" is open. Because of the mobility of the beach, the breaches are regularly closed by south easterly storms. At these times, the fresh water levels rise until they are balanced by seepage through the sands. As a result, the area can be occasionally converted to a freshwater lake.

The Kilcoole marshes, between Kilcoole and Newcastle, are a proposed Natural Heritage Area (NHA). Between Kilcoole station and Leamore Lower, the marsh area is a designated Special Protection Area (SPA). In this area, the ecology and environment must be protected and this designation would effectively prohibit major development work, unless absolutely unavoidable. Further south, the area bordering on the railway line is generally designated as a Special Area of Conservation (SAC) for which some development constraints also apply. The NHA, SPA and SAC are all shown on **Figure 2.1.**

Over the years, the area of the marshes has been reduced by the construction of embankments and other drainage protection works. This has considerably diminished the area affected by tides. To the south of the SPA area, the land is used for a private airstrip and the particular marsh ecology and its associated flora and fauna are not in evidence.

Between the railway line and shore line, there is a narrow strip of sand dune. The sand dune area varies in width from approximately 35 metres to the north of "The Breaches" to less than 15 metres to the south. Although not extensive, surveys indicate a number of plant species considered to be local, or only locally frequent in Ireland.

The inter-tidal area of the marshes has been much reduced by the drainage and embankment works carried out, as already noted. The main area remaining is in the vicinity of "The Breaches" and the North Channel. Moving away from "The Breaches," the limited saltmarsh ecology gives way to a more typical fresh-water ecology. The saltmarsh infauna recorded in the surveys, while limited in its diversity, provide important sources of foods for birds such as Red Shank and Curlew. The organic loading to the marshes contributes to the productivity of the area. Upgraded wastewater treatment will reduce the organic loading, but is unlikely to alter the ecological characteristics.

Bacteriological analysis of the coastal waters showed only marginal contamination arising from the wastewater discharges. Nevertheless, the discharge of untreated or partially treated sewage to the marshes has the potential to cause local bacterial contamination at Kilcoole beach, particularly in the vicinity of the "Breaches".

2.4 EXISTING INFRASTRUCTURE

2.4.1 Newtownmountkennedy Sewerage System

The old treatment works at Newtownmountkennedy has been decommissioned and flows have been transferred to Kilcoole via a new pumping station in Newtownmountkennedy constructed as part of the interim scheme. No additional area is being serviced by the interim scheme, so the Garden Village

estate is still being served by its own package treatment plant the operation of which was described as being less than satisfactory in the 1999 Preliminary Report.

The Interim Scheme replaced the existing treatment works with a new pumping station transferring flows to Kilcoole from where flows are further pumped to Greystones WWTW.

2.4.2 Kilcoole Sewerage System

In Kilcoole, the southern half of the village, including the industrial estate, is now serviced by the new pumping station constructed under the interim scheme which transfers around 750m^3/day to Greystones WWTW including 400m^3/day from the Kilcoole catchment. The northern portion of the village is still being serviced by the existing extended aeration treatment plant at Kilcoole. The design capacity of this plant is 3,000 P.E., which was overloaded prior to the commissioning of the Interim Scheme. It now treats at around 2,100 P.E. and continues to discharge to the sensitive Kilcoole Marshes, which may cause breaches of water quality at Kilcoole beach.

2.4.3 Kilpeddar

A package treatment works services the Glenview housing development and receives pumped flows from ribbon development alongside the N11. The Preliminary Report noted that sampling of the stream into which this plant discharges indicates minimal treatment with pollution of the stream during low flows.

The Laneswood development in Kilpeddar East is serviced by septic tanks.

2.4.4 Kilquade Hill

A package treatment plant services a housing estate in Kilquade. The 1999 Preliminary Report reported evidence of minimal treatment before discharging to the stream.

2.4.5 Newcastle

A relatively new extended aeration treatment plant services the village satisfactorily, but will not accommodate future expansion over the design horizon. The package treatment plant requires desludging almost daily at present.

2.5 REGIONAL DEVELOPMENT SUMMARY

The total flows expected within the study area is summarised in **Table 2.1** as follows:

Table 2.1: Total Flows Expected within the Study Area

	2003 Total Load (PE)	2023 Total Load (PE)	Dry Weather Flow (m^3/d)	Dry Weather Flow (l/s)
Newtownmountkennedy	3,164	9,874	2,149	24.9
Kilcoole	3,412	6,515	1,336	15.5
Newcastle	851	1,833	368	4.3
Kilpeddar/Kilquade Hill	633	3,687	787	9.1
Total	**8,060**	**21,909**	**4,641**	**53.7**

The predicted 2023 population equivalent for the region, including all residential, commercial, institutional and industrial development is 22,000 p.e. This compares with a current equivalent population of 8,000 p.e. Therefore, the development needs demonstrates a requirement to treat up to 22,500 P.E. by 2023.

2.6 SUMMARY

Based upon this review of future loadings in the Study area, the following situations will arise:

(i) By 2007, the loading from Newtownmountkennedy, Kilcoole and environs will be around 12,000 P.E. (excluding Kilcoole TW and Newcastle). Therefore the transfer pipeline from Kilcoole P.S. to Greystones WWTW will be at capacity (10,000 PE. - 12,000 P.E.). The loading from the Greystones/Delgany catchment will be around 20,000 P.E. bringing the total load to Greystones WWTW to around 32,000 P.E.

(ii) By 2016, the loading from Newtownmountkennedy, Kilcoole and environs will be around 17,000 P.E. (excluding Kilcoole treatment works and Newcastle). Projected loading from the Greystones/Delgany catchment will be around 25,000 P.E. Therefore the total load to Greystones WWTW will be around 42,000 P.E. which is greater than the capacity of the treatment plant's outfall (i.e. its ultimate design capacity).

Therefore, by 2007, the capacity of the transfer pipeline will be reached, and the capacity of the Greystones treatment works will be exceeded. The future load estimates for the Region are shown in **Table 2.2**.

Table 2.2: Future Load Estimation (PE)

	2007	2016	2023
Greystones/Delgany	20,000	25,000	29,000
Newtownmountkennedy / Kilcoole[1]	12,000	17,000	21,000
Newcastle & Kilcoole WWTW	3,000	3,500	4,200

Note 1: Assuming no additional treatment facilities are provided in the short-term, all existing package plants to be decommissioned and transferred to the sewerage network and development areas are to contribute at the stated levels.

3 DESCRIPTION OF THE SCHEME

3.1 TREATMENT PLANT LOADING AND STANDARDS

The development of the treatment plant at Leamore will be implemented in two stages as follows:

- **22,500 population equivalent;** to incorporate full secondary treatment based on primary sedimentation, aeration and final settlement prior to discharge.
- **Ultimate 45,000 population equivalent;** involving duplication of the main treatment elements and upgrading of effluent pumping to cater for the ultimate situation.

An indicative layout of conventional treatment at the Leamore site is shown in **Figure 3.1**. At this stage, this must be regarded as indicative only and is not meant to preclude other treatment process and configuration options, which may prove more economical following a procurement process.

The design loadings at each stage are shown in **Table 3.1:**

Table 3.1: Treatment Plant Loads

Stage	Design Load (P.E.)	BOD (kg/d)	Flows (l/s)			Comment
			DWF	3 x DWF	Max	
1	22,500	1,350	53	159	201	Secondary Treatment
2	45,000	2,700	106	318	324	Ultimate Design

Effluent standards are based on the Urban Wastewater Treatment Regulations for plants discharging to Marine Waters, not classified as sensitive. These are:

BOD_5 - less than 25mg/l

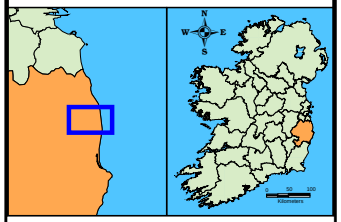
Suspended Solids - less than 35mg/l

Chapter 4 examines the bacteriological impact of discharging of effluent, following secondary treatment, to the marine waters. The length of outfall has been selected to satisfy relevant standards without further treatment such as disinfection.

3.2 DESCRIPTION OF TREATMENT PLANT

The treatment plant at Leamore will comprise a variety of process options to satisfy the effluent standards required by the Urban Wastewater Treatment Directive for normal conditions, BOD_5 of 25mg/l and suspended solids of 35mg/l. The treatment plant should include the following elements:-

- **Preliminary treatment;** to comprise inlet pumping, stormwater balancing, removal of screenings to a 6mm maximum size, grit removal and flow measurement. This element of the works is generally common to all options, sized for the phase 1 flow of 22,500 population equivalent, but with civil works suitable for duplication of the equipment at ultimate capacity
- **Secondary treatment;** comprising a variety of options with conventional plant including primary settlement, activated sludge and final settlement tanks designed for carbonaceous BOD



Wicklow County Council

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Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title

INDICATIVE LAYOUT OF TREATMENT PLANT

Figure 3.1

RPS mcos
Innishmore
Ballincollig
Co. Cork
Phone: 021-4872996
Fax No. 021-4872997
info@cork.mcos.ie

Issue Details			
Drawn:	TGB	Project No.	MCE 0209
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removal without nitrification or denitrification. This element of the works would be constructed as a modular two or four stream process, with initial development for 22,500 population equivalent and ultimately of double that capacity

- **Sludge handling and treatment;** The Sludge Management Plan for County Wicklow recommends that sludge arisings from the Newtownmountkennedy/Kilcoole area be dewatered on site and transported to the proposed Wicklow Hub Centre for sludge treatment.

3.2.1 Preliminary Treatment Works

In general, the preliminary treatment works should be designed to cater for the ultimate throughput with pipe sizes, channels and tanks constructed accordingly. In this case, the following elements are needed:

- **Storm water balancing:** flows in excess of the maximum treatment capacity, must be balanced and recirculated for treatment. Initial capacity of 400m³ is proposed with a facility for its future duplication if necessary. Storm water balancing tanks would be provided with cleaning equipment (tipping bucket or equivalent) and recycle submersible pumps (duty and standby) sized at approximately 60l/s each. An emergency 600mm overflow pipe should be provided, with a capacity of at least 300l/s to be protected by 6mm screens to cater for flows in excess of the treatment and storage capacity (major storm condition) or emergency overflow due to plant failure.
- **Screening plant**: 6mm mechanically raked screens are proposed, with two units in parallel at ultimate load, each rated at 200l/s. Screenings washing and compaction plant would be incorporated to produce a baled clean screenings end product, suitable for storage on site and disposal to landfill.
- **Aerated grit trap:** the provision of an aerated grit trap unit is recommended to trap heavy grit particles which would be intercepted, washed and stored in a suitable receptacle for disposal. A single unit is recommended.
- **Flow measurement:** Inlet flow measurement should comprise a flume or parallel flumes which could be used to divide flow between plant streams. The maximum capacity should be 318l/s, with flows in excess of this value overflowed to storage.

A compact design of the preliminary treatment works is necessary, in order that the pumping and screening plant can be accommodated within a preliminary treatment building, where air extraction and odour treatment facilities would be provided to avoid odour nuisance frequently associated with wastewater inlet works.

3.2.2 Secondary Treatment

The development of the plant is likely to be specified in terms of performance standards in a Design/Build contract format, by means of which alternative process options could be tendered for evaluation and selection of the Most Economically Advantageous Option.

At this stage, therefore, indicative design options are outlined as a basis for technical, economical and environmental appraisal and to establish boundary conditions for the works. **Figure 3.1** shows a conventional activated sludge plant, with primary sedimentation, activated sludge treatment and final clarifiers.

The typical performance criteria and requirements are summarised in **Table 3.2**

Table 3.2: Treatment Process Summary – Conventional Design

Unit	Criteria	Phase 1	Phase 2
Storm Water Balancing	2 hours x DWF	400m³	400m³ added
	300 l/s Overflow Capacity	600mm Overflow pipe	
Screening Plant	6mm at 0.5 m/s	200 l/s Unit & Bypass	200 l/s Unit
Aerated Grit Trap	2 minutes	20m³ Unit	-
Flow Measurement	Flume	Up to 360 l/s	-
Primary Settlement	1.2m/hr	2 x 187.5m∅ Tanks	2 x 17.5m∅ Tanks
Activated Sludge	MLSS = 3500 mg/l BOD_5 = 945 kg/d F/M = 0.15 O_2 Ratio 2.5:1	Vol. = 1620m^3 O_2 = 96kgs/hr	Duplicate
Final Clarifiers	1.0m/hr	2 x 20m ∅	2 x 20m ∅
Dewatering Plant	20% Dry Solids	500kgs D.S./hour	Possible Duplicate
Disposal Unit	2 days sludge	20m^3	40m^3

Provided primary sludge is drawn off in a closed system and channels and surfaces are well maintained, this plant should not produce unacceptable odours at or in the vicinity of the plant. With diffused aeration and mechanical mixing systems, the operation of the activated sludge plant can be optimised to suit the actual loadings from day to day, including seasonal variations and the affects of weather conditions such as temperature. Online monitoring would be incorporated to assist in process control (suspended soils, MLSS, dissolved oxygen etc).

3.2.3 Sludge Disposal

The objective of sludge treatment is to achieve stabilisation by digestion of the putrescible element, destruction of pathogens and substantial reduction in volume to make it suitable for re-use or disposal. The Sludge Management Plan for County Wicklow recommends that sludge treatment hub centres be located at Wicklow and at Greystones WWTW, however the plant at Greystones is a stand-alone plant and will not accept imported sludge.

Dewatering facilities will be incorporated into the design of the Leamore WWTW with the dewatered sludge then transferred by road to Wicklow hub centre for treatment and disposal.

As a minimum, the following facilities are required in the phase 1 development of the plant:-

- The provision of effective de-watering plant, either beltpress or centrifuge technologies, to produce a minimum 15% solids concentration cake, suitable for transportation offsite. This

plant would require holding tanks, positive displacement pumps and polyelectrolyte conditioning for effective de-watering. The stage 1 throughput (22,500 PE) is estimated at 2000 kg dry solids equivalent per day.

- A disposal unit or container for a minimum of two days sludge should have the capacity of 20m³ volume in phase 1 and double that capacity in phase 2.

The design of these sludge treatment elements must avoid open surfaces, whereby foul odours would be released to the atmosphere. This calls for a compact design, building enclosure and air extraction and treatment, in order to meet the odour control standard considered appropriate.

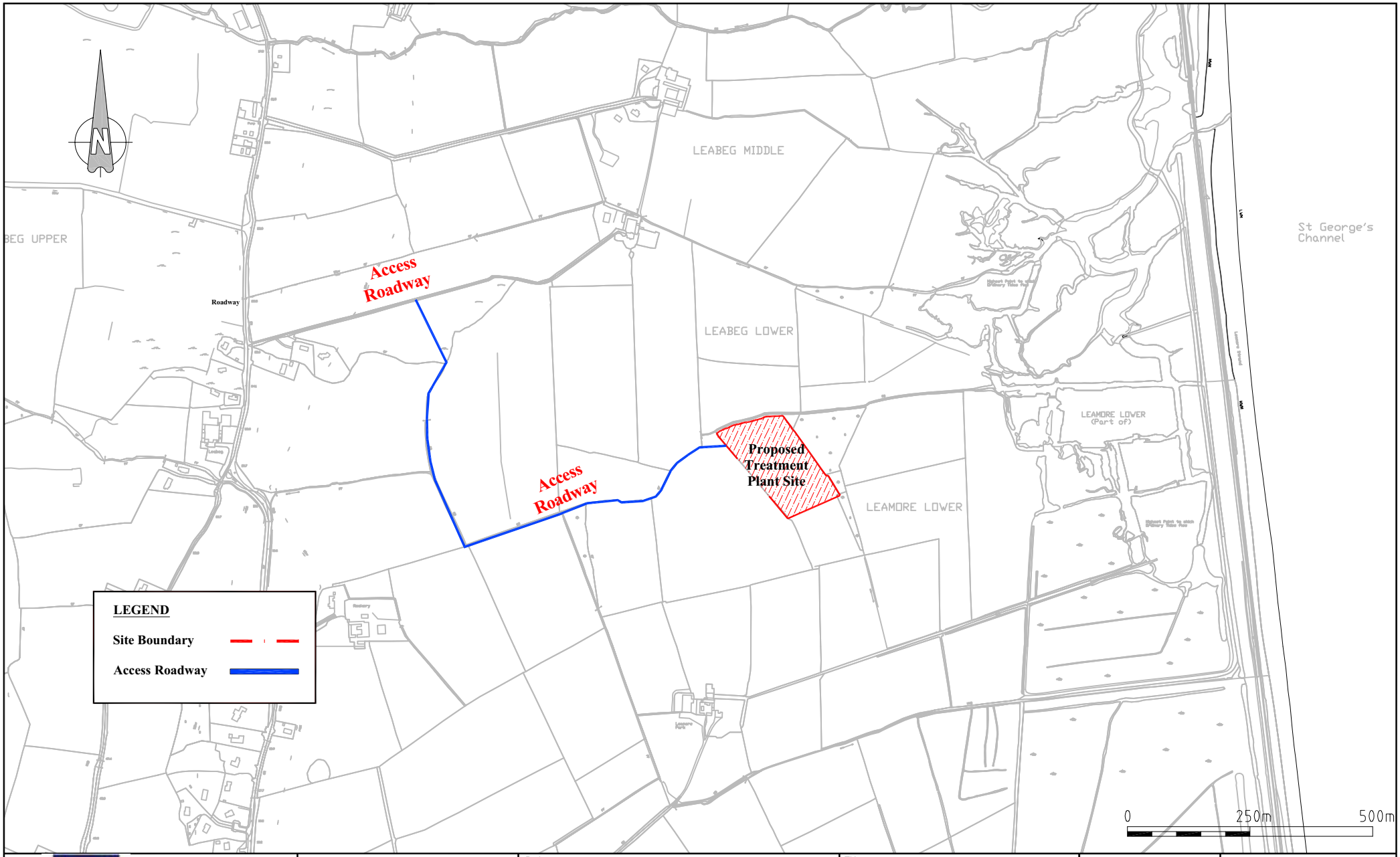
3.2.4 Associated Development

Apart from the foregoing treatment elements, the following associated development is required at the treatment plant:

- Long sea outfall
- Sewer network to transfer flows to the plant
- Development of the access road from the public road to the plant as indicated in **Figure 3.2**
- Secure fencing to site boundaries and entrance gate with circulation roads and pathways throughout the site
- Provision of services including power, telephone, site drainage, water supply to meet the needs of the site
- Landscaping plans to improve screening to the site boundaries in order to preserve amenity
- Odour treatment to meet the air quality standards required within the site and in its vicinity.

3.3 SUMMARY

To summarise, a central treatment plant is proposed at Leamore to cater for the Newtownmountkennedy/Kilcoole catchment. The site and the proposed treatment facilities have been selected to ensure that adverse environmental impacts are minimised and are not significant. The plant can be developed in stages to suit the loading from the catchment with disposal of effluent through a marine outfall to the Irish Sea.



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RPS MCOS
RPS-MCOS Ltd., West Pier Business Campus, Dun Laoghaire, Co. Dublin, Ireland.
T: +353 1 288 4499 - F: +353 1 283 5676
E: rpsmcos@rpsgroup.ie W: www.rpsmcos.ie

Project: Newtownmountkennedy & Kilcoole Sewerage Scheme

Title: Location Plan of Treatment Plant

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4 PROPOSED MARINE OUTFALL

4.1 OUTFALL LOCATION

The proposed treatment plant will require a long sea outfall to discharge final treated effluent from the plant in an environmentally sound manner. In 1992-93, preliminary investigations were carried out for an outfall from the proposed treatment plant at Leamore directly to the Irish Sea. These investigations included a number of marine boreholes, marine modelling and calibration surveys (dye surveys, drogue surveys and current speed measurements). A detailed description of this work is contained in **Volume 2, Appendix A.**

Two options were considered and arising from the designation of the Kilcoole marshes as a Special Area of Conservation supported by ecological surveys which have identified areas of particular sensitivity from the point of view of wild bird populations (notably the little tern), it was necessary to revise the route to a location approximately 1km to the south (outfall no. 2, **Figure 4.1**). In light of the environmental studies, this route was considered to have a significantly less adverse environmental impact and therefore was chosen as the preferred option.

This chapter examines the environmental and physical aspects of the outfall site. In designing the outfall the relevant standards are summarised in **Table 4.1**

Table 4.1: Relevant Standards

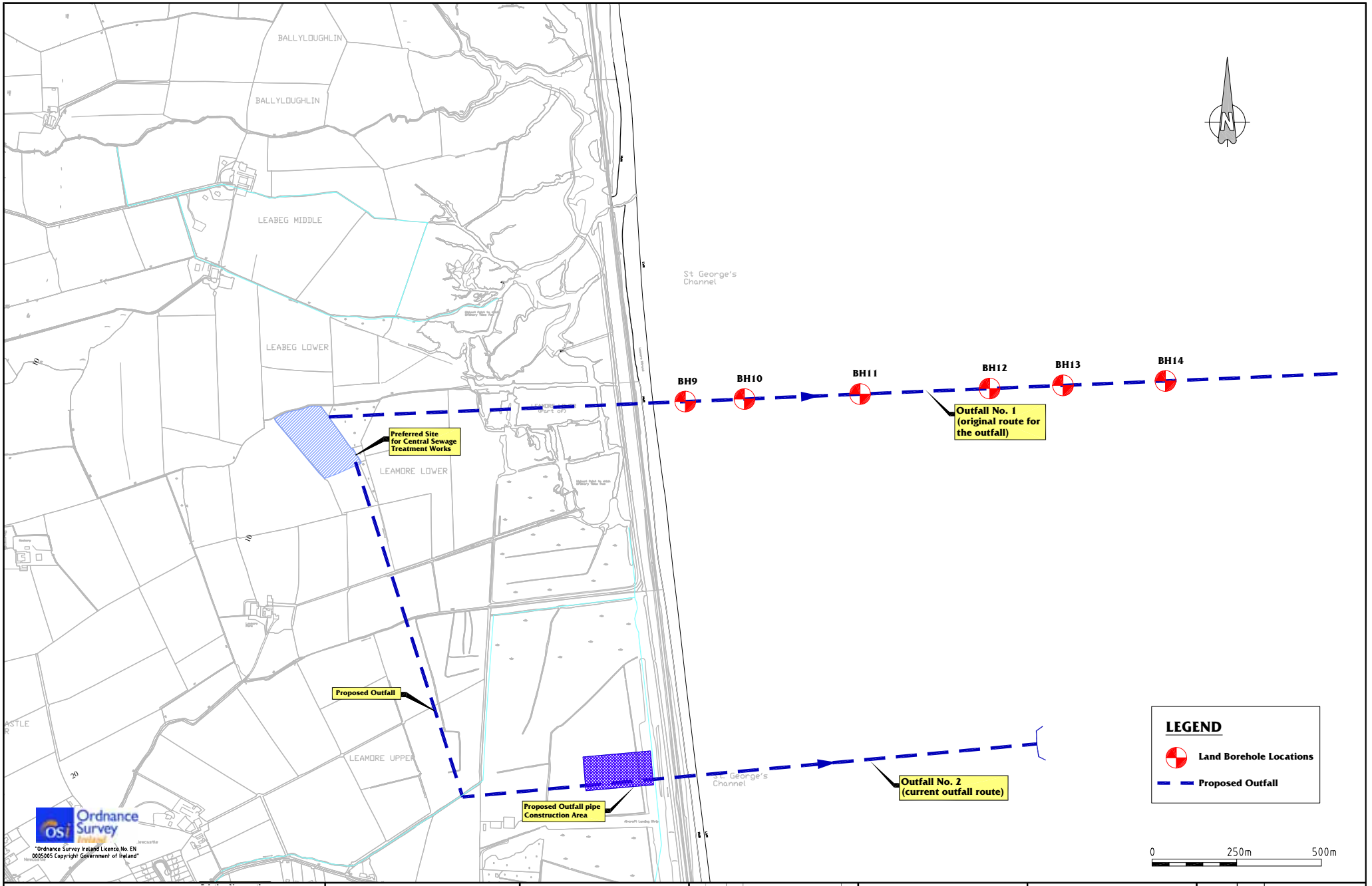
Ref.	Description	Comment
91/271/EEC	Urban Wastewater Treatment Directive	25/35 Effluent Standard from 2005
79/923/EEC	Shellfish Waters Directive	Bacterial/Metals Standards
76/160/EEC	Bathing Waters Directive	Bacterial Limit and Guideline Standards
NLV (1979)	D.O.E. Bathing Water Standards	
Shellsan	Dept. of Marine, Shellfish Waters, Hygiene Standards	
Blue Flag	EU Sponsored Beach Monitoring Programme	Equates to Guideline Standards

Note: Desirable Standard of faecal coliform level below 100 per 100ml in all conditions, including combined impact of outfalls at Bray, Greystones, Wicklow etc.

4.2 ENVIRONMENTAL STUDIES

Comprehensive hydrographic, geotechnical and environmental studies were carried out in 1992 and updated in 1999 to facilitate the technical and environmental assessment of the proposed outfall. The current validity of the modelling studies was examined by Irish Hyrodata who carried out the work and their comments are included in **Appendix A, Volume 2**. The study area is shown in **Figure 4.1**. These studies had the following objectives:-

- To provide comprehensive hydrographic data for the routing and design of a marine outfall
- To assess the environmental baseline conditions along the land and foreshore pipeline sections
- To provide preliminary geotechnical data along the pipeline route



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Comhairle Chontae Chill Mhantáin

RPS MCOS
RPS-MCOS Ltd., West Pier Business Campus, Dun Laoghaire, Co. Dublin, Ireland.
T: +353 1 288 4499 - F: +353 1 283 5676
E: rpsmcos@rpsgroup.ie W: www.rpsmcos.ie

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D01	March '05	DRAFT	JC

Project: **Newtownmountkennedy & Kilcoole Sewerage Scheme**

Title: **Location Plan of Outfall Options**

Drawn by:	D.B.	Job No:	MDW0135
Checked by:	A.G.	File No:	MDW0135SK0109D01
Approved by:	J.C.	Drg. No:	Fig. 4.1
Scale:	1:10,000 @ A3	Rev:	D01
Date:	March '05		

- To examine the dispersion of effluent in the marine waters at various discharge locations including the development of a calibrated model which could reliably predict these affects for a full range of tidal and weather conditions. The technical studies prepared by Irish Hydrodata Limited are provided in technical reports in **Appendix A, Volume 2** attached to the Environmental Impact Statement.

The baseline environmental studies of the marine waters and benthos are summarised as follows and discussed further in Chapter 11.

- Ecological benthic surveys showed a number of community types associated with the gravel/sand/silt matrix. Inshore, the community was typical of gravel – stone substrates, including a large number of attached and mobile epibenthic species. Further offshore, the substrate consisted of mobile sand waves, with a typical low diversity community present. The possible effects of treated wastewater discharge on these communities would only be discernible on a local scale, if at all, due to the high current regime in the area. The diversity of filter-feeders could possibly be slightly enhanced, due to the increased availability of food particles.
- Water quality conditions in the marsh waters vary considerably depending on whether "The Breaches" are open or closed and the state of the tide. With "The Breaches" opened, measurements indicated BOD_5 levels in the range 2-4mg/l with moderate levels of phosphates and nitrates. When they are closed due to strong south-easterly winds, the marsh volumes will have retention times ranging from 1 to 10 days or more, during which changes in water quality could be anticipated associated with algal growth. The effect of the proposed scheme, however, will be to substantially remove the pollution load from the marshes, apart from very infrequent stormwater or emergency overflows.
- The shoreline fronting Kilcoole marsh forms a typically steep coarse beach similar to that extending along the coastline from Wicklow Town to Greystones. Boreholes have shown fine to coarse rounded or sub-angular gravel overlying soft silt strata for some 3m and 4m typically. As a whole, this shoreline is relatively stable, though localised areas of erosion of up to 1.5m per annum have been recorded. Storm wave action associated with North-east, East and South-east winds would cause significant mobility of the beach sands outside the railway line of Kilcoole marsh. This has the affect of closing "The Breaches" from time to time, effectively impounding the marshes. The offshore limit of significant sediment movement was considered from the studies to coincide approximately with the –6.0m contour, which is approximately some 160m from the railway track. Therefore, it is prudent to regard the initial 200m strip of foreshore as having a significant degree of mobility with the seabed relatively stable beyond that limit.
- Bacteriological analysis of marine waters at two sites on the foreshore, close to the outlet from the marshes, indicated relatively low levels of bacteriological contamination. Nevertheless, elevated total and faecal coliform counts were identified on 9th November, 1992, which are evidence of some degree of impact from the sewage load entering the marshes, upstream.
- Samples of mussels were taken from three seabed dredges and analysed for total and faecal bacterial levels. The sites were between 600m and 1250m from the shoreline and indicated that the samples would be considered fit for human consumption without the need for depuration or processing in accordance with EC Directive 91/492/EEC. A more extended sampling period would be necessary to draw firm conclusions about the microbiological condition of shellfish stock, however. Nevertheless, these results point to good water quality conditions for shellfish in the area.

To summarise, baseline surveys indicate clean water quality and ecological conditions in the marine waters off Kilcoole marshes. Surveys of the surface streams and of the marsh waters themselves confirmed the impact of upstream sewage discharges, though the water quality has recovered significantly by the time it reaches the marshes proper. Minor contamination was identified in the shoreline marine waters close to the outlet from the marshes. The principal issues arising for the proposed scheme, therefore, are:

- The optimum location for effluent discharges in order to protect water quality in the marsh.

- The impact of beach mobility between the railway line and a point approximately 200m offshore, for the construction and general stability of the outfall.
- Minimising the impact on the terrestrial and dune ecology at the crossing point.
- The scheme should have a significant beneficial effect on water quality in Kilcoole marshes by removing the existing foul sewerage discharges, with only periodic stormwater overflows occurring in the future.

4.3 MARINE GEOTECHNICAL CONDITIONS

A total of nine marine boreholes were carried out along the original route selected for the outfall at the locations shown in **Figure 4.2** (directly offshore from the treatment plant site). Briefly, these boreholes indicated the following:

- **Borehole No. 9;** 90m offshore at seabed level –5.0 showed silty fine to coarse sandy gravel with occasional thin layers of sandy clay overlying stiff silty clay at 5m depth.
- **Borehole No. 10;** 265m offshore at –8.0m depth, showed firm grey silty clay and sandy gravel of 1m depth overlying brown silty clay with some sand and coarse gravel.
- **Borehole No. 11;** 607m from the shoreline and –9.8m depth, indicated shallow layers of fine to coarse gravel and silty clay overlying fine to coarse sand with some silt and gravel to 4.5m depth overlying stiff sandy clay.
- **Borehole No. 12;** 990m offshore at approximately –11.8m depth, indicated soft grey silty clay to 2.2m depth overlying medium to coarse sandy gravel.
- **Borehole No. 13;** 1207m offshore at –12.9m depth, indicated medium to coarse sandy gravel, ultimately changing to coarse sand below 2.7m depth.
- **Borehole No. 14;** at 1510m offshore and –15.1m depth, indicated medium to coarse sandy gravel over fine to medium gravelly sand to 3.9m, overlying silty clay at 3.9m with silty fine sand and fine sandy silt to stiff silty clay at 6.2m.

These geotechnical conditions represent a generally suitable environment for the construction of a marine outfall subject to the following provisos:

- The outfall should be relatively deep in order to cross under the railway line at the foreshore and this will ensure that it is below the levels of the mobile beach materials in the upper sections of the beach. Soft silt is indicated underlying the gravels in this area requiring special tunnelling techniques.
- Generally, the pipeline should be suitably weighted in order to ensure stability against buoyancy and the action of marine currents.
- It would be appropriate to backfill over the pipeline in a stable rockfill material, capable of resisting bed forces due to vigorous tidal currents during storm conditions.

In summary, the dense granular soils and stiff gravelly clays will provide a competent founding medium for the pipeline.

4.4 NUMERICAL MODELLING OF MARINE DISCHARGES

Numerical modelling of the marine environment was carried out to facilitate the selection and assessment of effluent discharges from a variety of outfall lengths. The extent of the area considered in the modelling studies was sufficient to include the combined impacts of the existing outfalls serving

Wicklow, Greystones and Bray (**Figure 4.2**). Note was also taken of the Shanganagh outfall, to the North of Bray with its significant effluent load.

Extensive field surveys were carried out to enable the marine model to be developed and calibrated. These surveys included the following:-

- Bathymetric surveys in the vicinity of the outfall to confirm sea-bed profile and levels.
- Measurement of current speed and direction at fixed sites for calibration purposes.
- A number of drogue tracking surveys were carried out to confirm speed, direction and travel journey with respect to outfall sites. **Figure 4.3** shows the typical results of these surveys.
- Dye release surveys were similarly carried out with concentration measurements to provide calibration data for the dispersion modelling. Typical results of the dye release surveys are illustrated in **Figure 4.4**.

The detailed results and interpretative reports resulting from these surveys are included in the Technical Appendices contained in Volume 2 of this Environmental Impact Statement. These results were used in verification of the models described below.

A 2D coastal dispersion model was established using the following data:

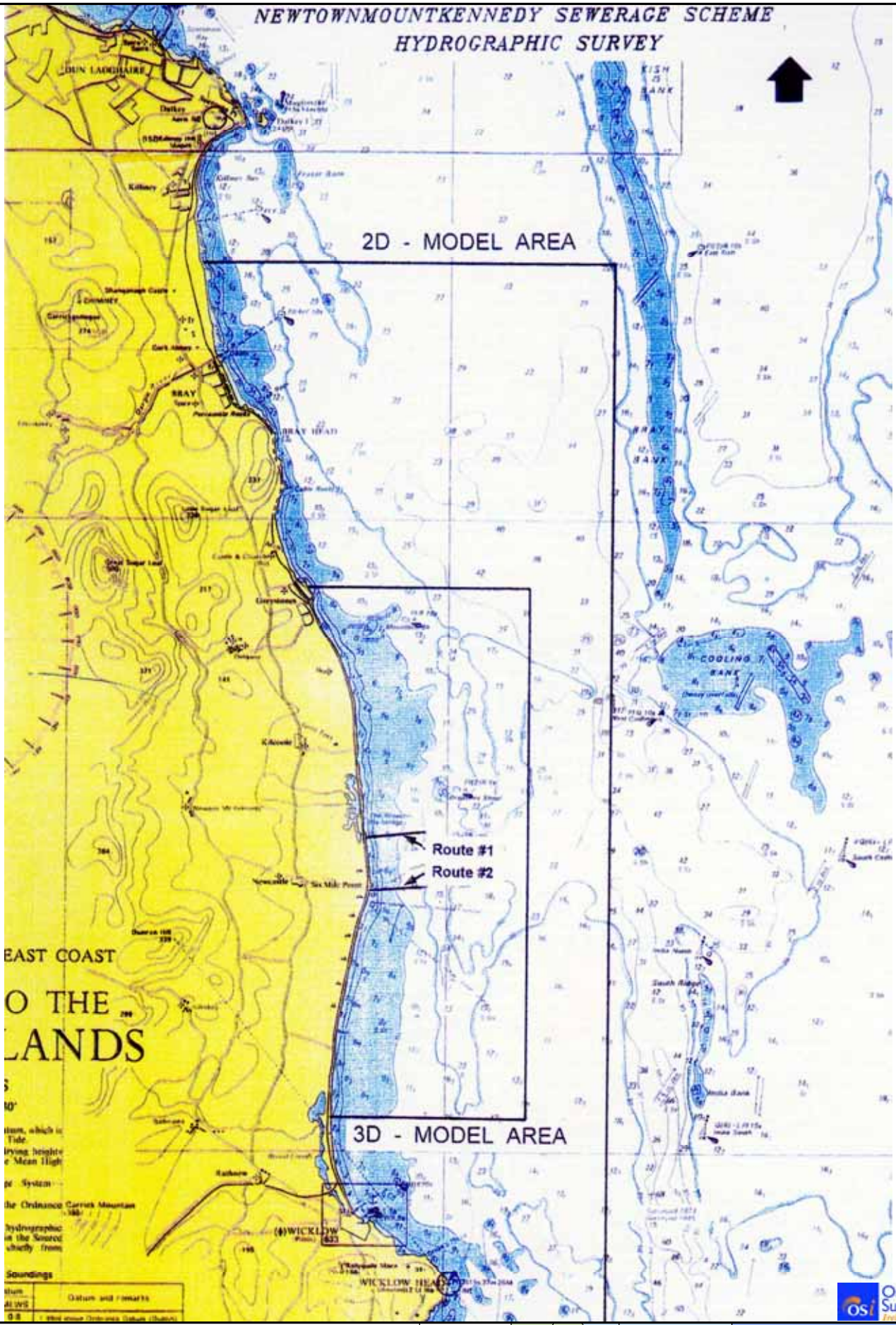
- Bathymetric data taken from Admiralty Chart data and related to Irish National Grid (ING) co-ordinates, supplemented by local field data.
- Tidal height data used measured data from Wicklow, Greystones and Kilcoole and from admiralty type tables.
- Data on currents in the nearshore area covered by the three outfall survey reports previously carried out by Irish Hydrodata Limited in relation to Bray, Greystones and Wicklow Town projects. These were supplemented by the direct reading surveys at fixed stations and drogue tracks which gave the speed between successive fixes. Further offshore, current data was taken from Admiralty Charts.
- Wind conditions for a worst case analysis were taken as equivalent to a 7m/s onshore wind which is considered to have an exceedance of approximately 1%, which would comply comfortably with the 5% failure limit set in the Bathing Water Regulations.

In addition to the 2D model, a 3D coastal circulation and dispersion model was established to examine specific cases (Kilcoole outfall and onshore wind) in order to confirm the validity of the 2D results. The calibrated 3D model provided estimates of effluent concentrations at different layers within the water column, whereas the 2D model provides only depth averaged estimates of concentrations at each location in plan. Both models were calibrated using the field data summarised above.

Faecal coliform concentrations were used as the contamination indicator with a value of 100fc/100ml as the target standard under adverse conditions. The 2D and 3D model results were consistent, confirming the overall reliability of the predictions. A maximum outfall flow rate of 360 litres/second (for 45,000 P.E.) was used, assuming normal secondary treatment.

For the Kilcoole outfall, the modelling indicated that a 1000m long outfall would result in shoreline coliform concentrations well below the 100fc/100ml target. The values would be negligible at the shoreline for calm conditions and for adverse onshore wind, the peak values would remain below 50fc/100ml. An 800m long outfall gave marginally higher values, remaining within the target standard.

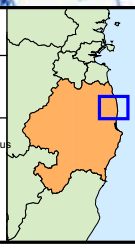
When the combined affect of the proposed and existing outfalls was considered, appreciable increases in concentration were noted. In calm weather, peak levels were indicated at 70fc/100ml with onshore wind conditions giving rise to maximum value of 120fc/100ml. The Greystones outfall is primarily responsible for the increased concentrations in the Kilcoole area. Modelled concentrations of faecal

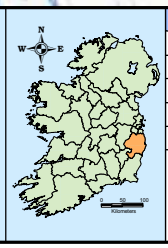


Project	*Newtownmountkennedy & Kilcoole Regional Sewerage Scheme*	**Figure**	**4.2**
Title	**Outfall Model Survey**		

Wicklow County Council

RPS mcos
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie





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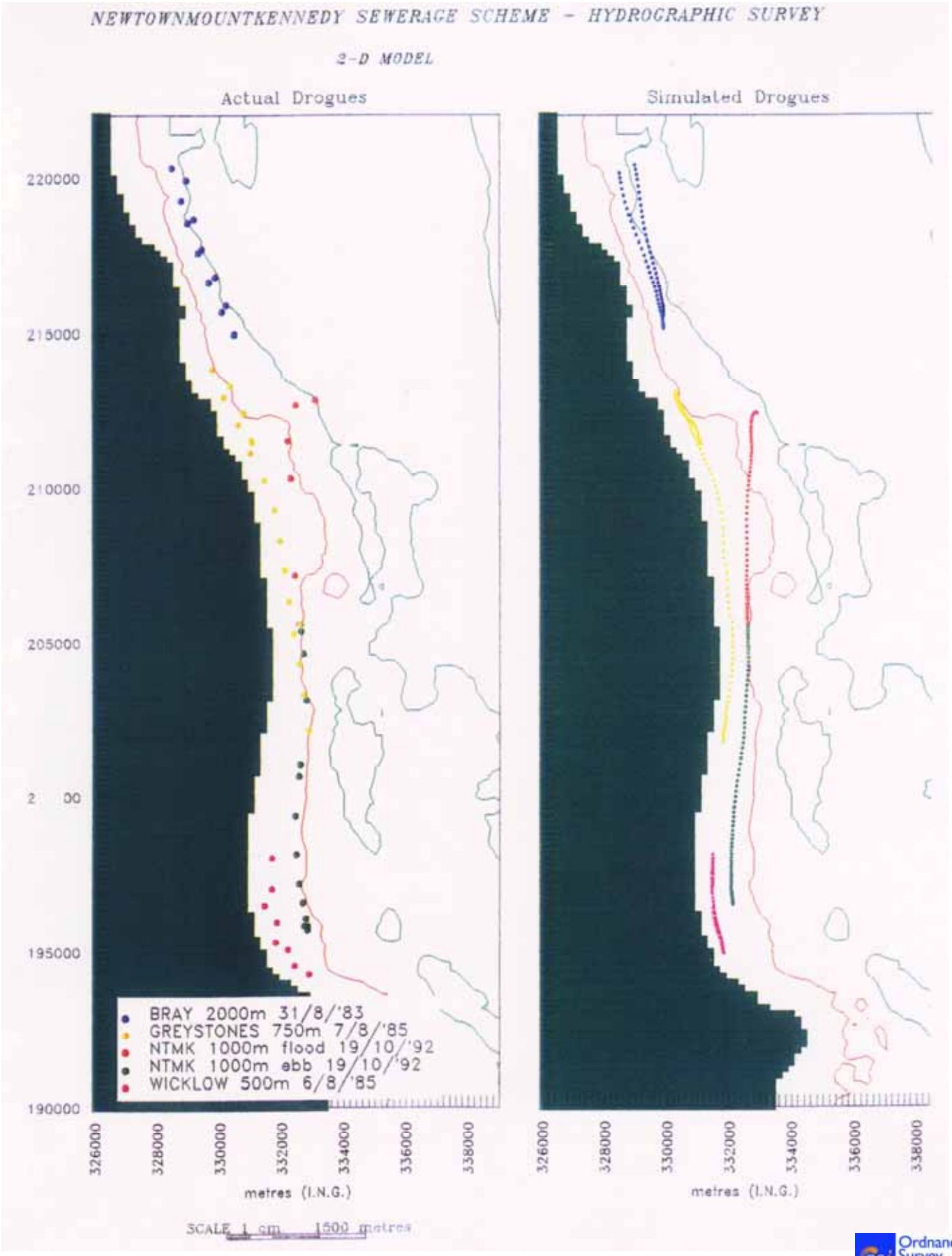

Project	*Newtownmountkennedy & Kilcoole Regional Sewerage Scheme*	**Figure**	**4.3**
Title	**Drogue Survey Result**		

Wicklow County Council

RPS mcos
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie

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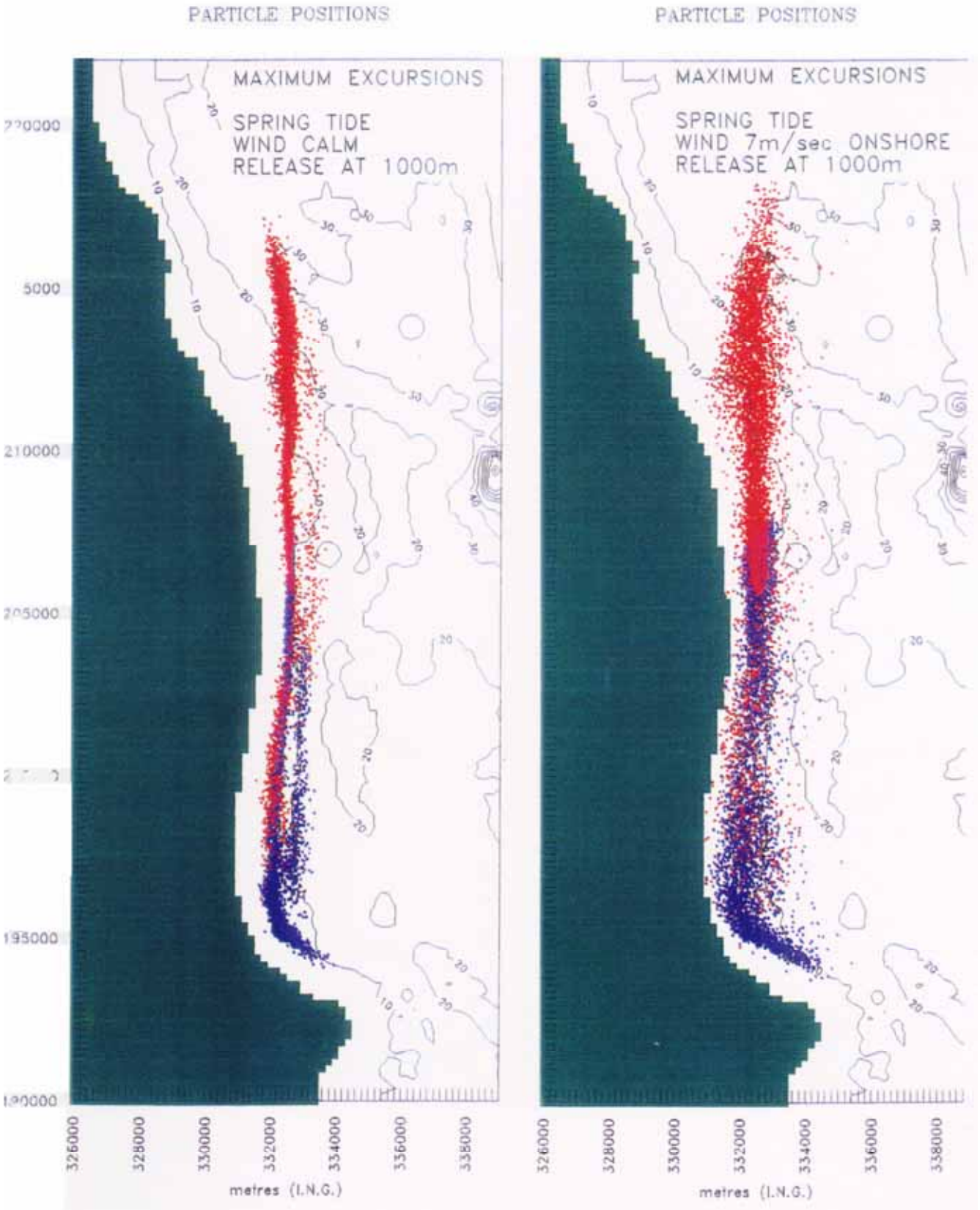
NEWTOWNMOUNTKENNEDY SEWERAGE SCHEME - HYDROGRAPHIC SURVEY



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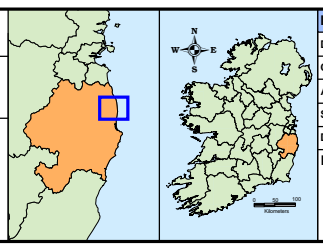
Project	*Newtownmountkennedy & Kilcoole Regional Sewerage Scheme*	**Figure**	**4.4**
Title	**Dye Release Survey Results**		

Wicklow County Council

RPS mcos
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie



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coliforms for the combination of outfalls and neap tide conditions are illustrated in **Figure 4.5** and **4.6** for model runs of 18 and 24 hours respectively. These graphically illustrate the results in terms of concentration bands.

The seabed area of Kilcoole contains several important seed mussel shellfish beds and is also fished for mature whelks. The field work and model predictions have shown that the plume from the proposed outfall will remain relatively compact and travel along a line parallel to the coast. Simulations of the vertical mixing in the far-field (greater than 1500m from the discharge point) suggests that bacterial concentrations near the seabed and along this line will not normally be greater than 50fc/100ml. Higher levels may occur closer to the outfall for short periods during the tidal cycle. However, as these have no affect on seed mussels, which are harvested for re-laying in other waters, they are not considered significant in determining the outfall length.

The near field dynamics of the effluent plume were considered using a jet discharge model and indicated that initial dilutions will be approximately 1 in 450 for mean flow conditions. For short duration slack water conditions, approximately 1 in 60 dilutions would be achieved over short periods.

In summary, the modelling studies indicate that a 1000m long outfall will perform satisfactorily under calm and adverse wind conditions and taking into account the combined effects of other outfalls at Greystones, Bray and Wicklow Town. Under most weather conditions, shoreline coliform concentrations will not exceed 50fc/100ml and during calm weather conditions no contamination will be recorded within 200-400m of the coast. While an 800m long outfall would also be generally satisfactory having regard to the standard, the longer length extends further east than the track of the Greystones plume, thereby minimising the combination effects. The outfall length of 1000m, therefore, is recommended as providing an increased factor of safety.

The model predictions are based on a decay time of 12 hours which is realistic for Irish Coastal Waters, though a lower value could be expected during warm and sunny summer conditions. This is a conservative approach. Onshore wind conditions are considered for a fairly extreme situation (7m/s wind) which would occur for less than 1% of the time.

Water depth at the 1000m discharge location is approximately 12m at mid-tide. A jet dilution model indicates that an initial dilution of 1 in 50 can be achieved with a ten port diffuser at slack water. Slack water periods are relatively short and speeds below 0.1m/s are normally only experienced for about 20 minutes. Under mean flow conditions of 0.4m/s, the predicted dilution is 1 in 450. These conditions would be very satisfactory.

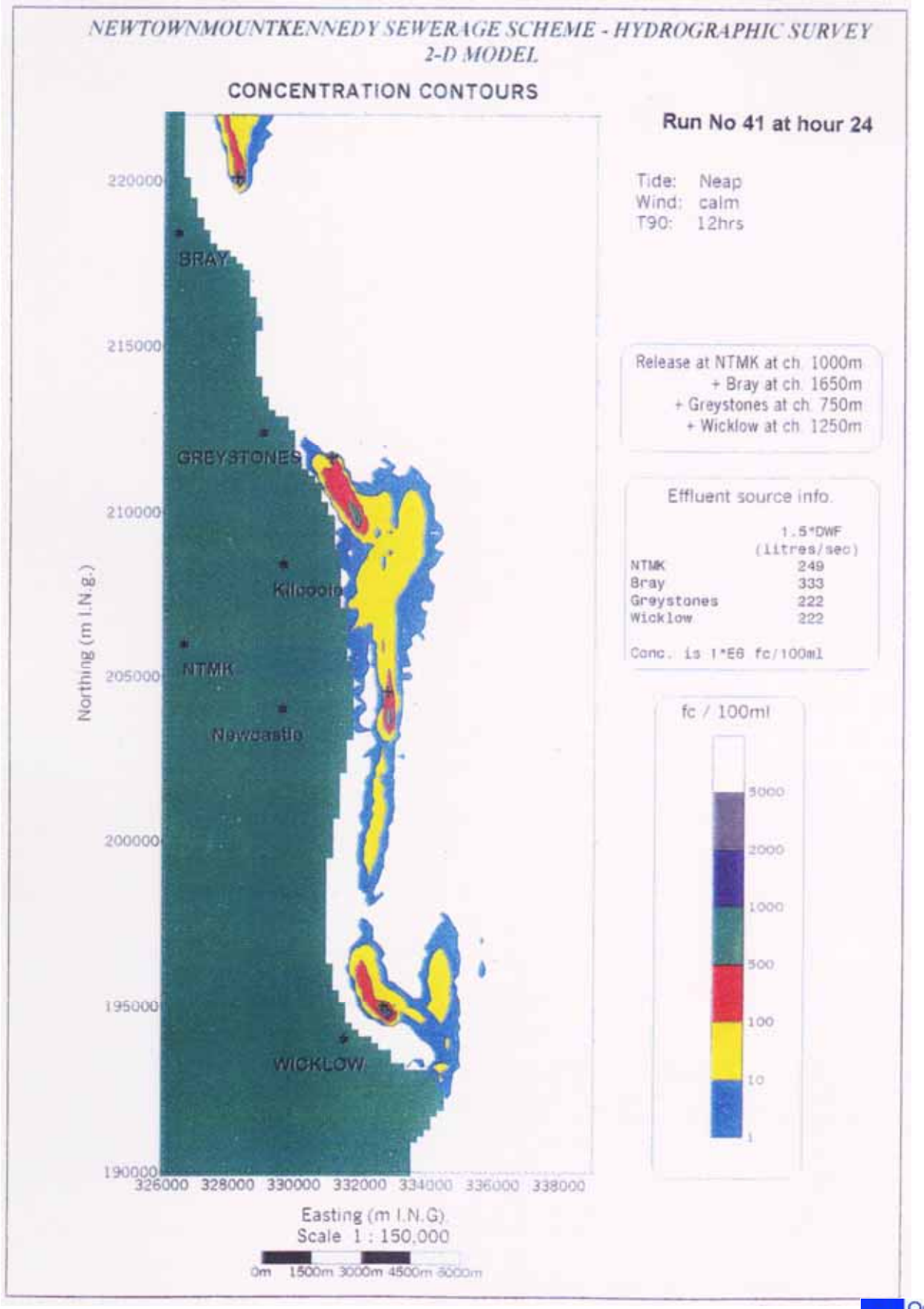
4.5 OUTFALL CONSTRUCTION

The 600mm outfall pipeline from the treatment plant outlet to the Newcastle stream crossing, adjacent to the railway line, would be constructed in conventional open-cut using a pipeline rated for pressure conditions to 7.5 bar. A second pipeline (600mm diameter overflow) would be laid in the same trench to deal with excess storm flows, overflowed from the stormwater balancing tank after screening.

The 600mm outfall pipeline would be laid under the bed of the Newcastle stream in an open-cut construction. Temporary dams would be constructed to either side, with a connecting temporary pipeline to maintain flows. The pipeline would be laid to a thrust shaft between the stream and the railway embankment.

The following sequence of operations would be required for the construction of the outfall pipeline:-

- A man-entry tunnel (900mm diameter) would be constructed under the railway line and continuing under the dunes in the upper foreshore area to a temporary receiving pit on the Kilcoole beach. This would be constructed as a thrust bore operation using suitable high

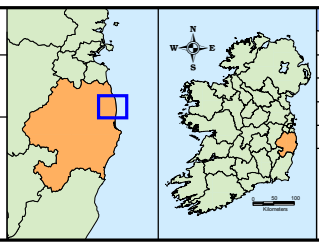


Ordnance Survey Ireland

Project	*Newtownmountkennedy & Kilcoole Regional Sewerage Scheme*	**Figure**	**4.5**
Title	**Modelled F.C. Concentration for Combined East Coast Outfalls at 18 hours**		

Wicklow County Council

RPS mcos
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie



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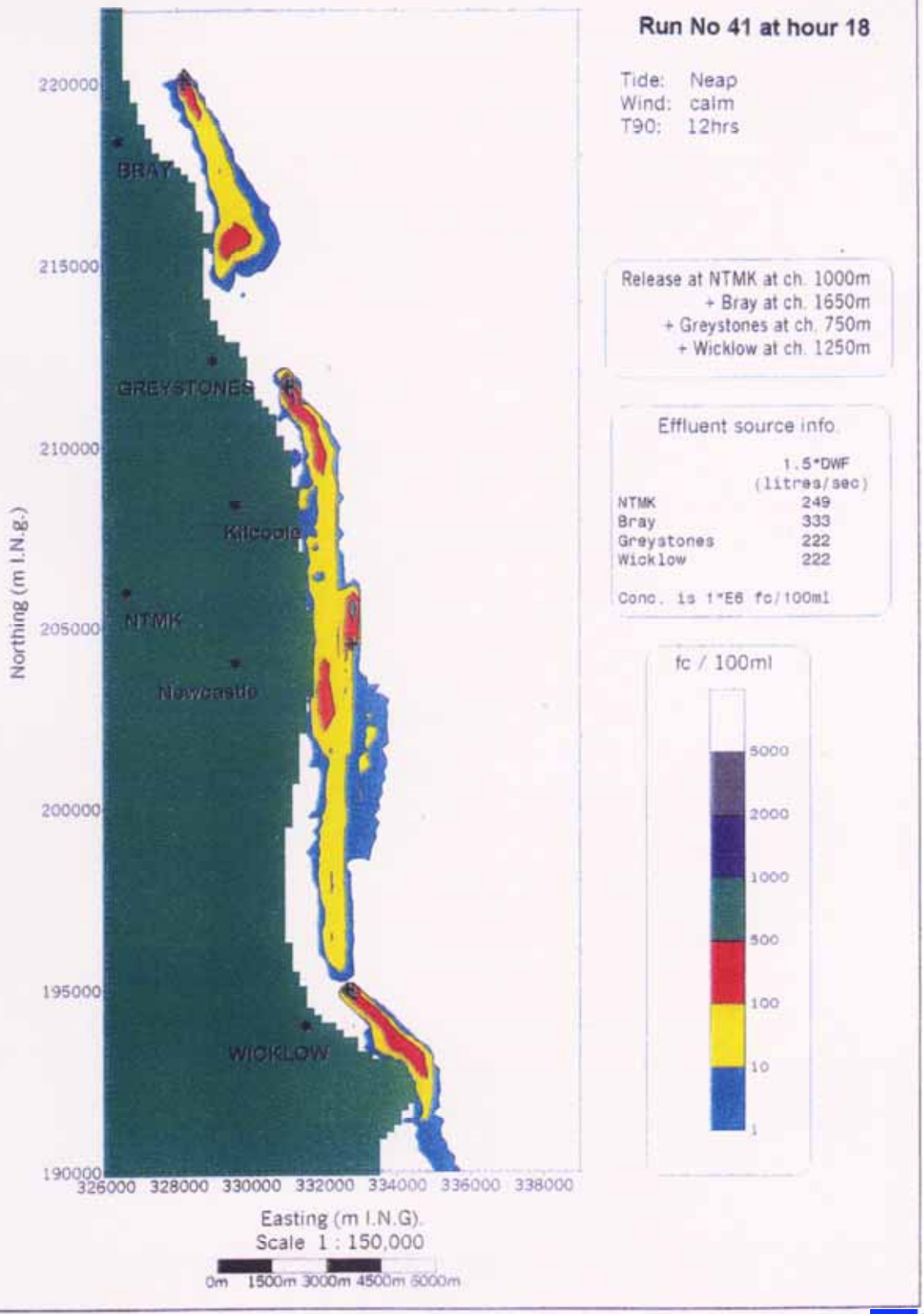
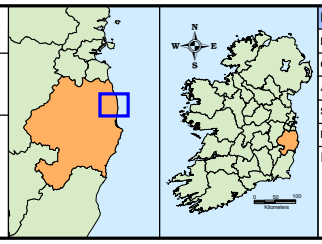
NEWTOWNMOUNTKENNEDY SEWERAGE SCHEME - HYDROGRAPHIC SURVEY
2-D MODEL

CONCENTRATION CONTOURS



Ordnance Survey Ireland

Project	*Newtownmountkennedy & Kilcoole Regional Sewerage Scheme*	Figure	4.6
Title	**Modelled F.C. Concentration for Combined East Coast Outfalls at 24 hours**		



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RPS mcos
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie

strength pipes. Tunnelling techniques to deal with soft silts and overlying gravels would be required. This may include advance stabilisation, full face support or other measures.

- A temporary construction site on the western side of the Newcastle stream/railway line would be required for the duration of the contract, in which the 600mm pipeline would be fabricated in strings, aligned on suitable running tracks with the tunnel and prepared for pulling out to the final position.
- A trench would be dredged to the levels and profile indicated in **Figure 4.7** to accommodate the pipeline. It is likely that this trench would have side slopes in the range 1:3 to 1:5, depending on the soil characteristics, in order to achieve a reasonably stable trench.
- When the trench is ready to receive the pipeline, a pulling operation using suitable tugs would be used to winch the pipeline from the fabrication area to the trench. At the beach, the pipeline would be fitted with buoyancy aids in order to reduce the effective weight of the pipeline during the pulling operation. Strings would be added to the pipeline progressively, until the full 1,000m length is launched and in position.
- At the head of the outfall pipe, the diffuser would be attached prior to final pull at Kilcoole beach or alternatively installed underwater using suitable jointing techniques.

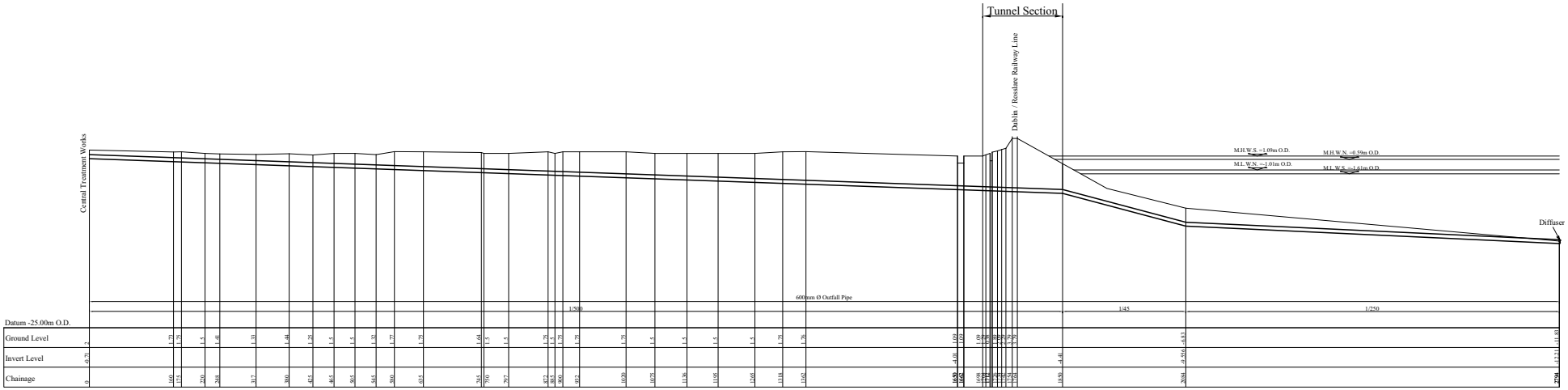
When the pipeline is in position, the buoyancy aids would be removed and the pipe stabilised at the correct profile and position. A stone backfill would then be placed to surround and cover the pipeline.

Given the tidal environment at the site, physical recovery of the seabed strata would be expected within a relatively short time. Experience would also indicate that the biotic communities would similarly recover within a matter of months.

The pipeline route and construction sites have been selected to minimise adverse environmental impact, particularly on the more sensitive environments in the area. The pipeline is to the south and outside of the Special Protection Area (SPA). Some impacts will be experienced locally on the beach area due to the need for construction plant and some construction operations. However, this would be very localised and would not significantly impact on the sand dunes in the area. At the chosen site, the width of dunes is a minimum compared with that to the north, in particular.

4.6 SUMMARY

To summarise, the effluent from the proposed Kilcoole wastewater treatment plant serving Newtownmountkennedy and the regional area, would be discharged through approximately 3,000m of 600mm outfall pipeline, extending some 1,000m from the shoreline to discharge at approximately 12m water depth at mid-tide conditions. The landward section would be constructed in a conventional trench along the route indicated in **Figure 4.1**. The marine section would be constructed in a dredged trench by Bottom-Pull Method, with fabrication on land and pulling of the completed pipeline through a specially constructed tunnel under the railway line into position and backfilling below seabed level.



Longitudinal Section of Sea Outfall

Client:

WICKLOW COUNTY COUNCIL
Comhairle Chontae Chill Mhantáin

RPS-MCOS Ltd., West Pier Business Campus,
Dun Laoghaire, Co. Dublin, Ireland.
T: +353 1 288 4499 - F: +353 1 283 5676
E: rpsmcos@rpsgroup.ie W: www.rpsmcos.ie

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No.	Date	Amendment / Issue	App.
D01	March '05	DRAFT	JC

Project:

Newtownmountkennedy & Kilcoole Sewerage Scheme

Title:

Longitudinal Section of Proposed Outfall

Drawn by:	D.B.	Job No:	MDW0135
Checked by:	A.G.	File No:	MDW0135SK0110D01
Approved by:	J.C.	Drg. No:	Fig. 4.7
Scale:	N.T.S.	Rev:	D01
Date:	March '05		

5 ALTERNATIVES CONSIDERED

5.1 REGIONAL SEWERAGE TREATMENT OPTIONS

The existing sewerage infrastructure in the study area is limited to local collection systems in each settlement with varying levels of treatment. Environmental monitoring has indicated that the streams in the area suffer significant pollution from inadequately treated sewage discharge. In turn, the streams discharge to Kilcoole marsh, where the impact appears to be relatively minor. Discharges from the marsh to the Irish Sea through "the Breaches" pose a risk of bacteriological contamination of the marine shoreline waters.

Given the small flows in the river system, the protection of water quality would require that any sewage effluents would have a very high level of treatment. In considering future treatment needs, the development potential of the area, based upon the Strategic Planning Guidelines for the Greater Dublin Area and the current development policies of the County Council must be taken into account. This requires consideration of a strategy which can achieve an integrated overall solution which is best suited to the regional needs as well as flexibility for development in the long-term. This requires that pumping and treatment systems would be capable of modular expansion as the need arises.

The options for upgrading of the sewerage systems in the light of these considerations are:-

5.2 CONTINUE TO TRANSFER FLOWS TO GREYSTONES WWTW

Greystones WWTW currently treats around 17,543 P.E. from Newtownmountkennedy, Kilcoole and Greystones/Delgany. By 2007, this is expected to increase to around 31,442 P.E. which will exceed the plant's capacity of 27,000 P.E. Therefore an alternative treatment strategy should be formulised now to accommodate these additional flows.

Further treatment capacity can be provided by increasing the modular wastewater treatment and sludge digestion capacity of the plant to 30,000 P.E. Core elements of the plant are capable of dealing with 30,000 P.E. This option will provide short-term capacity for future population and industrial growth within the catchment. However, due to the capital investment required for such an upgrade, it may be more economic to upgrade both the sludge digester and sludge treatment plants to the ultimate capacity of 40,000 P.E. having regard to ongoing development potential of Greystones/Delgany.

If the existing Kilcoole WWTW and the various package plants are maintained in operation, the interim scheme could accommodate the balance of the flows to 2007 with treatment at Greystones WWTW. Therefore this option is seen only as a short-term expedient and will continue to damage the sensitive receiving environment by allowing the unsatisfactory treatment plants to discharge into local watercourses.

5.3 UPGRADE LOCAL SEWERAGE TREATMENT FACILITIES

The effluent standards required for discharge to the stream network and to protect the marine waters at Kilcoole cannot readily be achieved locally since the package treatment plants at Kilpeddar and Garden Village currently operate at an unsatisfactory standard. Moreover, the flexibility required to meet the range of present/future loads would be very difficult to satisfy. Operational costs would also be excessive for separate plants located close to the individual settlements. Therefore their immediate inclusion into the public sewerage system is considered essential.

Similarly, the treatment works capacity at Kilcoole and Newcastle are inadequate for medium term conditions and their flows would have to be dealt with.

5.4 NEW TREATMENT WORKS AT LEAMORE

The 1999 Preliminary Report recommended that construction of a new central wastewater treatment works at Leamore should be advanced on a phased basis with an initial stage being construction to a design capacity of 15,000 P.E., followed by an upgrade to 22,500 P.E. with secondary treatment at 2005, followed by final development to 45,000 P.E. as required.

From the most recent studies it is apparent that in order to cater for the regional needs up to 2016, a new treatment works with an initial capacity of 22,500 P.E. is required to be in place by 2007. This plant would be capable of servicing the regional needs for a considerable time and could accommodate all of the existing developments plus residential and commercial development as indicated by the adopted settlement strategy. A future Stage 2 development option to duplicate the major treatment works elements on a modular basis would increase the ultimate capacity for the treatment works to 45,000 P.E.

The design loads for a two stage development at Stage 1 and 2 are summarised in **Table 5.1.**

Table 5.1: Design Loading Requiring Treatment - Summary

Stage	Flow (l/s)			Treatment Works P.E.	BOD (kg/day)
	DWF	3 DWF	4.5 DWF*		
Stage 1	54	161	204	22,500	1,350
Stage 2	107	322	402	45,000	2,700

* 3DWF at Pumped Areas

It is proposed that trunk sewers will be sized for up to 4.5 times dry weather flow, giving an ultimate discharge capacity into the works of 402 l/s. However, by combining storm water balancing with the treatment plant, the maximum hydraulic loading on the plant and outfall would be restricted to 322 l/s.

During 2007, on commissioning of Stage 1 of the new treatment works Newtownmountkennedy and Kilcoole can be expected to contribute 8,863 P.E., under the collection system scheme recommended within the 1999 Preliminary Report (see Chapter 6) this would increase to around 11,555 P.E. once the treatment plants at Kilpeddar, Kilquade, Garden Village and Kilcoole were decommissioned. It is estimated that by 2023, the load on the Leamore WWTW will be around 23,582 P.E. so an initial capacity of 22,500 P.E. would probably be reached around year 2021.

Once the Leamore WWTW has been commissioned in 2007, flows to Greystones WWTW from the Greystones/Delgany catchment will be around 20,000 P.E., leaving significant residual capacity for development in the Greystones/Delgany catchment if the transfer pipeline is decommissioned and loads transferred to Leamore WWTW.

5.5 SITE SELECTION

The provision of a new central treatment plant suitably located in order to discharge to the Irish Sea in the Newcastle/Kilcoole area is the recommended option.

In the siting of a central treatment plant, the following constraints must be taken into account:-

- The foreshore area incorporating Kilcoole marshes and extending to North and South and including the beach area comprises a proposed Natural Heritage Area part of which is designated as a Special Area of Conservation. Furthermore, from Kilcoole station south to

Leamore, the marshes area is designated as a Special Protected Area, due to its unique ecology and bird life.

- The shoreline area is generally low-lying with significant views from Kilcoole and from the railway line.
- Based on experience in the area, it would be desirable to site any new treatment plant as far as possible from existing developments in order to minimise objection to nuisance such as visual intrusion, odour, noise or other adverse impacts of a wastewater treatment plant. Avoidance of these nuisance issues would simplify the design, management and operation of a central wastewater treatment works.

Taking account of these constraints, the following site options were considered:

- Expansion of the existing Kilcoole treatment works with the construction of the marine outfall to the North of the Special Protected Areas in the vicinity of the Kilcoole station.
- A central location at Leamore between Kilcoole and Newcastle on a site which is well screened by existing woodland with local access from the Kilcoole – Newcastle Road and very removed from the existing settlements.
- Expansion of the Newcastle treatment works site.

The Kilcoole option is technically feasible if a site was obtained immediately to the northeast of the existing works. The development of a large central treatment works at this location would give rise to significant objection due to its relative proximity to Kilcoole, where the existing treatment plant has been the source of complaint and would be difficult to screen from Kilcoole station and from the shoreline generally. An outfall would be required through the SPA in the vicinity of the railway station, which would be strongly objected to, particularly by Birdwatch Ireland who own a site in this area and through whose land the outfall would require to be laid

The Newcastle option would give rise to similar objections and would suffer from the significant disadvantage that the bulk of the flows would have to be carried in a large trunk sewer to the southernmost point of the catchment, where it would have to be pumped to treatment.

The Leamore site is located approximately midway between Kilcoole and Newcastle and between the main road and the foreshore. This offers a number of advantages for a central treatment plant to serve the Newtownmountkennedy/Kilcoole/Newcastle region including:-

- A suitable site, of adequate area is identified, for a variety of treatment types, both small footprint and traditional.
- It has effective natural screening, particularly from the foreshore due to developed woodland to its northern and eastern boundaries.
- While located a significant distance from the road and all major settlements, it is readily accessed by an existing private road which can be suitably upgraded.
- It is located to the south of and outside of the Special Protected Area. It should be possible to construct an outfall through the Special Area of Conservation by conventional means. Environmental consideration, particularly of the bird communities and the existing ecology, would indicate that this location for the outfall should not adversely impact on the area.
- The site can provide for stormwater storage in excess of the treatment capacity and an emergency overflow can be provided to the watercourse adjacent to the railway line, by laying an overflow pipe in parallel with the outfall to this point.

These observations relating to the alternative sites are supported by a public consultation exercise whereby the central treatment plant at Leamore achieved general public approval. Accordingly, this site at Leamore has been selected as the most suitable site for a central treatment works to serve the region. **Figure 3.2** is a location plan showing the preferred site.

6 COMMUNITY

6.1 INTRODUCTION

This chapter examines the community in the study area and the impact if any the treatment works will have on people and community facilities. This community study was carried out with regard to EPA publications giving *Advice Notes on Current Practice* and *Guidelines on Information to be Contained in Environmental Impact Statements* (EIS) (1995, 2000 respectively). All national and local government strategies relating to landuse and economic development for the area were consulted including the current Wicklow County Development Plan.

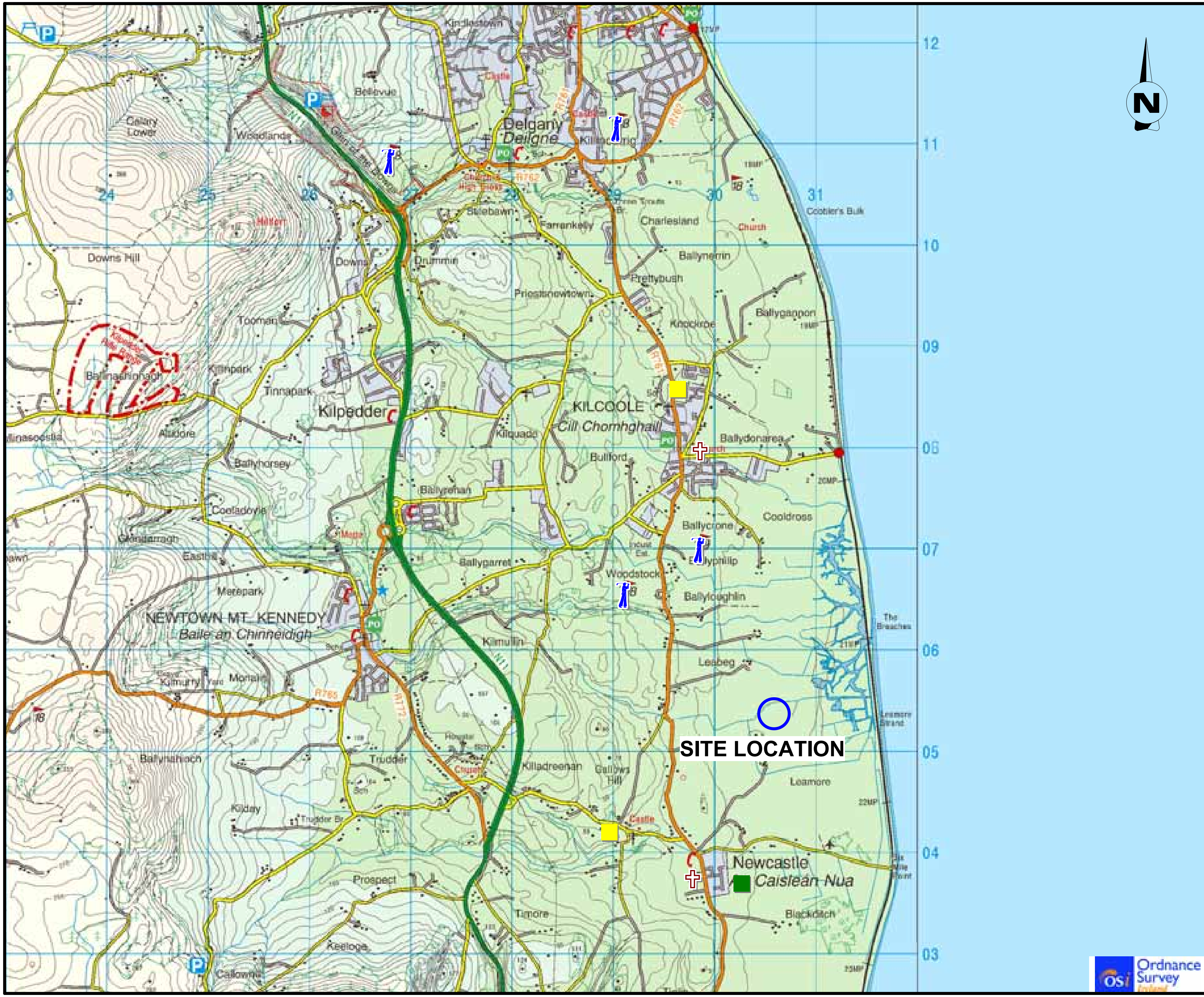
6.2 DESCRIPTION EXISTING ENVIRONMENT

The site for the proposed facility is located in farmland approximately midway between the villages of Kilcoole and Newcastle (**Figure 6.1**). It is separated from the foreshore by the railway line and will be assessed by a new road from the R 761. The beach is an important amenity and conservation area, however, the site itself is in private ownership.

The study area extends beyond the site of the proposed central treatment plant location to the communities of Newtownmountkenedy, Kilquade and Garden Village as sewage will be transferred through a sewerage network to the new treatment plant at Leamore. The catchment containing these dispersed communities is drained by four small rivers, denoted A, B, C, D.(Figure 2.1). These streams are characterised by very low summer flows, making them relatively unsuitable for effluent disposal. Furthermore, all four discharge to the Kilcoole inter-tidal marshes and from there, under the railway line at “The Breaches,” to the sea. Effluent discharge to the streams, therefore, results in the risk of pollution to the inter-tidal waters at the marshes and possible bacterial contamination of the marine bathing and recreational waters. In addition to the treatment plant the development will also involve the following:

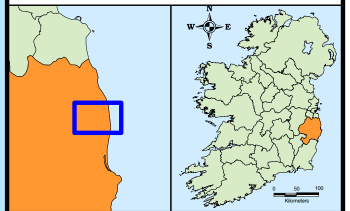
- Sewer network to transfer wastewater to the plant.
- Construction of a long sea outfall.
- Development of access road from the public road to the plant.
- Secure fencing to site boundaries and entrance gate with circulation roads and pathways throughout the site.
- Provision of services including power, telephone, site drainage, water supply to meet the needs of the site.
- Landscaping plans to improve screening to the site boundaries in order to preserve amenity.
- Odour treatment to meet the air quality standards required within the site and in its vicinity.

The current population of the area to be served by the treatment plant is 6,715 (Census, 2002) and is set to increase to 14,985 by 2023. The population centres closest to the treatment plant site are Kilcoole with a population of 2,826 and Newcastle with a population of 851 persons respectively. Both these villages have expanded significantly in recent years although expansion is currently restricted by the lack of sewerage infrastructure. The proximity to Dublin and the lack of affordable housing in Dublin has put a lot of development pressure on these village. The villages are served locally by the R 761 regional road and by the national route the N11 which is now a dual carriageway between the county boundary with Dublin and Rathnew. There are two primary school in Kilcoole (RC) and a newly constructed vocational school. There are two primary schools in Newcastle. There are GAA clubs in Kilcoole and Newcastle as well as two golf clubs in close proximity to Kilcoole.



Legend

- Playing Pitch
- Golf Course
- School
- Church



Wicklow County Council

Project
Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title
Community Facilities

Figure 6.1

RPS MCOS
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie

Issue Details

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6.3 IMPACTS AND MITIGATION MEASURES

The impacts both positive and negative of the proposed scheme on human beings and the community are considered here and are also described in subsequent chapters on air quality, noise, landscape etc. The impacts are considered under the following headings.

6.3.1 Socio-Economic

The scheme will have a positive impact on the social and economic development of the catchment through the following:

- Catering for existing and new residential developments.
- Catering for existing and new employment in the catchment area.
- Protecting and improving the marine environment through reducing bacterial load of discharge.
- Protecting and improving public health and freshwater aquatic environment by provision of adequate collection system overflow.

As the scheme will benefit the community from a socio-economic perspective no mitigation measures are required.

6.3.2 Health and Safety

The health and safety impacts/issues in terms of both residents and plant operatives include the following:

- **Site boundary and security**: secure fencing and gates will be provided to exclude members of the public.
- **Building Regulations**: Compliance with building regulations and appropriate standards in relation to the design of works for example through the provision of handrailing to 1.2 m, covers/decks where appropriate, cleaning equipment to maintain platforms and walkways, protective covers to moving parts etc.
- **Classification of hazardous/ventilation**: classification of hazardous area in buildings, appropriate zoning and specification of electrical apparatus, fixed and portable gas monitoring equipment (methane, petroleum vapours, oxygen level), with effective ventilation.
- **Hygiene facilities:** provision of hygiene facilities for operators including lockers and washing facilities.
- **Staff training**: training of operational personnel and development of a safe system of work for the plant.

6.3.3 Nuisance

The nuisance elements associated with the treatment plant include potential for odours, increased noise and traffic due to the operation of the plant. These will be mitigated as follows:

- **Odours**: High intensity odour generating areas will be covered with the foul air extracted for treatment before discharge. See **Chapter 8**.

- **Noise**: The pumping station and other plant equipment likely to produce noise will be designed to high standards to reduce any noise impact. The detailed design will incorporate noise control measures as described in **Chapter 9**.
- **Traffic**: The increase in traffic associated with the plant will be negligible. The normal operation of a treatment plant has very little traffic only about 3 vehicle movements per day associated with the operatives at the plant. A further one to two traffic movements per week will be associated with taking sludge offsite.

6.3.4 Landscape and Visual

The visual impacts are associated with possible impairment of views from the surrounding area due to the present of the facility in the landscape. This is dealt with in chapter 9.

6.3.5 Community Facilities

The site as described above is located on farm land in private ownership and does not impact directly on community facilities. The site however, is located adjacent to important recreational and conversation areas. While there will be a temporary impact from the construction of the pipeline across a Natural Heritage area the receiving environment will benefit overall from the improved quality of the discharge. In the larger study area there are no community facilities impacted by the scheme, as the proposed plant is some distance from the population centres.

6.3.6 Construction Impacts

The construction of the access road and the sewer network will have a temporary impact on landowners. The proposed access road has been selected so as to only pass through land of one single owner. Traffic accessing the site will pass in close proximity to the farmhouse and also to a house currently being built near the junction with the R 761.

The impacts are temporary and relate primarily to dust, noise and vibration and traffic. These will be dealt with at the contract stage in that the contractor will be obligated to put in place measures to reduce these impacts. Further details are contained in subsequent chapters.

6.3.7 Residual Impacts

No residual impacts are anticipated from the scheme.

7 AIR QUALITY

7.1 INTRODUCTION

Odour Monitoring Ireland was commissioned by RPS Consulting Engineers to carry out an odour impact assessment of the proposed Waste Water Treatment Plant (WWTP) in Newtownmountkennedy, Co. Wicklow. The purpose of the assessment was to determine the potential for the generation of odour impact on the surrounding vicinity from the proposed plant. The source of potential air quality impact is the odour emissions from the operation of the plant and the subsequent dispersion of any odours. The full Air Quality report is contained in **Appendix C, Volume 2**.

7.1.1 Odour Emissions and Dispersion

Odour is the sensation transmitted to the brain by the olfactory receptors in the nasal cavity when exposed to so-called odorous substances in the inhaled air. If these substances are of a malodorous nature and are present in air above a certain threshold concentration they may cause annoyance and constitute an environmental nuisance. The science of odour response measurement is known as olfactometry. Standard olfactometric methods for odour strength measurement by dilution techniques, using a panel of people operating according to standard procedures, have been developed (Frechen, 1994).

The concentration of odorants in air is expressed in odour units per cubic metre (OU/m^3). Its numerical value is quantified as the number of dilutions with clean air required to reach the odour perception threshold. The odour perception threshold is the lowest odour concentration which is detectable by half the members of a test panel (half the members do not detect any smell while the other half still smells something). At a concentration of 2 OU/m^3 an odour is faintly perceivable, at 3 OU/m^3 it is clearly perceivable while at 5 OU/m^3 is strongly perceivable and, if unpleasant, is likely to give rise to environmental nuisance. The duration of an odour is also significant. Dispersion calculations are normally based on meteorological data using mean 1-hour wind speeds, producing hourly means of odour concentration. A concentration of 5 OU/m^3 lasting 15 to 30 minutes is commonly used as the nuisance threshold. If the mean hourly odour concentration is less than 1 OU/m^3, it is unlikely that shorter duration odour concentrations will exceed 5 OU/m^3.

7.1.2 Wastewater Odours

Wastewater odours arise either through the discharge of odorous substances of industrial origin to the sewer system or from the anaerobic decomposition of biodegradable matter in the wastewater. Anaerobic biodegradation produces volatile fatty acids and a variety of reduced sulphur compounds most of which have a very low odour threshold concentration as indicated in **Table 7.1**.

Anaerobic biodegradation is inhibited in the presence of dissolved oxygen and thus does not occur while wastewaters remain aerobic. However, where there is a long residence time in the sewer system or where sewer gradients are small, resulting in low velocities and solids deposition, wastewaters are likely to become septic and malodorous. Biodegradation rates are also strongly influenced by temperature, hence odour problems are likely to be accentuated during warm weather or where industrial discharges raise the wastewater temperature.

7.1.3 Odour Emission from Treatment Processes

The rate of release of odorous compounds into the atmosphere at wastewater treatment works (WWTWs) is influenced by:

(a) the concentration of odorous substances in the liquid phase exposed to air

(b) total air/wastewater interface area

(c) conditions at air/wastewater interface.

Table 7.1: Odour detection thresholds of waste water odour precursors.

Chemical component	Detection Threshold Concentration (mg m^{-3})
Ammonia	0.03-37.8
Methylamine	0.0012-6.1
Trimethylamine	0.00026-2.1
Indole	0.0006-0.0071
Scatole	0.00035-0.00078
Hydrogen Sulphide	0.001-0.27
Methyl mercaptan	0.0000003-0.038
Ethyl mercaptan	0.000043-0.00033
Butyric acid	0.0004—42
Valeric acid	0.0008-0.12

O'Neill & Phillips et al. (1992)

7.2 METHODOLOGY

In order to obtain odour emission data for the site, a review of literature was performed. Measurements that were performed previously on similar operating WWTP's were used to construct the basis of the dispersion modelling. A phased modelling approach was used to ascertain the odour impact of the facility over its different operations. A worst-case odour emission scenario was modelled with 3 years worth of meteorology data representative of the study area. Two scenarios were calculated to determine the potential odour impact of the WWTP during its operation. These included:

- Predicted overall odour emission rate from proposed WWTP *without odour abatement (mitigation)*.

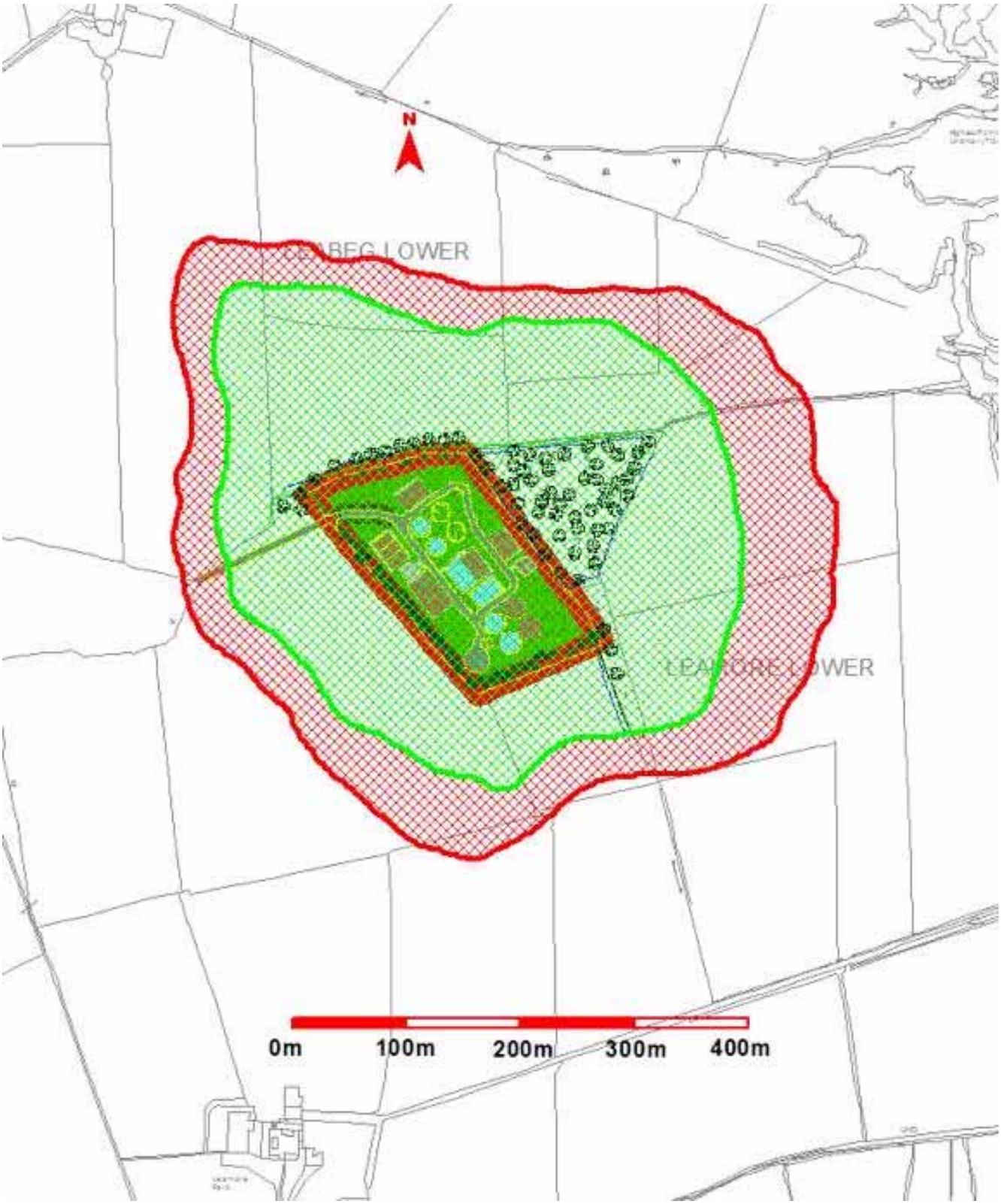
- Predicted overall odour emission rate from proposed WWTP design *with odour abatement (mitigation).*

7.3 IMPACTS

It has been concluded that:

- In accordance with odour impact criterion in the full report, and in keeping with current recommended odour impact criterion in this country, minor odour impact may be perceived by residents in the vicinity of the proposed WWTP operation without the incorporation of odour abatement protocols;

- In accordance with odour impact criterion, and in keeping with current recommended odour impact criterion in this country, *no major odour impact* should be perceived by residents in the vicinity of the proposed operating WWTP following the installation of odour abatement protocols/minimisation procedures discussed within this document. It is predicted that odour plume spread is greatly reduced with all residents in the vicinity of the proposed WWTP perceiving an odour concentration less than 3.0 Ou_E m^{-3} for the 98th percentile (**Figure 7.1**). Those sources considered most offensive have been abated and therefore it is less likely that any resident will have complaint (see **Table 7.2**).



before (—) and after (—) the implementation of odour abatement protocols at the 98th percentile for an odour concentration of less than or equal to 3.0 OuE m-3.

Ordnance Survey Ireland

Project	*Newtownmountkennedy & Kilcoole Regional Sewerage Scheme*	Figure	7.1
Title	**Comparison between predicted odour plume spread of proposed Newtownmountkennedy WWTP**		

Wicklow County Council

RPS mcos
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie

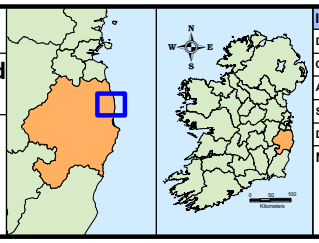


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Table 7.2: Odour emission rate for each individual process within Newtownmountkennedy WWTP operation.

Odour source	Odour emission flux ($Ou_E\ s^{-1}\ m^{-2}$)	Odour emission rate ($Ou_E\ s^{-1}$)	Odour concentration offensive level/Odour descriptor [1]
Inlet flow channels	22 (L)[2]		3.1 $Ou_E\ m^{-3}$ (sewer line/raw sewage/rotten eggs and cabbage odour)
Grit chambers	5.6 (L)[2]		2.2 $Ou_E\ m^{-3}$ (sour organic acid/sewer odour)
Grit storage containers	19 (L)[2]		2.26 $Ou_E\ m^{-3}$ (Faecal/sour organic acid/rotten eggs odour)
Fugitive odour emission based on influent flow	(L)[2]	7500 $Ou_E\ m^{-3}$ × maximum influent flow displacement	2.0 $Ou_E\ m^{-3}$ (Sewer/rotten eggs odour)
Primary settlement tanks	10 (L)[2]		3.1 $Ou_E\ m^{-3}$ (Musty/rotten vegetable odour)
Aeration tanks	5.4 (L)[2]		4.0 $Ou_E\ m^{-3}$ (musty dank odour)
Final settlement tanks	1.45 (L)[2]		4.3 $Ou_E\ m^{-3}$ (musty odour)
Storm water tank	0.5 (L)[2]		2.4 to 7.0 $Ou_E\ m^{-3}$ (musty/rotten vegetable odour)
Sludge storage	45 (L)[2]		1.8 to 2.2 $Ou_E\ m^{-3}$ (rotten vegetable/rotten eggs odour)
Sludge thickening tank	17 (L)[2]		2.0 to 3.1 $Ou_E\ m^{-3}$ (rotten vegetable/rotten eggs odour)
Sludge dewatering building	(L)[2]	1448 $Ou_E\ m^{-3}$ × 1.22	3.8 $Ou_E\ m^{-3}$ (musty dank odour)

Note: [1] denotes in-house odour intensity and hedonic tone (i.e. pleasant/unpleasant) evaluation of odours performed in Ireland and USA.
[2](L) denotes library based odour emission rate for similar WWTP's in Ireland and UK;

7.4 MITIGATION MEASURES

Odour abatement and minimisation procedures will be required at the proposed wastewater treatment plant in order to prevent any odour nuisance in the surrounding vicinity. The proposed measures are as follows:

1. The maximum allowable odour emission rate from the overall WWTP should not be greater than 15,928 $Ou_E\ s^{-1}$ inclusive of the odour emission contribution from the abatement systems installed on the inlet works and all sludge handling processes. The maximum overall odour emission rate from the inlet works and combined sludge handling processes shall be no greater than 83 and 706 $Ou_E\ s^{-1}$, respectively.

2. Maintain good housekeeping practices (i.e. keep yard area clean, etc.), closed-door management strategy (i.e. to eliminate puff odour emissions from sludge dewatering and storage building), maintain sludge storage within sealed airtight containers and to implement an odour management plan for the operators of the WWTP (i.e. for preventative maintenance of odour abatement systems). Headspace air from the inlet works and all sludge handling processes should be ventilated to an odour control system if any odour contamination of these buildings occurs. It will be assumed that any increase in odour concentration within the headspace of either process buildings will conclude contamination.

3. Avoid accumulation of floating debris and persistent sediments in channels and holding tanks by design (i.e. flow splitters and secondary sedimentation tanks, etc.)

4. Enclose and seal all sludge handling processes. Negative ventilation should be applied to all sealed processes. The volume of air to be removed will be equivalent to 1 air change the maximum volume of the tank + the maximum fill rate of the enclosed process. If any process air is added to this tank this will also be accounted for in the calculations (i.e. additive to above calculated amount). For more turbulent processes including the inlet works, all processes should be hood evacuated and enclosed. A maximum air exchange rate of 8 air changes per hour should be applied to the void volume of the inlet works building/dewatered sludge storage/sludge press building if deemed necessary. Any sludge tipping/transfer should be performed within an enclosed system (i.e. negatively ventilated building/pumping system), which prevents the emission of any odours from this process.

5. Operate the proposed WWTP within specifications to eliminate overloading and under loading, which may increase septic conditions within the anoxic/aeration basins.

6. Odour scrubbing technologies as suggested in the full report, should be installed on the inlet works and all sludge handling processes within the WWTP. These areas are considered most offensive than primary/secondary sedimentation and aeration processes and therefore more likely to cause odour complaints (see **Table 7.2**). This dispersion model is valid for the indicative design discussed within this document. If overall odour emission rates from the actual designed WWTP increase (i.e. if surface areas of primary, secondary and aeration processes increase), then overall odour impact area will increase. Therefore, the actual WWTP design will be required to be assessed to ensure no increased odour impact.

7.5 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

Construction activities both of the treatment plant, the long sea outfall and the remaining pipe network have the potential to cause formulation/accumulation of air borne pollution and dust, particularly during the earth moving phase. It will be necessary to provide an effective dust control plan in the vicinity of housing and grazing areas for cattle and horses and also to prevent a nuisance to road users. The dust mitigation plan will be prepared once the contractor has been selected.

8 NOISE AND VIBRATION

8.1 INTRODUCTION

This chapter examines the noise and vibration aspects of the proposed scheme. A Site Plan is shown in **Figure 3.1** and a schedule of typical plant elements is given in **Table 8.1**. Noise measurements were made at a similar modern plant at Greystones, Co. Wicklow to determine the potential noise that may be emitted from the proposed plant. Baseline measurements were made at residences near the site of the proposed treatment plant.

Sound levels are measured with a meter in units called decibels (dB), and noise has often been defined as unwanted sound. Environmental noise levels are usually assessed in terms of A-weighted decibels, the dB(A). The A-weighting approximates to the response of the human ear. Industrial, occupational and environmental noise is usually expressed in equivalent continuous levels, $L_{Aeq,T}$. This is based on the energy average level over the relevant time interval. Environmental noise may be corrected for tonal or impulsive characteristics and the unit is the rating level, $L_{Ar,T}$. Statistical parameters are also used as noise descriptors.

The operation of the plant and the other facilities will generate environmental noise in two principal ways which are:

1. Noise emission from outdoor aeration and settling tanks.
2. Noise emission from indoor plant.

The construction phase of the development will give rise to noise, some of which will be perceptible off-site. There will be no vibration effects off-site.

8.2 METHODOLOGY

The waste treatment works will be comprised primarily of the plant items listed in **Table 8.1**. The plant will operate 24 hours a day but the sludge pressing and removal operations are normally undertaken during day time working hours.

Table 8.1: Schedule of Principal Plant Items

Preliminary Treatment (All Enclosed)
Coarse Screens
Grit traps
Fine Screens

Primary Settlement Tanks

Sludge Removal Equipment (Scrapers)
Aeration Tanks
Air Blowers

Secondary Settlement Tanks
Sludge Removal Equipment (Scrapers)

Sludge Dewatering

Sludge Thickening & Storage Tanks
Mixers

Pumping
Sludge Pumps
General Liquid Transfer Pumps (effluent, storm water etc.)

The major external plant will employ essentially quiet technology with fine bubble diffusion in the aeration tank. In order to predict the noise resulting from the proposed plant noise measurements were made at a similar plant at Greystones and the results were:

Decanter Centrifuge	
10 metres	50 dB(A)
20 metres	45 dB(A)
30 metres	42 dB(A)
40 metres	40 dB(A)
Aerator Tanks	
above tanks, 1.5m	50 dB(A)
20 metres	40 dB(A)
Compressor Building	
10 metres	38 dB(A)

The air blowers and the sludge treatment plant will be housed in buildings of concrete construction. All air openings required for the housed plant will have attenuators sized and specified in terms of meeting the external night time noise criterion.

Noise measurements made c.25 metres from a pumping station similar to that proposed gave results of 42 dB(A) with the pump in operation.

8.3 DESCRIPTION OF BASELINE NOISE

The site at Leamore, Kilcoole is surrounded by agricultural land with a residences located c.550 metres south of the site, baseline location 1, and c.600 metres north of the site, baseline location 2. Outside of Kilcoole village there is little or no industrial activity in the local area.

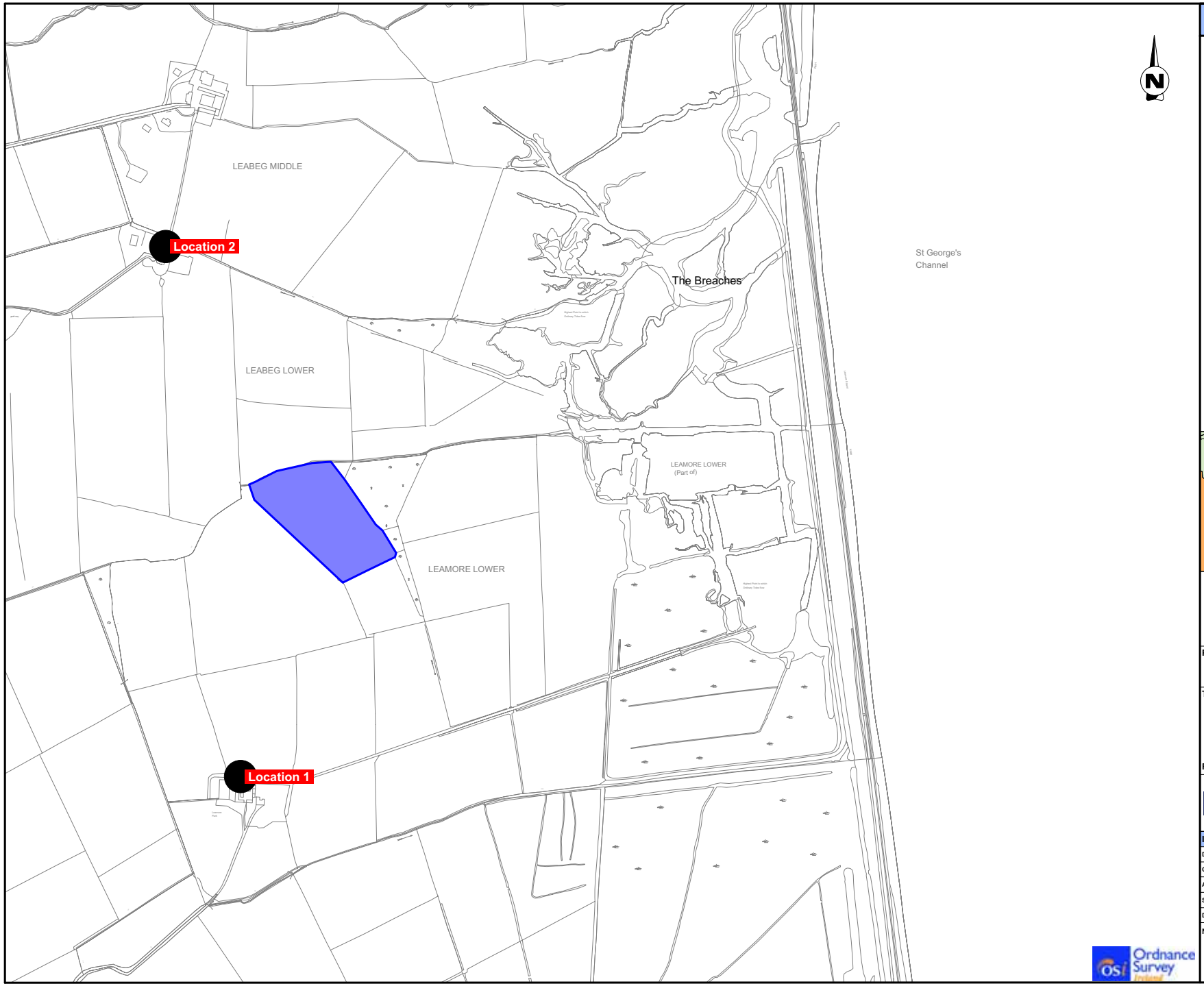
Noise measurements were made at the two nearest residences over a number of days with principally good weather conditions with light winds. The locations are marked in **Figure 8.1**. The microphone height was 1.5 metres above ground level at all locations. The instrumentation consisted of Environmental Noise Analysers CEL252 and a Bruel & Kjaer type 2231 Precision Sound Level Meter, with calibration checks being made with a B&K type 4230 sound level calibrator. The following parameters were measured:

$L_{Aeq,T}$ the equivalent continuous noise level for the measurement period. This parameter is very sensitive to local high level short time sources, e.g. local traffic, etc.

$L_{A01,T}$ the sound level equalled or exceeded for 1% of the measurement period, the maximum levels.

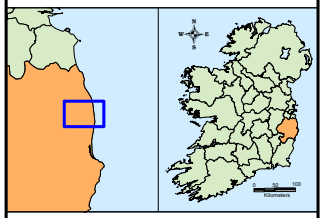
$L_{A10,T}$ the sound level equalled or exceeded for 10% of the measurement period, the parameter usually used for traffic noise assessment.

$L_{A90,T}$ the sound level equalled or exceeded for 90% of the measurement period. This level is sometimes taken to represent the “background” noise level.



Legend

- Noise Monitoring Locations
- Proposed Treatment Plant



Wicklow County Council

Project

Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title

Noise Monitoring Locations

Figure **8.1**

RPS mcos
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie

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The principal sources of existing noise at locations 1 and 2 were domestic and agricultural activity, local traffic and birdsong. The results are shown in **Appendix B** of this report. The minimum night time levels were $L_{A90,1\ hour}$ values of 23-24 dB respectively and the corresponding $L_{Aeq,1\ hour}$ values were 26 - 29 dB

8.4 IMPACTS

Due to the continuous nature of the plant operation the night time operation is of major importance as this requires a lower limit than daytime. There are no statutory limits for environmental noise emissions for this type of plant, or industry in general, in this country.

In general, noise is likely to provoke complaints when its level exceeds the level of the background noise level by a certain margin or when certain absolute levels are attained or when a pure tonal component is produced. The criteria for industrial noise generally lie in the range 35-45 dB(A) at night and 45-55 dB(A) by day. The lower values are normally applicable to rural areas and zones of hospitals, and the higher values are sometimes applicable to city centre areas or special cases such as mining or quarrying. The most widely applied criteria for Industry are that of 40 - 45 dB(A) (night-time) and 50 – 55 dB(A) (daytime) but further controls may be specified if there are prominent discrete tones or impulses. The existing noise levels, the character of the area and the nature of the development will also determine acceptable noise levels limits.

Selection of the preferred noise criteria values within the range of values above depends on the pre-existing noise levels, the character of the area and the nature of the development. Taking the above into account and the relatively low level of existing “background” noise at the proposed location the following criteria are proposed as being appropriate for minimal impact on the noise environment:

Kilcoole, Existing Residences

Night	:	35 dB L_{Aeq} (hourly)
Day	:	50 dB L_{Aeq} (hourly)

Newtownmountkennedy

Night	:	40 dB L_{Aeq} (hourly)
Day	:	55 dB L_{Aeq} (hourly)

These are limit values for the noise from the proposed plant measured outside any dwelling. There should be no significant pure tones or impulsive elements in the noise spectrum of the emissions from the plant. The noise characteristic associated with plants of this nature is generally perceived as being of a broad band unobtrusive character.

The construction and operation of the Waste Water Treatment Plant and other facilities can be undertaken without undue disturbance to local residents. The noise levels measured at a similar plant in Greystones extrapolated to the distances of the nearest residences give resultant levels well below the criteria. The noise levels measured at the pumping station at Greystones extrapolated to the distances of the nearest residences give resultant levels below the criteria.

Due to the distances involved the noise impact of the construction and operation of the treatment plant can be defined as “no impact”. The potential noise from the construction and operation of the pumphouse can be defined as “slight impact”

8.5 MITIGATION MEASURES

Noise control measures will be built into the design of the plant with the enclosure of the main sources of noise and the detailed design of the plant will incorporate noise control measures, as appropriate, to

meet the criteria. These will include enclosure of the compressors and screening of plant. Further mitigation is provided by the distance of the facilities from the nearest residences.

8.6 CONSTRUCTION IMPACTS AND MITIGATION

The construction of the treatment plant and the associated works including the construction of the long sea outfall the remaining sewage network will give rise to some noise of a temporary nature.

British Standard BS 5228: 1997 on Noise Control on construction and demolition sites provides guidance on the methods available to control noise from construction work and is used on road and other large scale construction projects.

8.7 RESIDUAL IMPACTS

The construction and operation of the Waste Water Treatment Plant and other facilities can be undertaken without undue impact on the noise environment. There will be no vibration perceptible off-site.

9 LANDSCAPE AND VISUAL

9.1 INTRODUCTION

This chapter examines the landscape and visual aspects of the proposed development. The assessment has been conducted to examine the capacity of the receiving environment to successfully absorb the proposed sewerage treatment plant in the area of Newtownmountkennedy and Kilcoole, Co. Wicklow. The chapter will expand upon the character of the site and surrounding landscape and quantify the significance of visual impacts identified.

A site visit was conducted during the month of November (2004). In terms of visual permeability it should be noted that the degree of visual screening is at its lowest during this time of year.

9.1.1 Methodology

The assessment methodology is based upon guidelines from the Department of the Environment Heritage and Local Government (DoEHLG) Landscape and Landscape Assessment: Consultation Draft of Guidelines for Planning Authorities (June 2000), Environmental Protection Agency (EPA) Guidelines on the Information to be contained in Environmental Impact Statements (March 2002), (EPA) Advice Notes on Current Practise: in the preparation of Environmental Impact Statements (1995) and The Landscape Institute & Institute of Environmental Assessment (LI/IEA) Guidelines for Landscape and Visual Impact Assessment, 2nd Edition 2002.

The assessment included the following:

- A desk top study of available data and published literature to establish landscape baseline,
- Site visits to establish landscape baseline,
- Interpretation of Site Master Plan, and
- Preparation of a photographic record.

The landscape and visual impact assessment in accordance with Environmental Protection Agency (EPA) guidelines requires that:

- The character of the surrounding landscape is defined.
- The visibility of the proposed development is established.
- The significance of this visual intrusion upon the visual receptors such as houses, viewpoints along roads and amenity/landmark areas is quantified.
- Mitigation and or compensatory measures are proposed to diminish any significant impact associated with the proposal.

9.1.2 Terminology

The following terminology has been used to describe type and duration of impacts:

- Positive Impact – A change, which improves the quality of the existing environment.
- Neutral Impact – A change, which does not affect the quality of the existing environment.
- Negative Impact – A change, which reduces the quality of the existing environment.

The aesthetic quality of the landscape is influenced by a balance of elements including scale of the landscape in human terms, sense of enclosure, type of texture, sense of colour and extent of diversity. Landscape quality can categorised using a 5 point scale as described in the Highways Agency Design Manual for Roads & Bridges (2000) Volume 11, Section 3, Part 5 as follows:

- Highest quality landscape.
- Very attractive landscape.
- Good landscape.
- Ordinary landscape.
- Poor landscape.

The Landscape Institute Guidelines for Landscape and Visual Impact Assessment, 2nd Ed., states that impacts can be of a direct, indirect, secondary or cumulative nature. Direct effects are those, which are directly attributable to a defined element or characteristic of the proposal. An indirect or secondary effect is an effect, which is not as a direct result of the proposed development and is often produced away from site or as a result of a complex pathway or secondary association. Cumulative effects result from additional changes to the landscape caused by the proposed development in conjunction with other developments or actions that occurred in the past, present or are likely to occur in the foreseeable future.

The degree of visual impact is also affected by a number of key factors that include:

- **The Scale And Mass Of The Development:** The scale of the proposed development has been assessed in terms of the setting of the development within the landscape around the Leabeg area.
- **The Receiving Environment:** The development has been assessed in relation to its surroundings. Consideration has been given to the angles of view and local topography, as well as foreground and background elements, which can affect the degree of impact.
- **Distance:** As a general rule, the greater the distance of the viewpoint from the site, the less the impact. The elevation of viewpoints have also been considered.
- **Observer Group:** The possibility of an observer moving at speed along a road, as opposed to receiving direct views may vary the degree of impact.

Table 9.1: Duration of Impacts as Defined by EPA Guidelines

Description	Years
Temporary impact	Impact lasting for 1 year or less
Short term impact	1 – 7 years
Medium term impact	7 – 15 years
Long term impact	15 – 60 years
Permanent impact	Impact lasting over 60 years

Table 9.2: Sensitivity of Receiving Environment, based upon DoELG

Sensitivity Type	Ability to absorb development
Low sensitivity	All development kinds
Moderate sensitivity	Many development kinds
High sensitivity	Few development kinds
Special sensitivity	Acceptable only in accordance with designation recommendations
Unique sensitivity	Negligible alteration

Table 9.3: Magnitude of Impacts

Magnitude of Impacts	Typical Criteria
HIGH	Total loss of or major alteration to key elements/features/ characteristics of the baseline, i.e., pre-development landscape or view and/or introduction of elements considered to be totally uncharacteristic when set within the attributes of the receiving landscape.
MEDIUM	Partial loss of or alteration of one or more key elements/ features/characteristics of the baseline, i.e., pre-development landscape or view and/or introduction of elements that maybe prominent but may not necessarily be considered to be substantially uncharacteristic when set within the attributes of the receiving landscape.
LOW	Minor loss of or alteration of one or more key elements/ features/characteristics of the baseline, i.e., pre-development landscape or view and/or introduction of elements that may not be uncharacteristic when set within the attributes of the receiving landscape.
NEGLIGIBLE	Very minor loss or alteration to one or more key elements/ features/characteristics of the baseline, i.e., pre-development landscape or view and/or introduction of elements that are not uncharacteristic with the surrounding landscape – approximating the 'no change' situation.

Table 9.3 defines the magnitude of impact (scale extent and duration of an effect) as high medium, low or negligible (LI/IEA, 2002 p 145). The degree of intrusion and therefore the development's impact is dependant upon a variety of factors including terrain, vegetative cover, and other landscape features that screen views of the development (Refer to **Table 9.4**).

Table 9.4: Degree of Visual Intrusion

Degree of Visual Intrusion	Typical Criteria
HIGH	Highly visible within the receiving environment
MODERATE	Partially screened and visible within the receiving environment
LOW	Heavily screened and partially visible within the receiving environment

9.2 RECEIVING ENVIRONMENT

9.2.1 Site Context

The location of the site proposed for the Newtownmountkennedy and Kilcoole Regional Sewerage Scheme and proposed access roadway is shown in **Figure 9.1** and **Figure 9.2**. The site is approximately 16 km south of Bray and 15 km north of Wicklow town, situated in the townland Leabeg.

The landscape character of the area is defined by a combination of good quality agricultural farmlands and a combined marsh and beach environment. The Breaches area is located within the wider landscape context of the coastal plains. The Coastal area category is defined by the Wicklow County Development plan as: “the area of land between the sea and the road nearest the coastline”. The road, in this case is the R761. The entire coastal area of County Wicklow is defined as an Area of Outstanding Natural Beauty Zone.

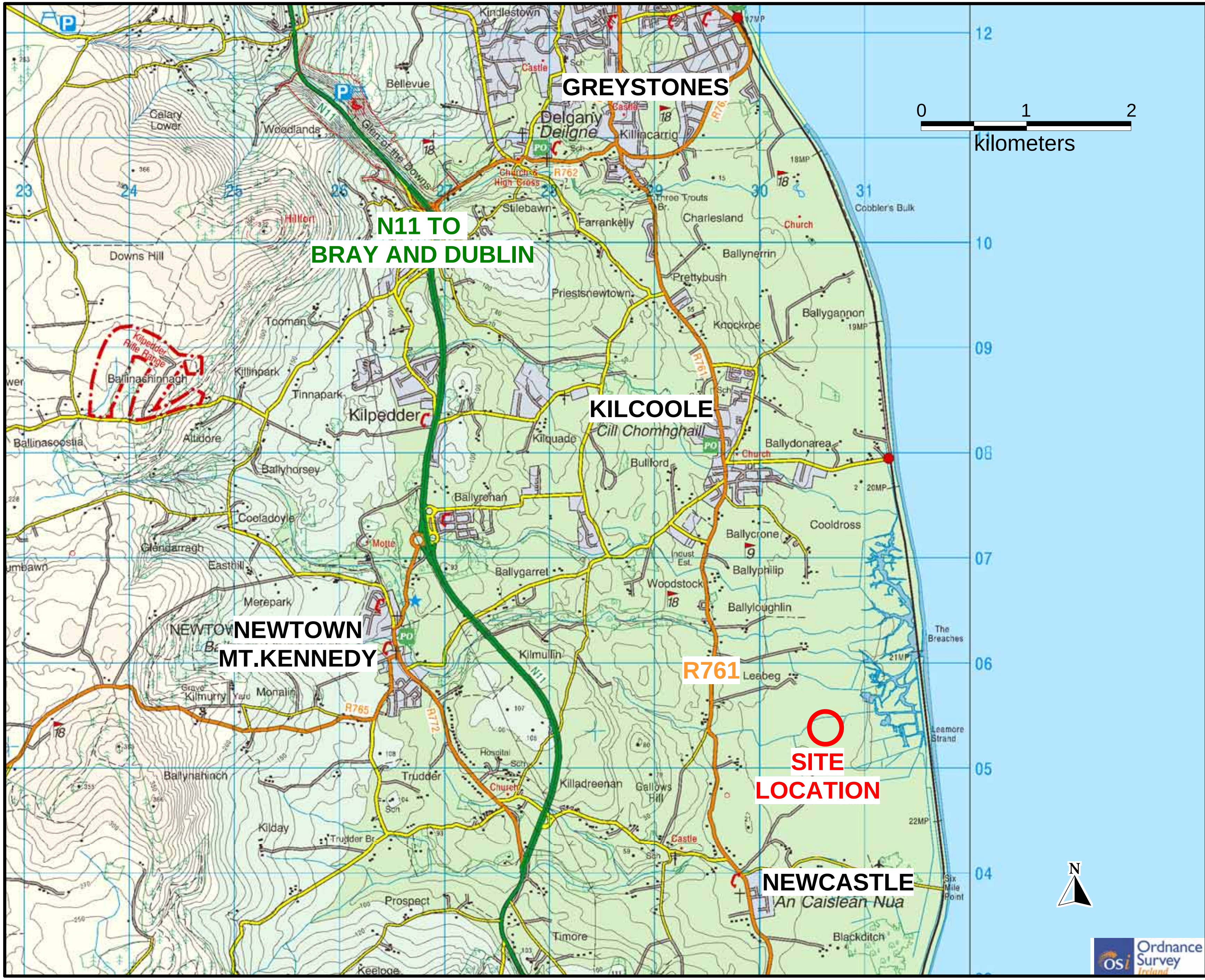
The proposed site is set against a back-drop of a series of small hills to the west of the site. This east facing ridgeline continues in a north- south direction and makes up the foothills of the Wicklow mountains, set further in the background to the northwest.

The study area’s eastern boundaries consist of the coastline of the Irish Sea, and the Dublin-Wexford railway line. Refer to **Figure 9.2**

The beach area is of landscape and environmental importance, due to its high level of amenity and conservation potential. In terms of being an important habitat area, Bird Watch Ireland headquarters is situated in Newcastle and bird watchers use the area adjacent to the railway area as a vantage point for bird watching.

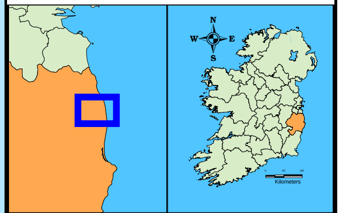
9.2.2 Landscape Character

The sensitivity of the receiving environment can be classed as being moderate to high. This classification has mainly been derived from the sensitive nature of the landscape character, as well as the existing site usage and the rural context in which the proposed development is to be located. In principle, the proposed development will contrast with the existing land use and landscape character of the area. **Figure 9.4** Landscape Character illustrates the wide range of landscape character types in the area.



Legend

Site Location



Wicklow County Council

Project
Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title
SITE LOCATION MAP, REGIONAL CONTEXT

Figure 9.1

RPS MCOS

Unit 3a, University Technology Centre
Curraheen Road
Co. Cork
Phone: 021-4804600
Fax No. 021-4804658
info@cork.mcos.ie

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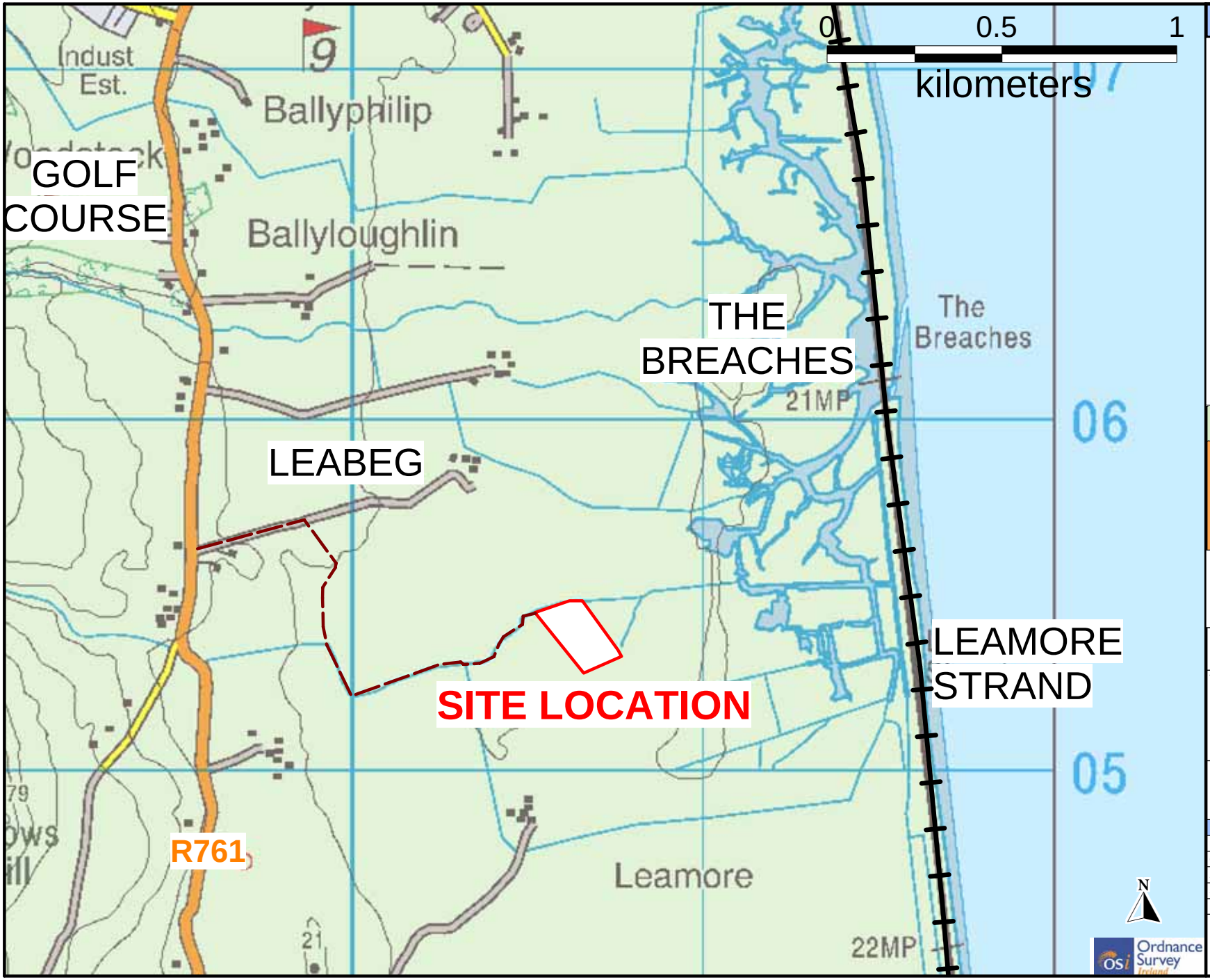
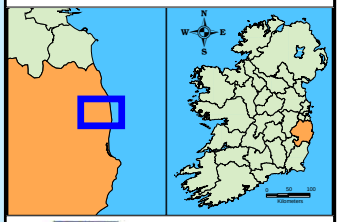


Legend

- Railway Line
- Proposed Access Roadway
- Site Location



Wicklow County Council

Project
Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title
Site Location Map
Local Context

Figure 9.2

RPS MCOS
Unit 3a, University Technology Centre
Curraheen Road
Co. Cork
Phone: 021-4804600
Fax No. 021-4804658
info@cork.mcos.ie

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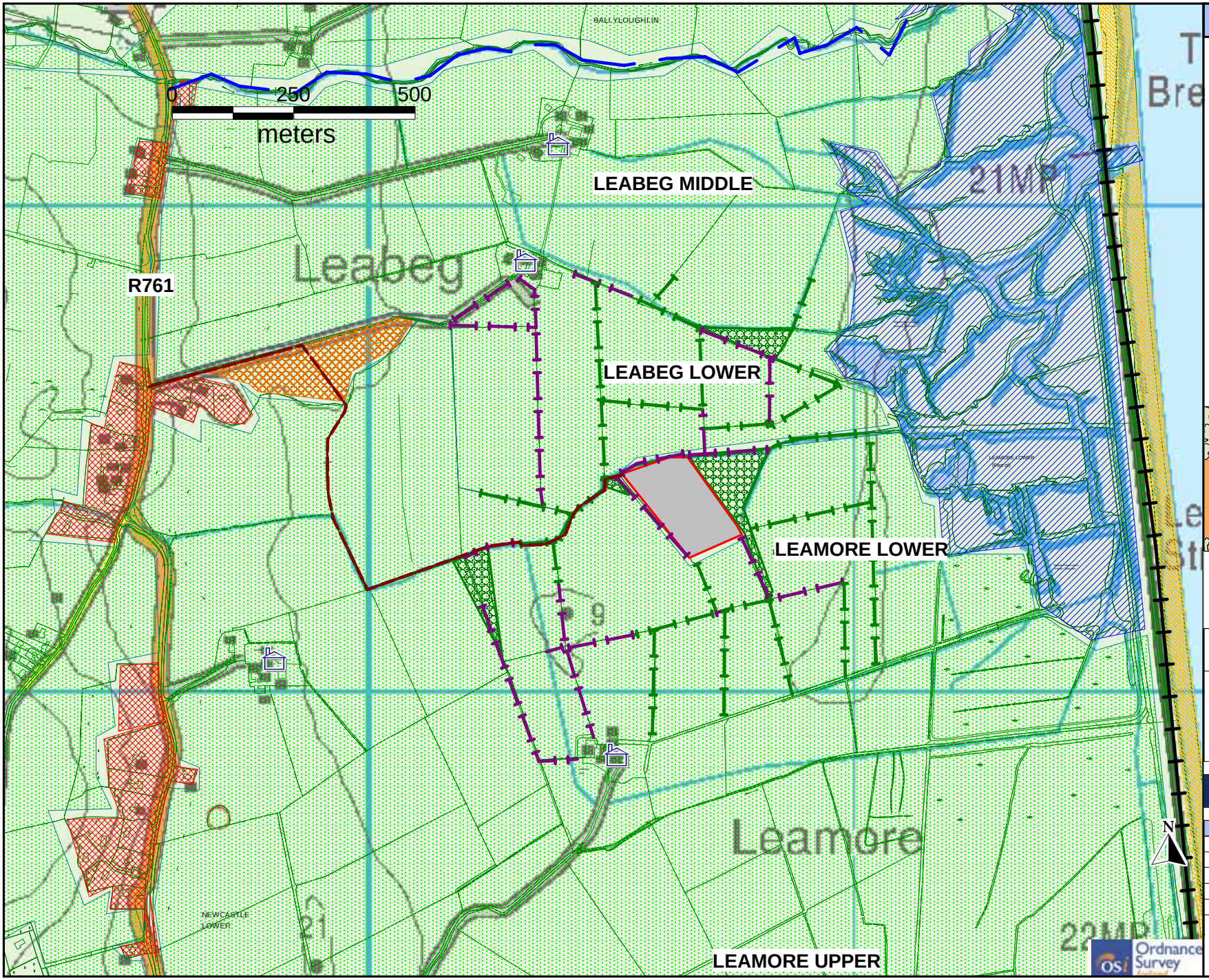
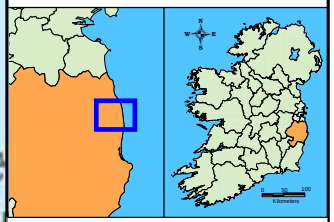


Legend

- Proposed Access Roadway
- Farm Dwelling
- Existing Hedgerow
- Existing Hedgerow of High Ecological Sensitivity
- Proposed Site Location
- Shoreline
- Rocky Outcrops
- Woodland
- River or Stream
- Agricultural Land
- Linear Residential Development
- The Breaches
- Railway Line



Wicklow County Council

Project
Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title
LANDSCAPE CHARACTER

Figure 9.4

RPS mcos
Innishmore
Ballincollig
Co. Cork
Phone: 021-4872996
Fax No. 021-4872997
info@cork.Group.ie

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The Kilcoole Marshes and Beach Environment

The Kilcoole Marshes, indicated in **Figure 9.3** comprise an intertidal area, which is separated from the sea by the railway line. It is subjected to normal tidal exchange when the outlet at the "the Breaches" is open. Because of the mobility of the beach, the Breaches are regularly closed by southeasterly storms. At these times, fresh water levels rise until they are balanced by seepage. As a result, the area can be occasionally converted to a freshwater lake, which can be opened by natural processes or local farmers using machinery.

Refer to **Chapter 10** for the complete description of the designation on the Kilcoole marshes and beach environment.

Agricultural Land

The managed agricultural lands located in the surrounding environment are actively used and of good quality. The fertile soil found on the coastal flats makes it ideal for cultivating a wide range of crops. Agricultural land use in the area mainly comprises crops as well as limited cattle grazing. Fields are large to medium in size and mostly square to irregular in shape

Linear Residential Development

Linear rural development is found along the R761, which links Newcastle (to the south), and Kilcoole (in the north). Medium to large sized detached dwellings are located next to, or near the road. New residential dwellings are also being built along this rural corridor. A number of new and existing residential and farm dwellings were identified within a 500m radius from the site. These are further described in Section 9.4.

Woodland Copses

A number of prominent woodland copses are found in the receiving environment. The most significant of these is adjacent to the northeastern site boundary. The site largely relies on this woodland copse as the main existing visual buffer, as it screens direct visual access from the beach environment.

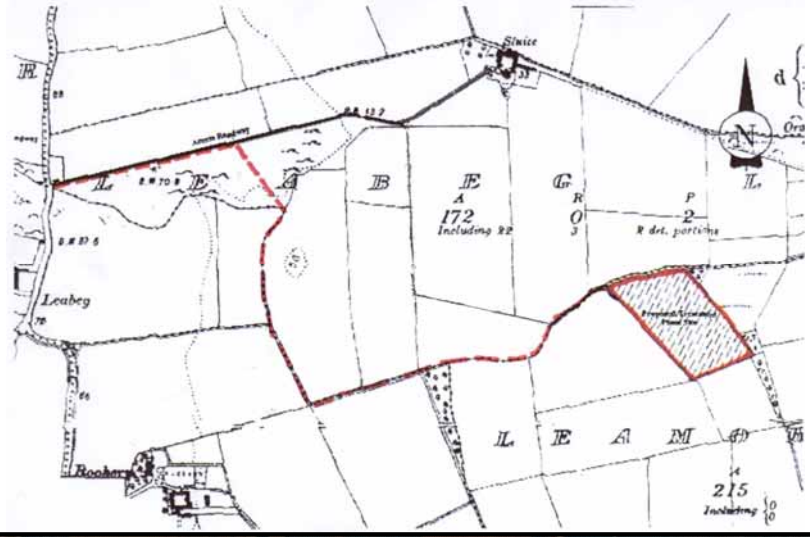
Another prominent woodland area is located to the west of the development site. This acts as a very successful visual buffer in the landscape.

Typical ranges of species to be expected in the woodland copses are the following: Willow species (*Salix spp*.), Black alder (*Alnus spp*), Ash (*Fraxinus excelsior*), Silver Birch (*Betula pendula*), Oak (*Quercus robur*) and Beach (*Fagus Sylvatica*)

Another prominent woodland area is located to the west of the development site. This acts as a very successful visual buffer in the landscape. The screening ability of these woodland areas is further discussed in Section 9.2.2 of this report.

Typical ranges of species to be expected in the woodland copses are the following: Willow species (*Salix spp*.), Black alder (*Alnus spp*), Ash (*Fraxinus excelsior*), Silver Birch (*Betula pendula*), Oak (*Quercus robur*) and Beach (*Fagus Sylvatica*).

Site Location Map

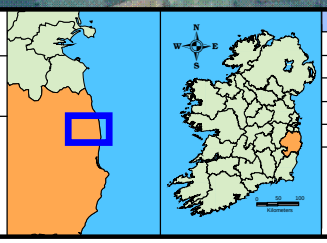


Project	*Newtownmountkennedy & Kilcoole Regional Sewerage Scheme*	**Figure**	**9.3**
Title	**Aerial Photograph and Location Map**		

Wicklow County Council

RPS mcos

Unit 3a, University Technology Centre
Curraheen Road
Co. Cork
Phone: 021-4804600
Fax No. 021-4804658
info@cork.mcos.ie



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Hedgerow

Most of the field pattern in the area is clearly defined by hedgerows, which contain some similar trees as found and described in the woodland with Gorse (*Ulex europaeus*) and Bramble (*Rubus fruticosus*) being the common species throughout. The majority of the hedgerow trees are overgrown with Ivy (Hedera helix).

An important feature of the hedgerow is the abundance of mature native trees found within the field boundaries as well as those lining the roadsides and access roadways to farm dwellings. Note the two distinct types of hedgerows mentioned in the Landscape Character assessment, (See **Figure 9.4**).

Typical species types found along these boundaries and roads include: Oak (*Quercus robur*) and Scots Pine (*Pinus sylvestris*), Sycamore (*Acer pseudoplatanus*) and Horse Chestnut (*Aesculus hippocastanum*). A number of these species types are also found lining the roadside proposed for site access to the proposed development site. Mature examples of Scots Pine (*Pinus sylvestris*) are also found on the site.

Rocky Outcrops

The receiving environment is characterised by some areas that show signs of exposed bedrock. These rocky areas are clearly identified as areas that will typically not be utilised as agricultural lands. In the receiving environment, a rocky outcrop area is found along the access road to farm dwelling outlined in **Figure 9.4** Landscape Character.

Table 9.5: Landscape Quality

Quality Ranking	Study Area Landscapes' Sensitivity to Change
Highest Quality	Landscapes of highest quality are, by definition, landscapes of an 'awe inspiring' or 'sublime' nature and are important on an international and national level. The Breaches and coastal plains are included in this category.[1]
Very attractive	Landscapes that are of high value, and can be defined as highly scenic. Hedgerows and mature tree-lined roadways, within the study area are all included in this category.
Good Landscape	Areas that although still attractive, have less significant and more common landscape features. These contain more intrusive elements such as residential developments and conspicuous infrastructure. The main linear development corridor, found in the study area can be classified as being a good landscape .
Ordinary Landscapes	The low-lying agricultural landscape, within the study area is included in this category
Poor Landscapes	There are no landscapes in this category, included in the study area

[1] The 1999 Wicklow County Development Plan (Refer to section 3.4.1) in regards to the Coastal Zone Management Plan says: "The Council will control development in the coastal zone in accordance with the objectives set out in the Coastal Zone Management Plan.

9.2.3 Planning and Designations

With respect to this area, the following designated sites were identified (Refer to **Figure 9.5**)

- Natural Heritage Areas (NHAs).
- Special Areas for Conservation (SAC).
- Special Protection Areas (SPAs).

The Kilcoole Marshes, which also contain the designations listed above, is in close proximity to the site of the proposed Development. This is located approximately 270 m from the eastern site boundary):-

In the 2004-2010 Draft County Development Plan (Chapter 10, Heritage and Landscape, 3.5.6 3.5.7), the following EU Directives are given for Special Areas for Conservation (SPAs) and Special Areas of Conservation (SAC):

- **Special Protection Areas EU Directive 79/409:** The Council will protect and preserve designated Special Protected Areas and any SPA's designated in the future. The Council will ensure that any development proposal in the vicinity of, or affecting in any way a designated SPA, provides sufficient information showing how its proposals will impact on the habitat of the SPA and proposals for appropriate amelioration.

- **Special Areas of Conservation EU Directive 92/43/EEC:** The Council will protect and preserve designated Special Areas of Conservation and any SACs designated in the future. The Council will ensure that any development proposal in the vicinity of or affecting in any way a designated SAC provides sufficient information showing how its proposals will impact on the habitat of the SAC and appropriate amelioration.

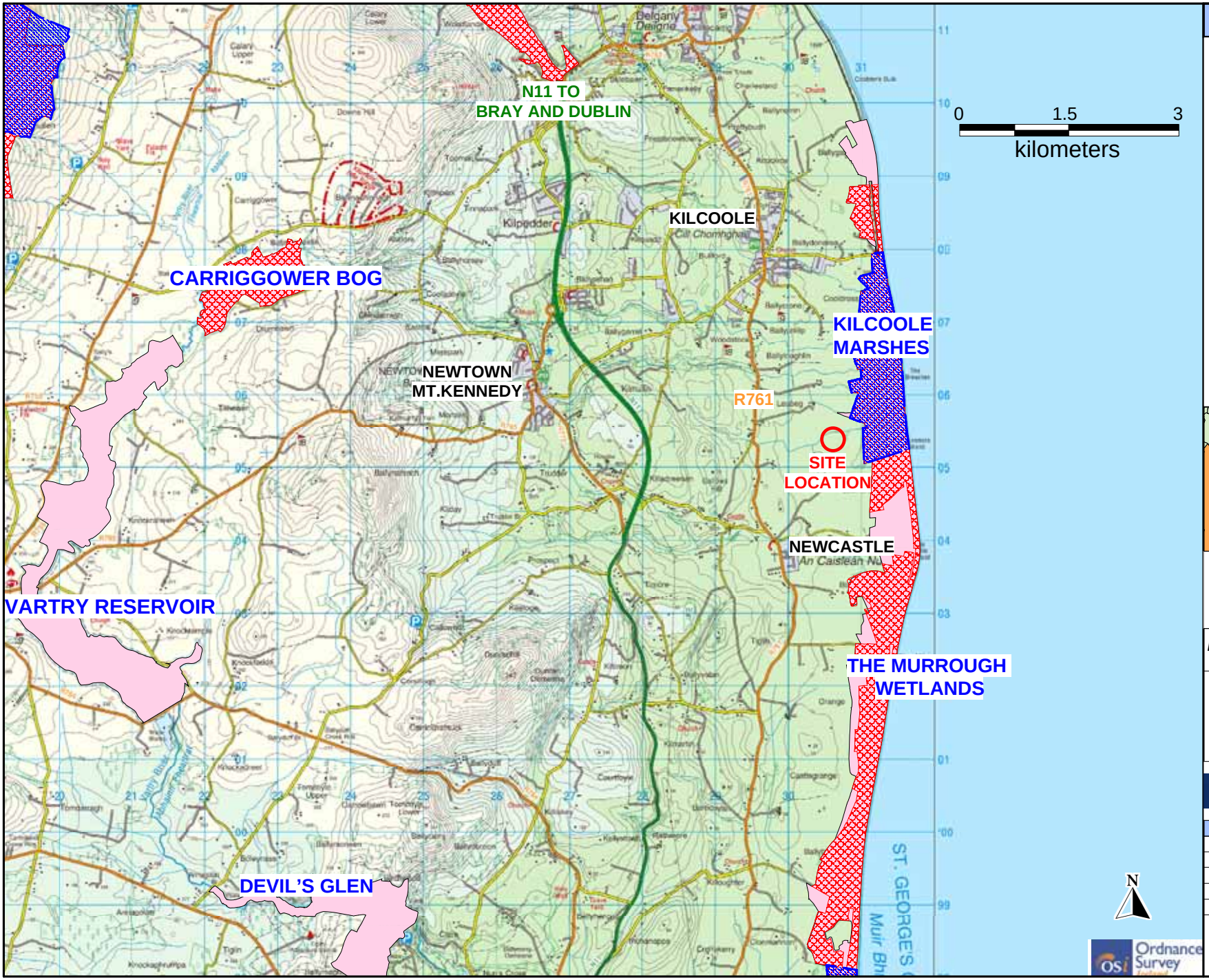
Landscape Zoning

The site is located within an area classified as and Area of Outstanding Natural Beauty (A.O.N.B.). 1999 Wicklow County Development Plan (Refer to section 1.3.8 & 2.4.3) “A landscape analysis has identified landscape categories within County Wicklow. Having regard to vulnerability, assimilative capacity and development pressures these categories have been organised into development control landscape zones.”

“The A.O.N.B. zone encompasses those areas which are most vulnerable and sensitive, and which are considered to be of greatest scenic value. These areas tend to be under severe development pressure.”

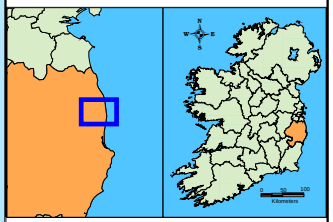
This classification is also stated in the 2004-2010 Draft County Development Plan. Section 3.3.11 in the Plan states that “The Council will reinforce and preserve the scenic quality of this zone by restricting development in it. The Council will require the submission of a visual impact assessment where a planning application is made for development in an Outstanding Natural Beauty Zone. The Council will seek to open up views of the sea from the coast road and of lakes from the lake roads and to restrict development on the sea-ward/lakeward side of the road where it would be injurious to the amenities of the beaches/lakeshores or injurious to tourism, or where it would be visible between the road and the sea/lake, except where settlements already exist …”

The Development Plan also states that “The Council will promote, in co-operation with the various relevant organisations, the more extensive use of this zone for such activities as touring, mountaineering, pony trekking, sightseeing, walking, etc. The Council will endeavour to keep open areas of commonage which are traditionally open areas and to establish, in co-operation with local



Legend

- Site Location
- Special Protection area (SPA)
- Special area of Conservation (SAC)
- Natural Heritage area (NHa)



Wicklow County Council

Project
Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title

DESIGNATED SITES

Figure 9.5

RPS mcos
Innishmore
Ballincollig
Co. Cork
Phone: 021-4872996
Fax No. 021-4872997
info@cork.mcos.ie

Issue Details

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landowners, and/or those with grazing/commonage rights public rights of way in order to provide access to the natural attractions of the area."

Views and Prospects

There were no prominent views or prospects identified in close proximity to the study area, but nevertheless the 1999 Wicklow County Development Plan (Section 3.3.15) states: "The Council will protect and preserve views and prospects of special amenity value or special interest in the County, whether listed or not."

Tree and Hedgerow Preservation

In the Wicklow Draft County Development Plan 2004-2010 (Chapter 5.6 and Chapter 5.7) the following guidelines are given in order to ensure the protection of trees and hedgerows during site construction.

"When mature trees or substantial hedgerows are located on lands that are being considered for development, a detailed tree and hedgerow survey shall be submitted with the application. All trees with diameter of 75mm and above (measured at a height of 1.4m above ground level) should be included in the survey. Hedgerows should be surveyed with reference to species, branch canopy, spread, shape, height and condition. Remedial works should also be indicated where appropriate and trees should be identified on site with suitable tags. Provision should be made in site layout for incorporating specimen trees that are in good condition. Mature trees or hedgerows felled prior to lodging a planning application will reflect negatively on the case for planning permission."

Also outlined in the Development Plan, is the importance of: "Prevention of damage and protection of trees/ hedgerows during site development. Where trees or hedgerows are to be preserved on a development site, it is essential that the trees be protected by the erection of secure fencing prior to any site or engineering works commencing and that no materials be stored within the fenced area and that no vehicles have access to the fenced area. To ensure that trees and hedgerows are protected on a site which has been the subject of a grant of planning permission, a cash lodgement may be required, the amount of which shall be determined by the Planning Authority."

Design of Agricultural Buildings

Section 3.3.4 in the Draft County Development Plan 2004-2010 gives an outline of the importance of the sympathetic design of agricultural buildings.

"The sympathetic design and layout of agricultural buildings determine how the development is assimilated into the landscape over time. In assessing applications for planning permission for agricultural buildings the Council will have regard to:

- Recommendations contained in An Foras Talúntais Handbook, 'Farm Buildings and the Environment'.
- The grouping of farm buildings in so far as is practical and a unifying design of individual buildings to help to absorb them more easily into the landscape.
- Screening and shelterbelt planting composed principally of native species.

- Where cladding is used on the exterior of farm buildings dark colours (preferably dark green, red or grey) with matt finishes will normally be required. Roof areas should be the same or in a darker shade of the colour used on the side panels."

9.2.4 Site Visibility

Site visibility will greatly depend on the vegetation cover and time of year. The site is exposed to long-range views to the northwest and short to medium range views from the north and south. The overall visibility of the site can be summarised as follows:

- From a series of locations along the roadside the site's visibility will greatly depend on the hedgerow and field pattern as well as local topography on that specific location.

- The site is generally exposed on the north west and to a lesser extent on the western and south western boundaries.

- Visual permeability to the site, viewed from the east along the coastline and railway is greatly reduced due to the screening provided by the dense woodland vegetation.

- On the approach to the site, visibility from the farm access road is, generally poor (when travelling along the main access road from east to west).

- The hedgerows found on the site (in particular on the north and western boundaries) provide a minimal degree of effective vegetation screening. This is mainly due to two main factors: Visual permeability in the winter months would typically be much higher: plus the poor overall quality and structure of the hedgerow due to the lack of maintenance.

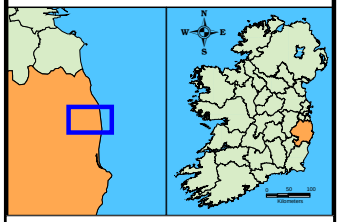
9.2.5 Characteristics of the Proposed Development

The location of the proposed wastewater treatment plant including the site access location are indicated in **Figure 9.6**

In landscape and visual terms the main component of the proposed development will be the Proposed Wastewater Treatment Plant consisting of: an access roadway, a range of tanks, buildings, interconnecting pipework and associated structures. The exact road access from the R761 to the construction and operational phase of the site is yet to be finalised. Access into the site itself will be from the far western corner of the site.

Treatment facilities will comprise of the following elements: The inlet works; Storm tanks; Blower (RAS, WAS); sludge dewatering system; aeration tanks and picket fence thickeners. The administration and control buildings with adjoining maintenance, and storage facilities are visually the most prominent structures. Sludge treatment works consisting of primary, secondary settling tanks, which will largely be sunken below ground level. The maximum overall height of any structure in the proposed layout is approximately 4 metres in height.

It is intended that the development would be designed in such a way as to minimise the visual impact upon the receiving environment, therefore a vernacular style is proposed. It is recommended to incorporate this style in the overall layout and material finishes for the works/development. It is considered appropriate to mimic a typical farmyard arrangement when developing an architectural concept.



Wicklow County Council

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Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title

INDICATIVE LAYOUT OF TREATMENT PLANT

Figure 9.6

RPS mcos
Innishmore
Ballincollig
Co. Cork
Phone: 021-4872996
Fax No. 021-4872997
info@cork.mcos.ie

Issue Details			
Drawn:	TGB	Project No.	MCE 0209
Checked:	JW	File Ref.	
Approved:	AR	MCE0209MI0004D02	
Scale:	N.T.S.	Drawing No.	Rev.
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As mentioned in Section 9.2.4 Planning and Designations, Wicklow County Council clearly outlines the importance of a design layout, and architectural style, that is in keeping with its surroundings.

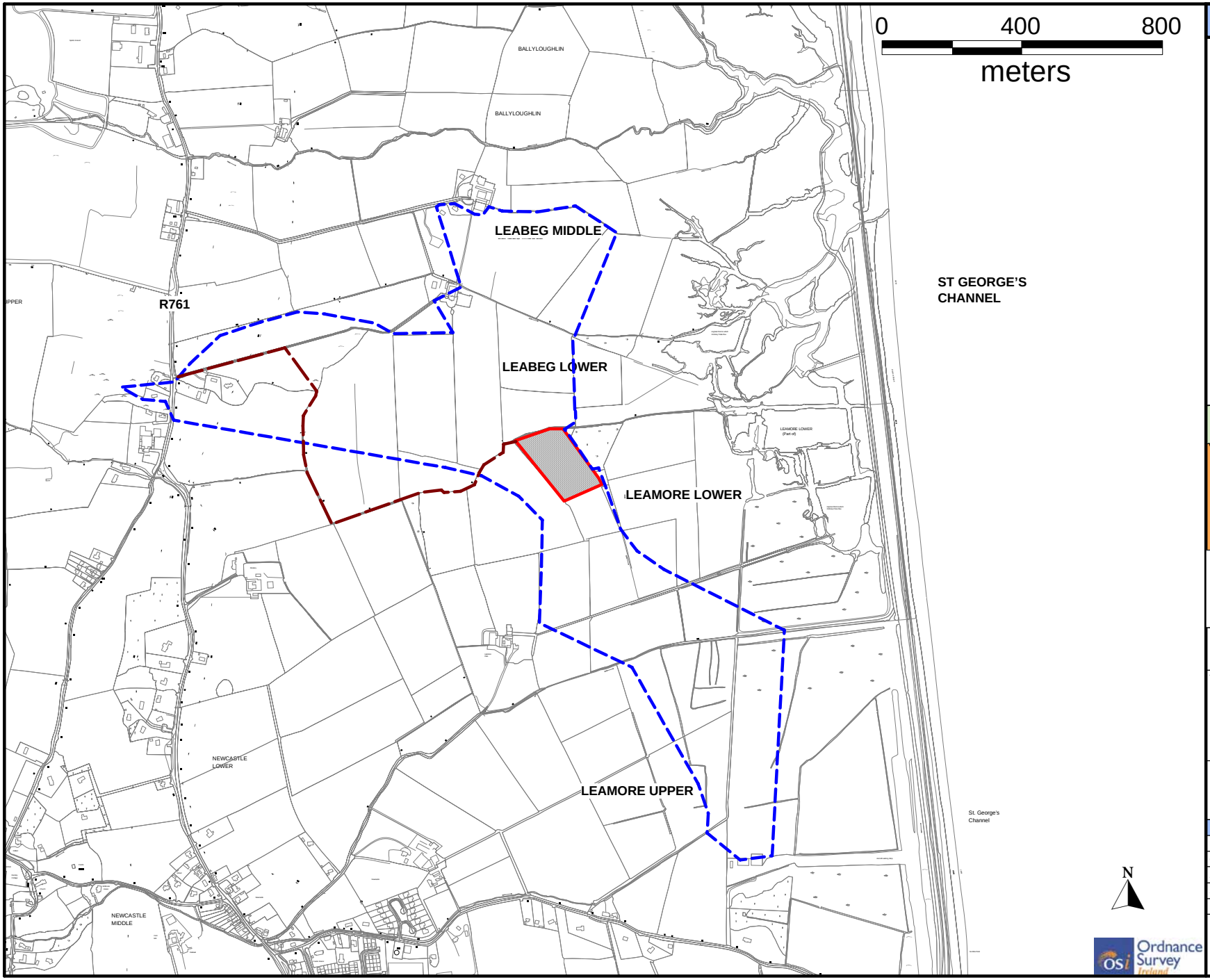
9.3 SYNOPSIS OF VIEWS

In order to assess the possible landscape and visual impacts that the proposed development will have on the receiving environment, a Visual Envelope Map (VEM) was generated. The Visual Envelope Map is based on approximate visibility and can only be considered as indicative. From this the site can be evaluated in terms of immediate and long-range visibility and the impact the development may have on various points, (being either positive, negative or neutral). The impact the development may have over the short and long term is evaluated on the basis of these points (Refer to **Figure 9.7.).**

As part of the site investigation a photographic record was taken. **Plates 9.1** to **9.8** were used to illustrate views to and from the site. **Figure 9.8** also illustrates at what location these images were taken from.

9.3.1 Views from the site

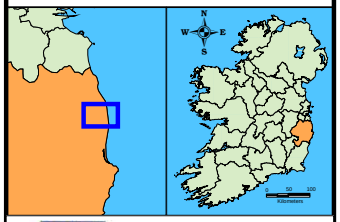
Plate 9.1: View from the Site, facing Northwest



Legend

- Proposed Access Roadway
- Approximate Zone of Visual Influence
- Proposed Site Location

* A VEM is a tool of approximation and is to used as a general indication of visual infuence



Wicklow County Council

Project
Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title
VISUAL ENVELOPE MAP (APPROXIMATE VEM MODEL FOR SITE *)

Figure 9.7

RPS mcos
Unit 3a, University Technology Centre
Curraheen Road
Co. Cork
Phone: 021-4804600
Fax No. 021-4804658
info@cork.mcos.ie

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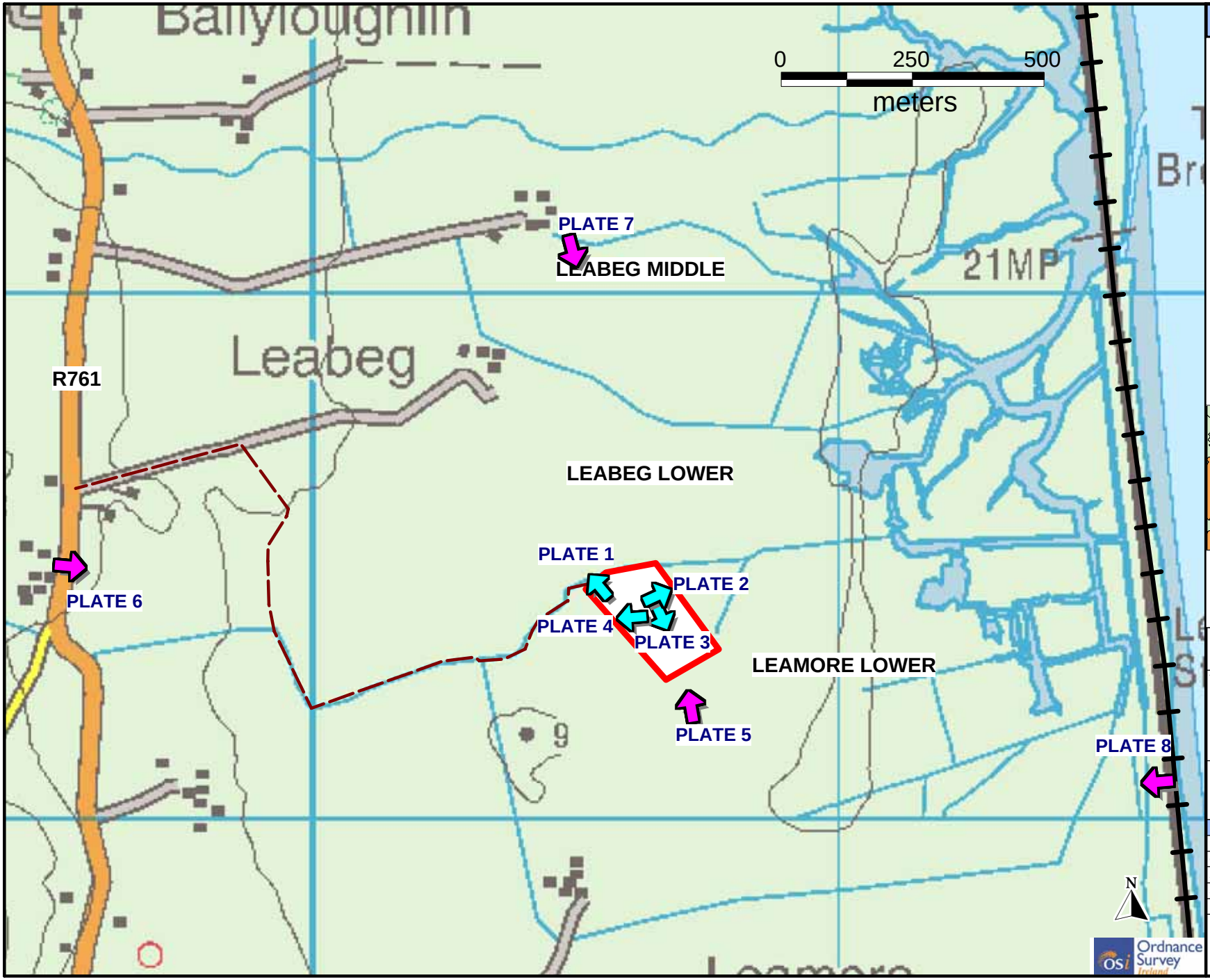
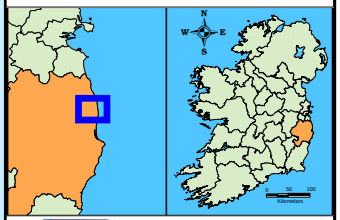


Legend

- Viewpoint locations to site
- Viewpoint locations from site
- Proposed Site Location
- Proposed Access Roadway



Wicklow County Council

Project
Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title

VIEWPOINT LOCATION

Figure 9.8

RPS MCOS
Innishmore
Ballincollig
Co. Cork
Phone: 021-4872996
Fax No. 021-4872997
info@cork.mcos.ie

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Plate 9.2: View from the Site, facing East

The woodland copse area is triangular in shape and extends to the south of the site, narrowing out to a standard hedgerow size and density.

Due to the size and density of the vegetation found in the woodland copse, it provides an existing landscape buffer and visual screen. Most direct views from the shoreline (viewed in a western direction) will be largely screened and prevent all visual access to the site.

Plate 9.3: View from the Site, facing South

Looking across to the southern site boundary, it is evident that the existing field extends beyond the proposed southern site boundary. At present, there is no clear definition of the southern site boundary, when compared with the existing environment with the indicative layout of the proposed Treatment Plant (Refer to **Figure 9.6**).

Plate 9.4: View from the Site, facing West

Note the overall hedgerow structure on the western (and northern) site boundary is of poor quality. Visual permeability along these boundaries, especially during winter months will not provide sufficient screening of the proposed development.

9.3.2 Views to the Site

Plate 9.5: Views to the Site, facing North

Plate 9.6: View to the Site, facing an Eastern Direction

Plate 9.7: Views to the Site, facing in a Southern Direction

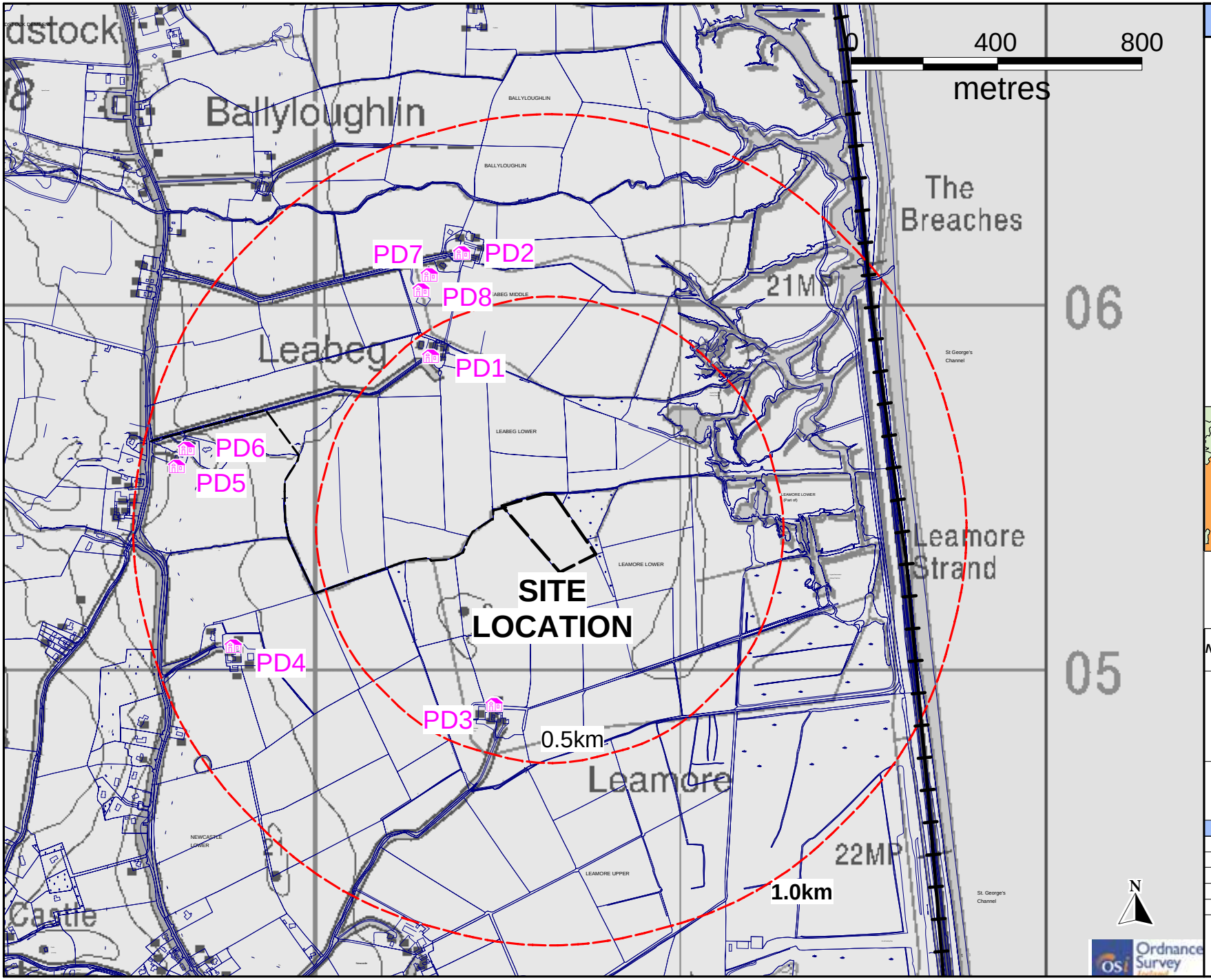
Viewed from across the agricultural fields, potitioned in close proximity to farm dwelling (identified as PD1). The proposed development site is indicated in **Plate 9.7**.

Plate 9.8: Views to the Site, facing in a Western Direction (Standing adjacent the railway)

9.4 POTENTIAL IMPACT OF THE PROPOSAL

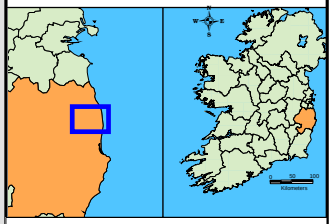
Views to the site were investigated from a variety of key locations and both long and short range distances were considered in the assessment. (Refer to **Plate 9.1** and **Plate 9.7**). Views from the site were also investigated to further illustrate the suitability or appropriateness of the proposal in relation to the visual and landscape amenity of the receiving environment and the ability to absorb the proposed development.

A series of possible sensitive receptors are identified in **Figure 9.9** and listed in **Table 9.6** with regards to potential visual impact. The potential sensitive receptors identified in **Table 9.6** have a varied degree of visual intrusion due to the proposed development. These likely impacts were identified on the basis of a scenario that excluded any mitigation measures.



Legend

- Potential Sensitive Receptors
- Aproximate Distance from Proposed Site
- Site Location



Wicklow County Council

Project

Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title

POTENTIAL SENSITIVE RECEPTORS

Figure 9.9

RPS mcos
Innishmore
Ballincollig
Co. Cork
Phone: 021-4872996
Fax No. 021-4872997
info@cork.mcos.ie

Issue Details

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Table 9.6: Potential Sensitive Receptors

Residence Number	Residence Type	Type of View	Description of Visual Impact
PD1	Farm Dwelling	Direct visual access	High Visual Impact
PD2	Farm Dwelling	No direct visual access, largely screened; facing away from development site.	Negligible visual impact
PD3	Farm Dwelling	No visual access because of local topography	No visual impact
PD4	Farm Dwelling or Estate Buildings	Slightly elevated position, largely screened woodland-cops	Negligible visual impact
PD5	Private Residential Dwelling	Visual impact relatively low impact because of distance to site.	Low visual impact
PD6	Private Residential Dwelling	Visual impact relatively low impact because of distance to site	Low visual impact
PD7	Temporary Dwelling	Visual access to site possible, some open views because of the relatively flat topography	Medium visual impact
PD8	Private Residential Dwelling	No direct visual access possible; largely screened by PD1	No visual impact

In order to further assess and summarise the likely landscape and visual impact on the receiving environment, **Table 9.7** outlines the likely impact the proposed development will have on the receiving environment (mainly landscape component) as well as observer groups (mainly visual impacts) identified in the area.

Table 9.7: Impact Summary

	Landscape Impacts		Visual Impacts	
	Impact	**Duration**	**Impact**	**Duration**
Proposed Development	Low negative impact	Long term	Low negative impact	Short term

9.4.1 Construction Phase

The potential impact that the proposed development could have on the receiving environment during the construction phase would be negative in the short to medium term, due to the processes involved in the construction of any development of this scale. As part of the development an access roadway will also need to be built. Construction processes may include any or all of the following:

- Increased traffic volumes due to materials delivery and removal;
- The potential removal of soil and vegetation to achieve a suitable finished ground level to make way for the proposed building; and

- The potential removal of soil and vegetation to achieve a suitable slope and level to make way for the proposed access roadway.

9.4.2 Operational Phase

During the operational life of such a development (the proposed regional Sewerage Scheme) the following potential impacts are likely to occur:

- Presence of development in the landscape
- Vehicular access to and from the site being used by personnel

Taking into consideration the review of current design proposals the potential impact on the receiving environment would be neutral to negative in the short to medium term.

9.5 MITIGATION MEASURES

The primary mitigation measures per EPA Guidelines are as follows:

- Total avoidance of certain negative landscape and visual effects; particularly in terms of sensitive and or prominent landscapes.
- Reduction of certain impacts where avoidance is not possible requiring consideration of the environmental constraints contained on the site.
- Remedy and minimise the possible adverse negative impacts.

A series of mitigation and compensatory measures based upon the analysis of the site context, existing conditions, and the proposed site layout have been considered. The aim of proposed mitigation measures is to ensure that the degree of visual intrusion posed by the proposed development at Leabeg is minimised and that the site achieves a high degree of visual integration into the existing fabric of the receiving environment:

- Trees and hedgerows around the perimeter of the site and along the proposed access road will be surveyed to identify trees and elements of the hedgerows that are worthy of retention and which will be protected during the construction phase.
- A Landscape Master Plan will be prepared by the developer and will address landscape issues within the boundary of the site and along the access road. It should also include the following elements:-
    - A tree protection program in accordance with *British Standard 5837 – Guide for Trees* in relation to Construction as part of an ongoing site management strategy. This will assist in ensuring the retention of the existing hedgerows, hedges and trees identified for preservation; and protection of any newly landscaped areas.
    - A planting strategy, consisting of tree species capable of adapting to varied site conditions in conjunction with appropriate understorey species. The principal objective of the planting plan should be to assist in the visual integration of the development into the surrounding environment with a scale of planting that adequately screens the site.
    - Facilitate effective visual screening by augmenting the existing planting with similar species of trees and hedgerow material. The improved screening of the north-eastern,

northern and southern site boundaries will greatly increase the screening along the site boundaries.

- A symphatic architectural design will be developed in conjuction with a qualified architect. The architecture of the facility should take into consideration the following:-
    - The receiving environment through the choice of suitable construction materials and colours.
    - Minimise the overall heights of the structures or works proposed.
- To incorporate appropriate road design that accommodates potential widening and increase in road usage along the section of road shared by the local residence, a detailed survey along the proposed route shall be completed.
- If a defined boundary treatment is required to ensure restricted access into the site, then the boundary should be set back a minimum of 1.5m from existing hedgerows and set out and constructed by hand – this will ensure the continued integrity of existing screening vegetation. Fencing shall be in dark green, blue-grey in colour, matching the exterior finishes on the stuctures proposed for the development.
- The use of directional lighting, on a timer, or motion sensitive, lighting shall be explored to further reduce negative impact.
- The existing woodland area shall be protected through agreed site practices, and if necessary physical barriers such as fencing may be implemented.

9.6 PREDICTED IMPACT OF THE PROPOSAL

The predicted impacts that the proposal will have on the receiving environment are based the initial desk study, analysis of information collected in the field, and the implementation of above mentioned proposed mitigation/compensatory measures.

9.6.1 Construction Phase

During the construction phase the proposed extension will have a negative to neutral impact in the temporary to short term.

As with any construction of this scale there will be a degree of high visibility due to the processes involved in construction. These include:

- Increased traffic volumes due to materials delivery and removal.
- The site works involved in the removal of vegetation and topsoil adjacent to the proposed access roadway and entrance into the site.

These actions will be evident in the short term from a variety of locations, especially from the north-west, and west due to the elevation of surrounding lands

9.6.2 Operational Phase

During the operational phase adherence to the objectives of the proposed mitigation measures, will ensure that the site will continue to be adequately screened from its surrounds. A landscape maintenance regime will be a key component of on – going site management. This regime should include a defects liability period

during which any defective plant materials are to be replaced. Weed control and litter picking must also be monitored carefully, especially during the early growing seasons of the landscape maintenance contract.

After construction of the proposed developement, it will be partially visible. Due to the scale and mass of the development, and the limited amount of sensitive receptors negatively impacted upon the completed development poses a moderate visual impact over the short term. This visibility will diminish as the landscaping is established, therefore the proposed development will have a neutral to low negative impact upon the visual fabric of the receiving environment in the medium to long term.

9.7 RESIDUAL IMPACTS

The preservation of the intrinsic qualities and high scenic value of the landscapes will be of vital importance to the success of the scheme. In landscape and visual terms the proposed development does not pose a threat to the landscape charcter associated with this part of Wicklow County. The wooded area to the northeast of the site will continue to provide a backdrop to the buildings or structures proposed. This will significantly reduce the visual impact, due to the fact that there will be no impact on the skyline.

As soon as vegetation screening reaches maturity (10 to 15 years) the short term negative visual impact of the proposed Newtownmountkennedy and Kilcoole Sewerage facility will diminish as the augmented hedgerows and proposed landscape mitigation measures are implemented and established.

10 TERRESTRIAL FLORA AND FAUNA

10.1 INTRODUCTION

The proposed Newtownmountkennedy and Kilcoole sewerage scheme is located in the coastal lowlands of east Wicklow. Land lying below the 100m contour forms a band about 5 km wide, between the foothills of the Wicklow Mountains and the sea. The solid geology underlying the scheme area is the Bray group of Precambrian/Cambrian sandstones, shales and quartzite; rock outcrops occur in places throughout the scheme area. The main soils of the area are well draining and fertile acid brown earths, suitable for tillage and intensive grassland production. Agriculture is the main land use. Tillage crops include cereals, rape, potatoes and fodder beet. Livestock enterprises include dairying and beef production, sheep farming, horses and free-range hens. There are substantial glacial deposits of sands and gravels in the area, and these have been quarried in a number of areas, notably around Kilpedder.

Five steams rise in the foothills of the Wicklow mountains and flow west - east through the study area. The stream valleys are generally fairly steep sided, often cutting through glacial sand and gravel deposits. The valley sides often support narrow strips of broad-leaved semi-natural woodland. All the streams flow into the low-lying Kilcoole Marshes, which are separated from the sea by a shingle ridge barrier beach. The marshes drain through a network of brackish and tidal channels to the sea at The Breaches. Embankment construction and the installation of flap valves on drainage channels in the late 1980s has significantly altered the hydrology of the marshes.

10.2 METHODOLOGY

General habitat and land cover in the scheme area was mapped, using aerial photography and ground truthing. More detailed survey work was carried out along pipeline route options and proposed treatment plant and pumping station sites, using Phase 1 habitat survey methodology to classify the habitats and plant communities present (NCC, 1990). Plant identification follows Webb *et al* (1996), Fitter et al (1984) and Jermy *et al* (1982), plant nomenclature follows Scannell and Synnott (1987). Survey work was originally carried out during February and March 1999; because of seasonal factors not all plant species will have been recorded, and it was not possible to identify all plants to species level. However, the survey findings provide a sound basis for the assessment of the significance of the plant communities and habitats present, in the context of the proposed development.

The study area was walked again in October 2004 and the habitat designations have been revised where possible to comply with Fossit (2000).

Reference has also been made to previous surveys of flora carried out in Kilcoole Marshes as part of the Hydrographic Survey for the proposed development in October 1992, and to surveys carried out by Dúchas - National Parks and Wildlife, in 1993 and 1998.

10.3 DESCRIPTION OF EXISTING ENVIRONMENT

10.3.1 Conservation Designations

Wildlife Act, 1976 and Wildlife (Amendment) Act, 2000

The Wildlife Act, 1976, is the principal national legislation providing for the protection of wildlife and the control of activities, which may adversely affect wildlife. Under the Act, the Minister responsible for nature conservation may afford protection to all wild species of fauna and flora.

In 2000, the Wildlife Act was amended (Wildlife Amendment Act 2000) and additions were made to the existing legislation including;

- A mechanism to give statutory protection to proposed Natural Heritage Areas (pNHAs). Proposed Natural Heritage Areas are deemed to be of special interest containing important wildlife habitat and often containing rare or threatened species.
- Statutory protection of geological and geomorphological sites through designations as NHAs;
- Enhancing the conservation of wildlife species and their habitats;
- Strengthening of the protective regime for Special Areas of Conservation (SACs) by removing any doubt that protection will in all cases apply from the time of notification of proposed sites;
- Provision of specific statutory recognition to the Minister's responsibilities with regard to promoting the conservation of biological diversity, in light of Ireland's commitment to the UN Convention on Biological Diversity.

Birds Directive

The Birds Directive (1979) requires each member state to designate "Special Protection Areas" for birds. The Directive contains lists of birds, which require particular conservation measures (Annex I), including Whooper Swan, Greenland White-fronted Goose, Peregrine Falcon, Corncrake and Terns. Member states are also required to protect sites, which are important for migratory species such as ducks, geese and waders. The EU Natural Habitats Regulations, 1997, also covers the Birds Directive.

Habitats Directive

The Habitats Directive (92/43/EEC) was adopted in the EU in 1992. The main aim of the Directive is to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. The objective is to conserve natural and semi-natural habitats and species of flora and fauna through a series of measures including the establishment of a network of protected areas throughout the European Community. Each member state has been charged with designating Special Areas of Conservation (SACs) within their state. These areas serve to protect as diverse a range of habitats and species as possible, and, together with the Special Protection Areas (SPAs) designated under the 1979 Birds Directive (79/43/EEC), form "Natura 2000". It is Article 6 of the 'Habitats Directive' that plays the critical role in the management and conservation of the “Natura 2000” sites.

In the Habitats Directive, there are two lists -Annex I (Habitats) and Annex II (Species) which require conservation. Annex I, includes *Priority Habitats* which require particular attention and examples in Ireland include lagoons, turloughs and limestone pavement. Other Annex I habitats are estuaries and

tidal mudflats. There is also a list of species, which must be afforded protection, and for Ireland examples include the Bottle-Nosed Dolphin, otter, various lampreys and the Freshwater Pearl Mussel.

The Habitats Directive was transposed into Irish legislation by the European Union (Natural Habitats) Regulations, 1997 (S.I. No. 94 of 1997). An amendment to the Directive 97/62/EC adapted both Annex I and Annex II to take account of technical and scientific progress.

The coastal section of the study area is important for wildlife and has a number of important conservation designations. The designations are described below and are illustrated in **Figure 2.1.**

Natural Heritage Area

Kilcoole Marshes are part of a larger coastal wetland complex which extends from Ballygannon to the north of Kilcoole, to Wicklow town. This extended area is proposed for Natural Heritage Area designation (The Murrough, Site Code 00730) by Dúchas - National Parks and Wildlife. It includes two separate areas which have been identified as being of particular significance for birds: Kilcoole Marshes and Broadlough, both of which have been designated as Special Protection Areas (SPA) under the Birds Directive (79/409/EU).

Special Protection Area (Birds Directive)

Kilcoole Marshes was designated as a Special Protection Area (SPA) in 1996, in Statutory Instrument No. 305 of 1996. The extent of the area covered by the designation is shown on **Figure 2.1**. Kilcoole Marshes are important both for wintering and breeding birds.

Wintering waterfowl include internationally important numbers of light-bellied Brent geese *Branta bernicla hrota*, with regionally important numbers of whooper swan *Cygnus cygnus*, wigeon, teal, curlew and redshank. Greylag geese occur mainly between Killoughter and Newcastle, but also use grasslands in the Kilcoole area.

Little terns *Sterna albifrons* breed on the shingle beach near The Breaches, and feed in open water in the salt marsh as well as in the sea. This colony is the largest on the east coast of Ireland. Little terns and whooper swans are both listed in Annex 1 of the Birds Directive, as species requiring special conservation measures to ensure their survival and reproduction. This listing gives an equivalent level of protection as priority species listed under the Habitats Directive.

Special Area of Conservation (Habitats Directive)

The area covered by the proposed The Murrough Natural Heritage Area designation has been notified to the European Commission as a proposed Special Area of Conservation (SAC) under the Habitats Directive (92/43/EEC). A number of habitats are listed as occurring within the candidate SAC (The Morrough Wetlands, Site Code 002249), including drift line vegetation, shingle, salt marsh, alkaline fen and *Cladium* fen, the last of which is a priority habitat which occurs between Broadlough and Newcastle Station. The proposed SAC extends from Ballygannon to Wicklow, and varies in width (i.e. from east to west) depending on the distribution of wetland habitats on the inland side of the shingle ridge which carries the railway line. The shingle ridge is included throughout its length.

Additional Conservation Activities

BirdWatch Ireland owns and manages a significant area of wetland habitat at its reserve at Blackditch. Blackditch Reserve adjoins the Newcastle Station Road to the south, and lies within the Murrough Wetlands SAC designation. The priority Annex 1 listed habitat Cladium fen occurs within the reserve. BirdWatch Ireland also owns and manages a small reserve at the northern end of Kilcoole Marshes SPA.

BirdWatch Ireland manages and staffs the little tern protection scheme at Kilcoole. The tern colony at Kilcoole varies somewhat in precise location from year to year, and in some years the terns try several locations, if they fail to breed in the first site they choose. Colony size and breeding success have increased significantly in recent years as a result of the protection scheme.

10.3.2 Habitats

Habitats occurring within the scheme area were as follows:

- Broad-leaved semi-natural woodland (WN)
- Plantation woodland
- Scrub (WS1)
- Hedgerow (WL1)
- Intensive grassland and arable land (BC)
- Improved grassland (GS)
- Recreation/amenity grassland (GA2)
- Stream habitats (FW)
- Buildings, gardens and unvegetated surfaces (BL3)
- Kilcoole Marshes; wetland habitats

The distribution of these habitats within the scheme area is shown in **Figure 10.1.** More detailed mapping of habitats along the long sea outfall pipeline route, including wetland habitats in Kilcoole Marshes, is given in **Figure 10.2**. A detailed list of the species encountered in the field survey is given in **Appendix C** of this report.

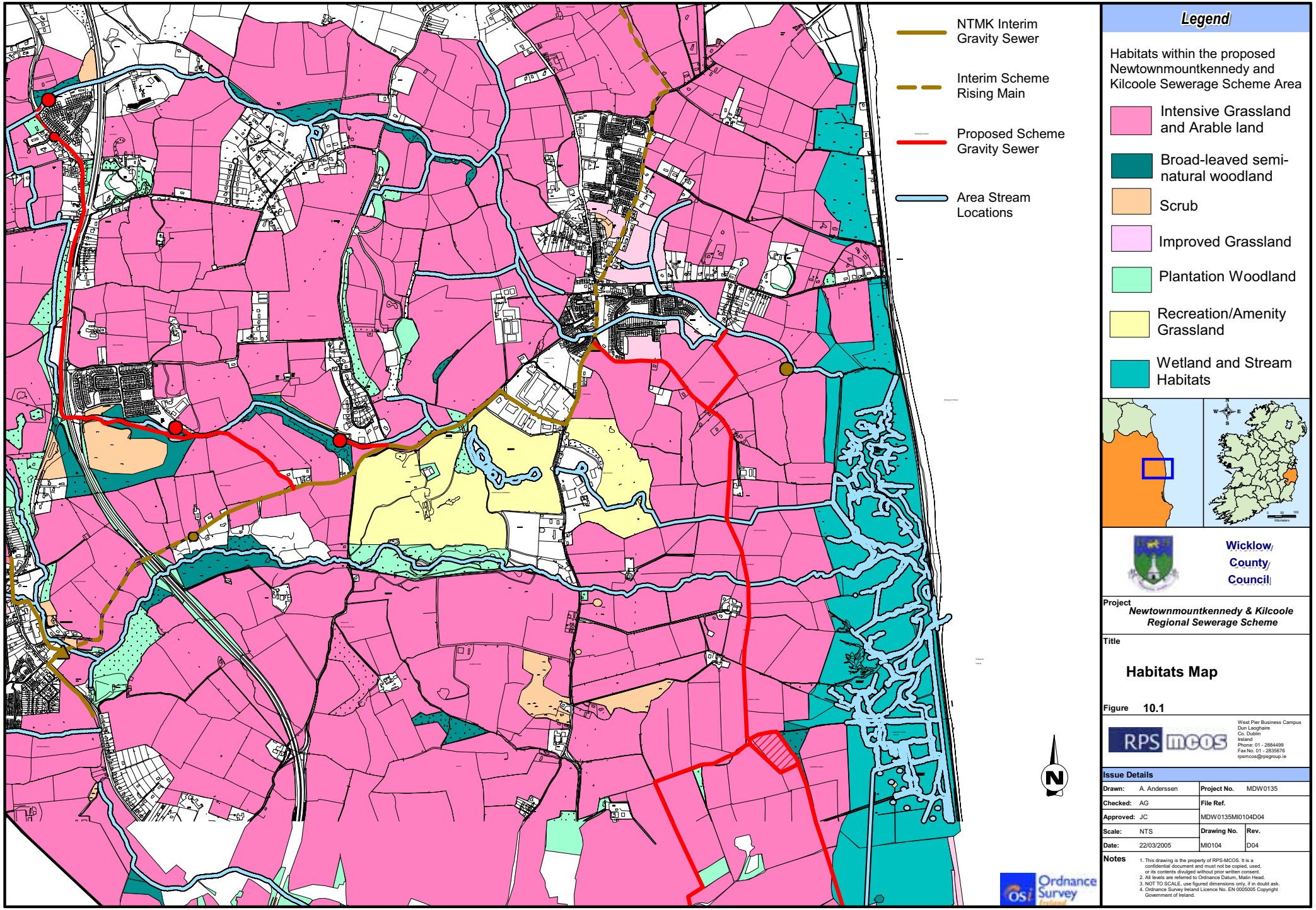
Broad-Leaved Semi-Natural Woodland

Broad-leaved semi-natural woodland occurs mainly along the valleys of the streams which flow through the scheme area. The species present vary with drainage and soil conditions, and with the extent of under-grazing by livestock. Ash is the dominant tree species present in drier woodland areas, with hazel, holly, and birch occurring commonly, and occasional oak, beech and sycamore. The shrub layer, where not limited by grazing, includes sapling trees together with elder, hawthorn, blackthorn, honeysuckle and bramble. The ground flora in dry woodland areas typically includes lesser celandine, primrose, bluebell, cow parsley, hogweed, wood anemone, golden saxifrage, false brome, wood sedge, remote sedge, creeping bent-grass, *Veronica* spp., herb robert, wood avens, dog violet, cleavers, wild garlic, lords and ladies, and occasional sanicle. Nettle and dock are common in undergrazed woods. Ivy dominates the ground flora in densely shaded areas. Dry woodland margins often merge with gorse dominated scrub, or occasionally with bramble scrub with bracken. An area of dry woodland in Kilmullin has been felled and replanted with conifers and broad-leaved trees.

Birch tends to dominate ash as woodlands become wetter, with alder and willow dominant in the wettest woodland areas. The ground flora in wet woodlands includes sedges, hard rush, water mint, brooklime, creeping buttercup, meadowsweet, common reed, *Glyceria* spp., sharp-flowered rush, jointed rush, and yellow iris. Marsh violet was found in an area of wet woodland on peaty soil near Newcastle Station. Wet woodlands occur as narrow bands along streams, and on peaty soils liable to waterlogging near or in the coastal wetlands. An area of wet woodland occurs on level ground subject to seepage of base rich water from sands and gravels on steeper valley sides, along the stream at and upstream of Kilquade Hill.

Plantation Woodland

Plantation woodland includes conifer plantations, and plantations of broad-leaved trees. Shrub and ground layer flora in conifer plantations are limited by shading. Broad-leaved plantations include oak,



Wicklow County Council

Project
Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title

Habitats Map

Figure 10.1

RPS mcos
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie

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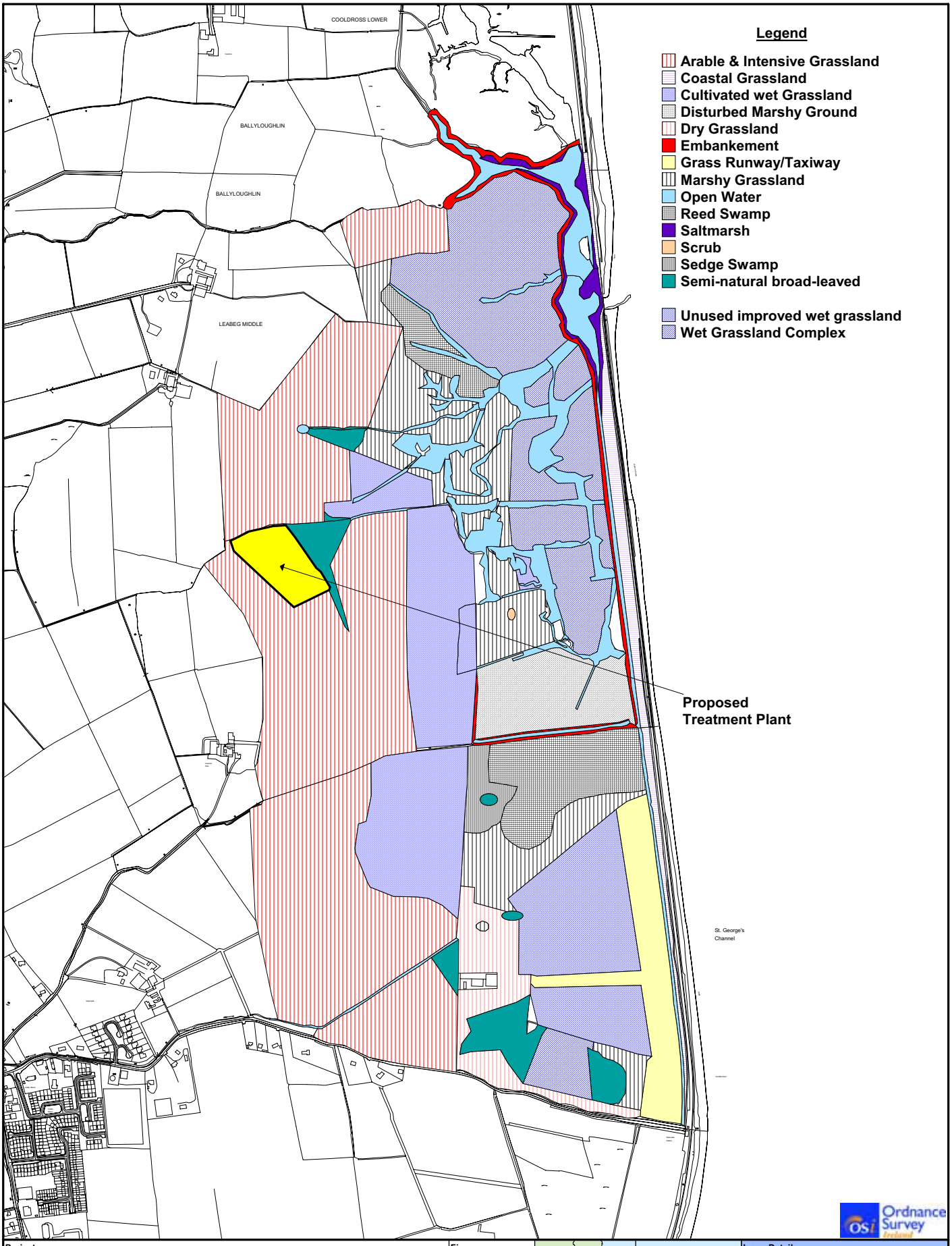

Project *Newtownmountkennedy & Kilcoole Regional Sewerage Scheme*

Figure 10.2

Title **Wetland and Coastal Habitats**

Wicklow County Council

RPS mcos
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie

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ash, beech, lime, sycamore, horse chestnut, and sweet chestnut. This category includes areas of well spaced planting with a grassy, undergrazed ground flora, for example on Kennedy Demense lands along the N11. Closed canopy broad-leaved plantation woodlands often have a sparse shrub layer of holly, and a ground flora of herbaceous species similar to that described for dry broad-leaved semi-natural woodland. The small oak woodland at Leamore Lower is an example of this type.

Scrub

Scrub is generally dominated by gorse. Within the scheme area, gorse scrub has developed on abandoned sand and gravel pits, and also occurs on steeply sloping ground which is not in agricultural production. Tree and shrub species occurring with gorse include hawthorn, blackthorn, birch, willow, and alder. Grass dominated swards lie between stands of gorse, with grass species including red fescue, crested dog's tail, Yorkshire fog and cock'sfoot. Dicotyledon species growing among gorse stands include clovers, vetches, docks, tormentil, ribwort plantain, wild carrot, and occasional hogweed. Hard rush and jointed rush occur in wetter areas, with carnation sedge, long-stalked yellow sedge and glaucous sedge.

The main area of scrub occurs on an abandoned sand and gravel pit to the south of Garden Village. Gorse occurs in dense stands, with bramble and some willow, birch, and butterfly bush *Buddleia*. The gorse scrub merges into dry broad-leaved semi-natural woodland on higher ground, and into wet woodland along the stream.

Hedgerow

The plant species mix in hedgerows varies with management. Regularly trimmed hedgerows are dominated by bramble, with hawthorn, blackthorn and elder. Less intensively managed hedgerows are more species rich. These are generally dominated by hawthorn and blackthorn, with holly, elder, gorse, wild rose, honeysuckle, hazel and bramble also occurring. The most common hedgerow tree is ash, with sycamore, oak, beech, sweet chestnut, horse chestnut, scots pine and wild cherry also occurring. Elm suckers are occasionally present. Generally, hedgerows contain few mature trees, but there are some fine rows of mature ash, oak, beech, and sweet chestnut trees. Alder and willow occur in hedgerows along streams, and on wet ground.

Hedgerow ground flora is most diverse where mature trees are present, and resembles woodland ground flora. Roadside verges adjoining hedgerows are mown occasionally, and are grass dominated. Species present include Yorkshire fog, cocksfoot, bent grasses, red fescue and ryegrass. Creeping buttercup, nettle, dock, hogweed and alexanders also occur, with winter heliotrope and woodland species such as cleavers, lords and ladies, wild garlic, and celandine under trees.

Hedgerows are significant habitat features in intensively farmed areas, since they are a reservoir for wild plants, particularly woodland flora. They provide important habitat for insects, birds and mammals.

Intensive Grassland and Arable Land

Intensive grassland and arable land covers most of the proposed Newtownmountkennedy and Kilcoole sewerage scheme area. Grassland is intensively managed, ryegrass dominated with white clover, and is species poor. Additional species typical of intensive grassland occur sparsely. Most grassland in the scheme area is re-seeded regularly in rotation with tillage crops. Some fields which are less intensively managed but remain dominated by ryegrass are included in this category.

The main crops grown in the scheme area are wheat, barley, rape and potatoes, and occasionally linseed. Fodder crops include fodder beet, and maize which is grown for silage.

Improved Grassland

Improved grassland is limited in extent within the proposed scheme area. It is defined here as fallow or lightly grazed grassland, on land which was previously in full agricultural production, which now generally adjoins or is proposed for development or other change of use/ownership. Improved grassland is a transitional habitat, and supports a wider range of grass and dicotyledon species than intensive grassland. It generally includes developing gorse or willow scrub, and if unmanaged will tend to develop into scrub woodland.

Recreation/Amenity Grassland

Recreation/amenity grasslands include golf courses and sports fields. The vegetation is intensively managed and species poor grassland, usually consisting of sown fescue swards. Areas of introduced shrub landscape planting are included in this category, these consist mainly of non-native ornamental species.

Buildings, Gardens and Unvegetated Surfaces

Buildings, gardens and unvegetated surfaces were not mapped in detail, although gardens and open spaces among houses and other buildings are generally vegetated with both native and introduced plants. Any impacts on these areas arising from the proposed scheme are considered under headings for individual components of the scheme.

Stream Habitats

Stream beds within the scheme area consist of gravels, fine gravels and sands, with small areas of silt accumulation. A total of six streams flow west to east through population centres and townlands in the scheme area as follows:

- Delgany/Greystones
- Kilpedder/Kilcoole (Stream A)
- Garden Village/Kilquade Hill (Stream B)
- Newtownmountkennedy (Stream C)
- Leabeg/Leamore
- Newcastle (Stream D)

Aquatic and marginal stream flora varies with the degree of shading by overhanging trees and scrub. Stream channel and marginal flora typically includes fool's watercress, watercress, and brooklime, with occasional hemlock water-dropwort, creeping bent grass and sweet-grass. Additional stream margin and bank species are great willowherb, soft rush, hard rush, creeping buttercup, nettle, dock and meadowsweet. Reed canary grass and marsh marigold occur with great willowherb on the Delgany/Greystones stream just upstream of the Greystones sewage treatment plant.

Filamentous green algae attach to larger stones on the stream beds in some unshaded areas. The plant species present are typical of relatively enriched lowland watercourses. There is evidence of point source enrichment of streams associated with all of the existing sewage treatment plants in the proposed scheme area, with gross pollution of the Newtownmountkennedy stream at and for several hundred metres downstream of the sewage treatment plant. There were no aquatic macrophytes in this section during the survey, but abundant bacterial slime/sewage fungus coated the bed of the stream.

Kilcoole Marshes: Wetland Habitats

Wetland habitats within the Kilcoole Marshes area relevant to the proposed development are described in detail below, and mapped in **Figure 10.2**. Wetland habitats and vegetation types within Kilcoole Marshes between The Breaches and the Newcastle Station Road were assessed in order to select the most appropriate route for the proposed sewage treatment plant outfall pipe and associated pipeline assembly site. Two further options were considered for the outfall pipe: immediately to the south of the Kilcoole Station Road, and immediately to the south of the Newcastle Station Road. Both these options were rejected on grounds of habitat sensitivity.

Kilcoole Marshes are separated from the open sea by a shingle ridge, with strong offshore currents and highly mobile gravels resulting in closure of The Breaches, through which the marshes drain to the sea. Closures are unpredictable, and may last for days or several weeks. The Breaches may open naturally, but are more often opened by machinery. Sediments within the marsh area consist of fen peats interbedded with marine or estuarine clays (Nairn and Crowley, 1998), indicating that the hydrology of the area has changed through time, with fen peats being laid down under fresh water conditions, and clays under brackish or fully tidal conditions. The An Foras Forbartha listing of Areas of Scientific Interest refers to well developed saltmarsh at The Breaches during the 1970s (see An Foras Forbartha, 1981).

The construction of embankments with flap valve outfalls on drainage channels during the late 1980s has altered the hydrology of the marshes. Tidal influence is now restricted to the channel between the embankment and The Breaches. When The Breaches close periodically, flap valves in the embankment close as water level rises in the tidal channel, and the main area of the marshes floods with fresh water from the inflowing streams. Vegetation surveys in October 1992 (Newtownmountkennedy Sewerage Scheme Hydrographic Survey) and 1993 (Dúchas - National Parks and Wildlife) indicated reduced, but still evident saline influence in the main area of the marshes, to the west and north of the embankments, with saltmarsh vegetation still present along drainage channels. Vegetation survey in February and March 1999 indicates that saline influence in the main area of the marshes has diminished further. Habitats recorded in the coastal wetlands between Newcastle and Kilcoole are as follows:

- Sandhill and shingle ridge vegetation
- Coastal grassland
- Saltmarsh
- Marshy grassland
- Sedge swamp
- Reed swamp
- Wet grassland complex
- Unused improved wet grassland
- Cultivated wet grassland
- Dry grassland
- Scrub
- Semi-natural broad-leaved woodland
- Aquatic communities of drains and channels.

The distribution of wetland habitats between The Breaches and Newcastle Station is shown in **Figure 10.2**.

Sand Hill and Shingle Ridge Vegetation

The main area of sand hill vegetation occurs to the north of The Breaches, where the main species are marram grass and lyme grass. This vegetation grades into coastal grassland (see below). The shingle ridge is vegetated throughout its length above the spring tide line with colonising species including sea rocket, sea beet, sea sandwort, sea holly, yellow horned-poppy, and sea spurge.

The introduced species Hottentot fig and sea buckthorn both occur in this habitat.

Coastal Grassland

This grass dominated vegetation lies mainly between the railway line and the drainage channel which runs parallel to the railway line on the landward side. Small areas of coastal grassland lie on the seaward side of the railway line, and merge into shingle ridge vegetation. The main area of coastal grassland between The Breaches and Newcastle Station is an ungrazed grass dominated vegetation. The dominant grass species is red fescue, with some cock'sfoot, Yorkshire fog, crested dog'stail, creeping bent-grass, and ryegrass. Dicotyledon species include wild carrot, ribwort plantain, creeping cinquefoil, yarrow, bird's foot trefoil, scentless mayweed, kidney vetch, and sea campion. Curled dock and hogweed also occur occasionally. Buck'shorn plantain is common on well trodden pathways. A more diverse flora dominated by dicotyledon species occurs on recently disturbed gravelly soils. Sea beet occurs in lower areas liable to flooding.

Saltmarsh

The area of saltmarsh in Kilcoole Marshes is now very restricted. It is limited to the margins of the tidal channel on the seaward side of the embankments, with the main area occurring close to The Breaches **(Figure 10.2)**. The main grass species are red fescue (Festuca rubra rubra), common salt-marsh grass and sea couch. Dicotyledons recorded in February 1999 were sea-purslane, common scurvey-grass, thrift, bucks'horn plantain, greater sea-spurrey, and sea lavender. Additional salt marsh species recorded in previous surveys were lesser sea-spurrey, glasswort species, sea aster, sea plantain, sea arrowgrass, and sea milkwort.

Marshy Grassland

Marshy grassland occurs on peaty soils with a high water table. Species present include purple moor grass, creeping bent-grass, rush species including soft rush, hard rush, sharp-flowered rush and jointed rush, sedges including carnation sedge and glaucous sedge, water mint, brooklime and meadowsweet, and occasional black bog-rush. Stands of yellow iris also occur. Marshy grassland is species rich and forms a mosaic with both drier and wetter vegetation types. A greater number of species would be recorded during the summer months when plants are well grown and more readily identified. The area in which black bog-rush was recorded surrounds a small stand of scrub, with alder, willow, gorse, hawthorn and bramble.

An area of marshy grassland has been modified by unsuccessful re-seeding, and was largely unvegetated during survey. It is mapped as disturbed marshy grassland, and is likely to re-establish a marshy grassland type of vegetation.

Sedge Swamp

Areas of sedge swamp occur adjoining the main areas of reedswamp in Kilcoole Marshes. The main species present is greater pond sedge, which forms virtually mono-dominant stands.

Reed Swamp

Reed swamp is dominated by the common reed. The main areas of reed swamp are shown in **Figure 10.2.** Common reeds also occur in drains and larger water channels within the marsh area.

Wet Grassland Complex

Wet grassland complex occurs on mineral soils in areas that are liable to flooding by fresh water when The Breaches are closed. This vegetation type has not been reseeded, but has been improved by fertiliser application and is no longer subject to tidal influence. Salt marsh vegetation recorded during the 1992 and 1993 surveys has virtually disappeared from this area, greater sea-spurrey and buck'shorn plantain were the only salt marsh dicotyledons found during February and March 1999, near

the reed swamp in Leabeg Middle. Common saltmarsh grass was rather more widespread. Wet hollows were dominated by floating sweet-grass, marsh foxtail and creeping bent-grass. Drier areas were vegetated with sweet vernal grass, crested dog'stail, ryegrass, Yorkshire fog and meadow grasses. White clover and daisy were abundant, with occasional ragwort, dock and thistle. Small gorse bushes were occasional along drainage channels. The side slopes of drainage channels were vegetated with grasses, principally creeping bent grass, replacing salt marsh vegetation which occurred along the channels when they were tidal.

A further grassland area to the north of The Breaches has been reseeded with ryegrass, but is liable to flooding and thus retains some wetland grass species.

Unused Improved Wet Grassland

This vegetation occurs on land which has been drained and reseeded, but has not been subject to regular agricultural use subsequently (**Figure 10.2**). Sown ryegrass dominates the sward through much of the area, but is gradually being replaced by a more diverse grassland with species including Yorkshire fog, sweet vernal grass and creeping bent-grass, with creeping buttercup, meadow buttercup and occasional dock. This vegetation becomes wetter towards the north, and is developing a more species rich wet grassland/marshy grassland flora including marsh pennywort and sea club-rush.

Cultivated Wet Grassland

Cultivated wet grassland lies on peaty soils that are relatively well draining, although subject to some surface flooding or waterlogging and which have been cultivated and seeded. The main area of this vegetation is in ryegrass production, but a small area has been in tillage. The wetland influence in this type is evident in surface depressions and hollows, which are vegetated with floating sweet-grass, creeping bent-grass, jointed rush and brooklime.

Dry Grassland

Dry grassland has developed on an area of freely draining, formerly disturbed ground, and contains elements of ephemeral and short perennial vegetation of disturbed ground. Grass species present include couch grass, Yorkshire fog, cock's foot, and creeping bent. Dicotyledon species include thistle, dock, fumitory, chickweed, scentless mayweed, creeping buttercup, corn marigold, and sow thistle. Patches of tall herbaceous vegetation occur, dominated by nettle and great willowherb. This vegetation merges into marshy grassland towards the north, with stands of yellow iris, soft rush, and increasing rush and sedge cover.

Scrub

A single small area of scrub occurs, surrounded by marshy grassland with black bog-rush **(Figure 10.2)**. The scrub includes gorse, alder, willow, hawthorn and bramble.

Semi-Natural Broad-Leaved Woodland

The woodland areas shown in **Figure 10.2** are principally wet woodland areas, as described previously. The main woodland area adjoining the site of the proposed sewage treatment plant, along its eastern boundary, is dominated by alder and birch, with willow and ash also occurring. There is a dense shrub layer of bramble through most of the woodland, with occasional common reed and great willowherb. The soil is organic rich and peaty. A narrower strip of woodland running southwards along the eastern site boundary is on drier soil, and includes sycamore, ash, beech and birch, with occasional hawthorn, bramble and willow. The grazed ground flora includes hogweed, cleavers, nettle, and lords and ladies.

Aquatic Communities of Drains and Channels

Drains and channels have developed an aquatic and emergent vegetation since the embankments were constructed and the channels ceased to be tidal (P. Farrelly, pers. comm.). Most of the channel vegetation occurs within the areas surrounded by marshy grassland, and it is currently relatively sparse. Species recorded during February and March 1999 were fool's water-cress, water-cress, common duckweed, spiked water-milfoil, branched bur-reed, bulrush, common club-rush, sea club-rush, and common reed.

Taxiway Runway Grassland

A taxiway and runway grass airstrip **(Figure 10.2)** has been seeded with ryegrass, and is mown regularly.

Fauna

Field survey was carried out in February and March 1999 and walked again in October 2004 to confirm the habitat mapping. The presence of mammalian fauna was established with reference to field signs such as tracks, droppings, burrows, feeding signs etc. Birds observed during habitat surveys were recorded. Information on breeding little terns *Sterna albifrons*, and data on wintering waterfowl from the I-WeBS database, were acquired from Birdwatch Ireland.

Mammals

Evidence of otters was common in Kilcoole Marshes and along streams in the scheme area. Spraints were particularly common in the marshes. Mink signs were not observed, but they do occur in the area, sometimes predating the little tern colonies on the shingle beach. Fox and badgers signs were found throughout the scheme area, and a number of badger setts were located. Mammalian fauna was typical of rural areas. Bat surveys were not carried out, but suitable mature trees in woodlands and hedgerows are likely to be used as bat roosts.

Wintering Waterfowl

Wintering waterfowl use the wetland areas included in the Murrough proposed NHA and SAC; the grazing species in particular whooper swans and Brent geese also use intensive grassland in the area, while greylag geese feed on stubbles and root crops as well as grassland and wetlands. Peak counts for the main species using the area between Kilcoole and Six-Mile Point are given in **Tables 10.1** and **10.2** below, for the 1995/96 to 1997/98 and 98/00- 02-03 winter seasons.

Table 10.1: Winter Waterfowl Counts for the Area between Kilcoole and Six-Mile Point

Species Name	1995/96	1996/97	1997/98
Little grebe	5	14	8
Cormorant	14	18	36
Grey heron	6	10	9
Mute swan	19	37	35
Whooper swan	48	35	49
Greenland white-fronted goose	8	0	20
Greylag goose		*50	1
Light-bellied Brent goose	**650	**962	**1,040
Shelduck	80	39	41
Wigeon	950	960	830
Gadwall	3	12	6
Teal	*500	475	440
Mallard	150	130	180
Pintail	1	0	1
Shoveler	14	10	6
Pochard	10	16	1
Tufted duck	0	5	2
Common scoter	*200		4
Water rail	2	2	3
Moorhen	5	15	8
Coot	3	5	1
Oystercatcher	30	24	55
Ringed plover	20	40	25
Golden plover	50	400	*1,500
Lapwing	*2,500	*3,520	230
Dunlin	400	250	20
Curlew	350	400	395
Redshank	150	110	75
Turnstone	30	25	19
Little gull	7	26	0
Black-headed gull	700	1,300	280
Common gull	100	30	14
Herring gull	500	800	200

Data from I-WeBS, provided by IWC BirdWatch Ireland. WeBS is a joint project of BridWatch Ireland, the National Parks and Wildlife Service and the Wildfowl and Wetlands Trust.

** indicates counts equal to or exceeding the threshold for international importance, i.e. 1% of the world population of a species or sub-species (Delany 1997)

* indicates counts equal to or exceeding the threshold for national importance, i.e. 1% of the all-Ireland population of a species or sub-species (Delany 1997).

Table 10.2: Winter Waterfowl Counts for the Area between Kilcoole and Six-Mile Point

Species Name	1% National	1 % International	98/99	99/00	00/01	01/02	02/03	Mean	Peak
Red throated Diver		750	11	22	17	20	28	20	28
Great Northern Diver		50	2	1		1	2	1	2
Little Grebe	30		7	9	12	13	13	11	13
Great Crested Grebe	35		1	1	2	1	1	1	2
Cormorant	105	1200	22	22	22	36	50	30	50
Grey Heron	105	4500	10	10	10	12	16	12	16
Little Egret		800		3	3	4	3	3	4
Mute Swan	100	2400	36	30	30	20	34	30	36

Species Name	1% National	1 % International	98/99	99/00	00/01	01/02	02/03	Mean	Peak
Bewick's Swan	20	170	2	4				1	4
Whooper Swan	100	160	60	49	40	59	108	63	108
Pink fronted Goose		2250			1			0	1
Greenland White Fronted Goose	140	300	14			3		3	14
Greylay Goose	50	1000		290	215	191	315	202	315
Canada Goose				3				1	3
Barnacle Goose	80	320		1		1		0	1
Dark Bellied Brent Goose				1	2	1	2	1	2
Light bellied Brent Goose	200	200	655	780	1080	1160	1086	952	1160
Shelduck	125	3000	31	27	38	83	72	50	83
Wigeon	1000	12500	1080	525	1010	565	455	727	1080
Gadwall	20	300	3	1	8	6		4	8
Teal	500	4000	475	527	552	310	383	449	552
Green winged teal					1			0	1
Mallard	500	20000	232	291	270	120	59	194	291
Pintail	20	600	2		9	2		3	9
Shoveler	40	400	5	17	7	11	2	8	17
Pochard	350	3500	1					0	1
Tufted Duck	300	10000			2	3		1	3
Scaup	50	3100				1		0	1
Long tailed duck	20	20000		1				0	1
Common Scoter	120	16000	20	25	6	8	2	12	25
Goldeneye	100	3000	2		2			1	2
Red breasted Merganser	25	1250		1		5		1	5
Coot	300	15000		1		1	8	2	8
Moorhen			6	19	25	22	17	18	25
Water Rail			2	2	5	1	2	2	5
Oystercatcher	700	9000	29	12	160	44	46	58	160
Ringed Plover	100	500	65	26	80	37	47	51	80
Golden Plover	1500	18000	25		70	10	73	36	73
Grey Plover	50	1500	1			3	1	1	3
Lapwing	2000	20000	350	226	86	450	831	389	831
Knot	250	3500		12	1	1	1	3	12
Sanderling	40	1000			1			0	1
Little Stint		2100	1	1	3	4		2	4
Pectoral Sandpiper			2					0	2
Curlew sandpiper		4500	5	1	1		1	2	5
Dunlin	1200	14000	75	61	186	40	79	88	186
Ruff		10000	11	2	6			4	11
Snipe		10000	2	4	10	10	30	11	30
Back Tailed Godwit	80	700	8	4	11	1	11	7	11
Bar tailed Godwit	175	1000	1	3	1			1	3
Whimbrel		6500	5	4				2	5
Curlew	1000	3500	260	316	390	169	214	270	390
Spotted Redshank		1500		1				0	1
Redshank	250	1500	30	30	98	28	44	46	98
Greenshank	20	3000	1		1	1	1	1	1
Turnstone	100	700	12	5	16	25	9	13	25
Grey Phalarope						2		0	2
Mediterranean Gull				1				0	1
Little Gull		750	1			18		4	18
Black headed Gull		20000	500	400	404	338	424	413	500
Common Gull		16000	40	15	60	20	22	31	60

Species Name	1% National	1 % International	98/99	99/00	00/01	01/02	02/03	Mean	Peak
Lesser black backed Gull		4500	30	1	43	4	19	19	43
Herring Gull		13000	300	300	40	100	32	154	300
Glaucous Gull			1	1				0	1
Great black backed Gull		4800	8	11	12	5	12	10	12
Sandwich Tern		1500		150	15	24	9	40	150
Black Tern		2000		2				0	2
Kingfisher			1		1	1	1	1	1

Data from I-WeBS, provided by IWC BirdWatch Ireland. WeBS is a joint project of BridWatch Ireland, the National Parks and Wildlife Service and the Wildfowl and Wetlands Trust.

Light bellied Brent geese occur in Kilcoole marshes in internationally important numbers. During the mid 1990s, teal, golden plover and lapwing occurred at least occasionally in nationally important numbers. Golden plover and whooper swan are both listed in Annex 1 of the Birds Directive as species requiring special conservation measures. Numbers of Brent geese recorded in the marshes during February and March 1999 fieldwork varied between 350 and 700, there was a count of 850 in January 1999 (P. Farrelly, pers. comm.). Thirty three whooper swans were present on several counts.

Some changes are apparent in more recent waterfowl data (Table 10.2), with greylag geese now regularly present and whooper swan occasionally present in nationally important numbers. Little egret now occur at Kilcoole, this bird is a recent addition to the Irish avifauna. The winter waterfowl populations using Kilcoole Marshes have altered since the embankments were constructed and the marshes have become less saline (P. Farrelly, pers. comm.). Wader numbers have declined, apparently in association with reduced areas of intertidal mud. Brent geese have increased substantially in association with reseeding of wet grassland. **(Figure 10.1)** Pochard, tufted duck, gadwall and garganey now occur regularly in small numbers.

As regards habitat use, whooper swans feed on cultivated wet grassland and wet grassland complex. Brent geese feed mainly on wet grassland complex vegetation. Greylag geese and curlew used to use the area now occupied by unused improved wet grassland, this vegetation was unsuitable for use by significant numbers of waterfowl when surveyed in 1999. Teal feed mainly in marshy grassland. Wigeon feed on marshy grassland and wet grassland complex, with some use of wet areas within cultivated wet grassland.

Breeding Waterfowl

The numbers of waterfowl species which breed in Kilcoole Marshes have grown as fresh water influence has increased. Mute swans, little grebe, moorhen, coot, water rail, redshank and snipe all breed successfully, mainly in marshy grassland, sedge swamp and reed swamp. Wet grassland complex is suitable breeding habitat for lapwing, and birds were seen in territorial behaviour by mid-March. Between 10 and 15 pairs breed annually in the marshes area (P. Farrelly, pers. comm.). The main area of unused improved wet grassland is too dry to support breeding waders; the northern end which merges into marshy grassland and reed swamp may be included in snipe and redshank breeding territories. Shelduck and mallard breed in small numbers in unused improved wet grassland. Ringed plover and oystercatcher nest on the shingle ridge.

Other Bird Species in Kilcoole Marshes

Reed bunting, meadow pipit, stonechat and skylark breed in unused improved wet grassland and marshy grassland habitats. Sedge warbler and possibly reed warbler also breed in the reed beds. The rare bearded tit has been recorded breeding within the Murrough, but has not been recorded in Kilcoole Marshes to date.

Marsh harriers and short eared owls have been recorded hunting over the marshes, peregrine falcons, sparrowhawks and kestrels are resident in the general area.

Farmland and Woodland Breeding Birds

The bird species recorded within the proposed sewerage scheme area are typical of lowland rural habitats. Resident species encountered during field survey were as follows:

Woodpigeon, collared dove, grey wagtail, pied wagtail, wren, dunnock, goldcrest, robin, blackbird, song thrush, mistle thrush, great, coal, blue and long-tailed tits, yellowhammer, chaffinch, greenfinch, goldfinch, house sparrow, starling, rook, jackdaw, magpie, and hooded crow. Additional species in woodland habitats include siskin and redpoll in the wet woodland near Newcastle Station; treecreepers and the migrant blackcap breed in the wet woodland adjoining the proposed sewage treatment plant at Leamore Lower (P. Farrelly, pers. comm.), migrant chiffchaff and willow warbler also breed in woodlands. Meadow pipit and skylark were recorded in improved grassland areas, where low intensity land use favoured these ground-nesting species. Whitethroat are expected to breed in scrub habitats.

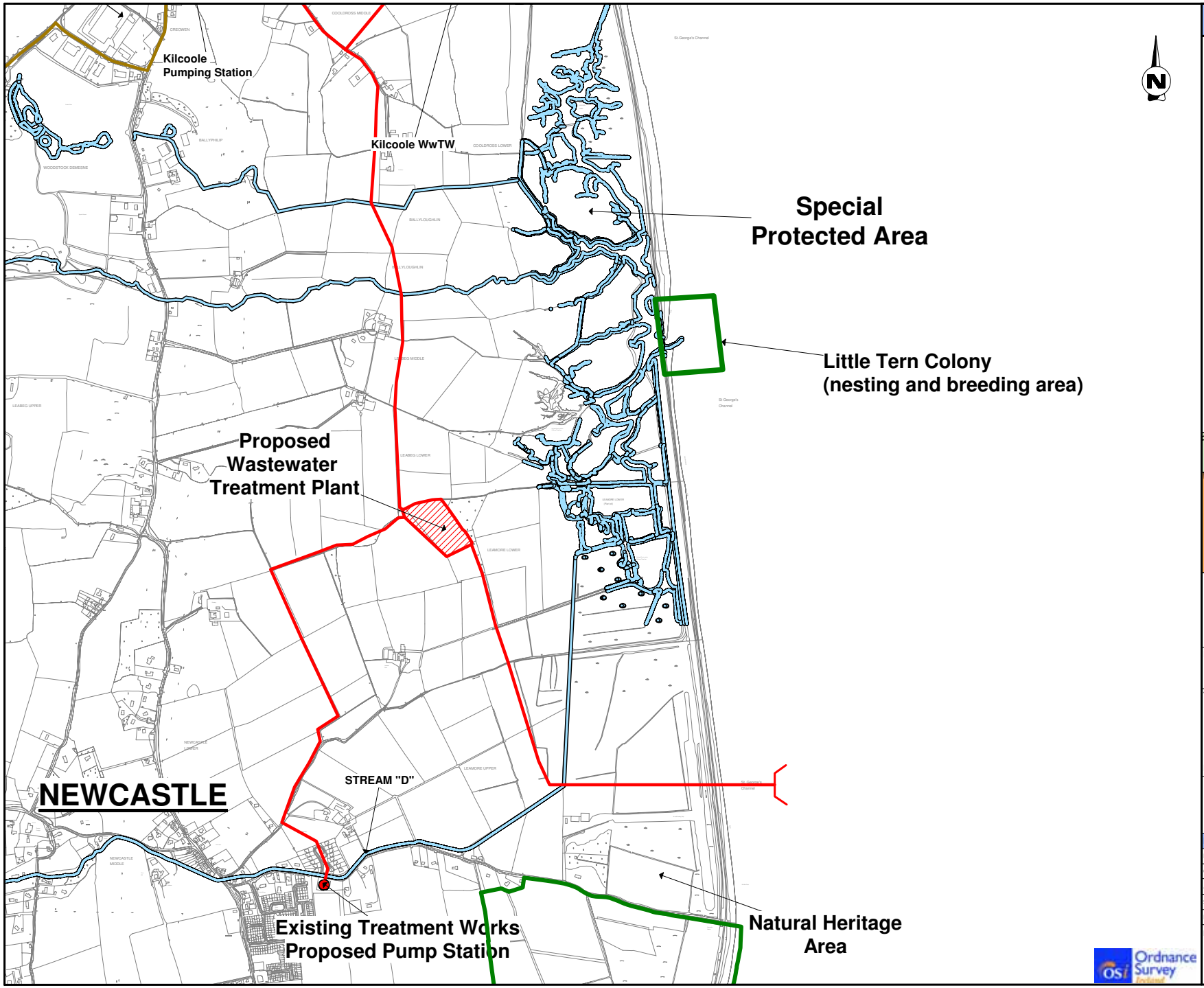
A small number of pairs of grey heron nest in trees at Leamore Park. Birds of prey recorded during field survey were kestrel, sparrowhawk, peregrine falcon, and buzzard. A pair of buzzards was recorded circling over fields between The Rookery and Leamore Park in early March 1999; buzzards have recently become established as a breeding species in County Wicklow. Barn owl territories are located near Kilquade Hill and Woodstock/Ballyphilip.

Breeding Little Terns on the Shingle Beach

The largest breeding colony of little terns *Sterna albifrons* on the east coast of Ireland is located on the shingle beach near The Breaches. Most of the terns nest either just north or just south of The Breaches. The usual recent position of the main colony extends over 200 to 400 metres from a point some 100 metres north of The Breaches. In previous years, the main colony was generally located just south of The Breaches (Phelan and Martin, 1998). The general location of the main colony is marked on **Figure 10.3**. In most years, a few pairs of terns nest at some distance from the main colony. In 1998 there were two distinct colonies. The second colony was located about 1km south of the Breaches, and spread out over a 650m length of beach to reach almost as far south as Six Mile Point , further south than the usual breeding distribution. Disturbance of the colony area at The Breaches by human activity during a fine weekend in mid-May was thought to have caused significant numbers of pairs of terns to attempt to nest further south. None of the nests of the southern colony succeeded, and the terns involved apparently re-nested at the colony at The Breaches (Phelan and Martin, 1998).

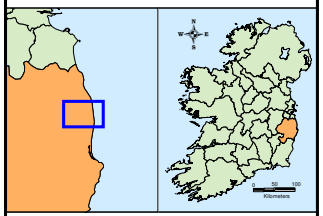
Little terns start to arrive at their breeding areas at the end of April or early May. The last birds generally leave the colony during the first week in August. Nesting generally begins around 20th May. Breeding success was poor in the early years of the little tern protection scheme, as a result of predation, human disturbance, and flooding by spring tides and/or storms. Poor water quality in Kilcoole Marshes when The Breaches are closed, due to sewage effluent in the inflowing streams, has been noted as problematic (Phelan, 1996; Leane and Phelan, 1997). Two or even three clutches of eggs may be laid as terns replace failed clutches. Successful breeding pairs generally leave the colony with their young as soon as they are fledged. More recently, experience gained in the operation of the little tern protection scheme has led to significant increases in the number of pairs of terns breeding, and in breeding success as indicated by the number of young fledged. In 2005, 100 pairs of little terns bred at the Kilcoole colony.

Little terns feed mainly at sea, up to 2km away from the colony, sand eels and sprats appear to be the main prey species taken. Terns also feed over the tidal/brackish channel at Kilcoole Marshes, particularly during stormy weather, and are thought to take gobies and young mullet (Phelan and Martin, 1998). Fresh water channels are used for bathing.



Legend

- NTMK Interim Gravity Sewer
- Interim Scheme Rising Main
- Proposed Scheme Gravity Sewer (indicative)
- Area Stream Locations
- Birdwatch Ireland (BWI) Reserve Areas



Wicklow County Council

Project
Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title
Little Tern Breeding Colony

Figure 10.3

RPS mcos
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie

Issue Details

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10.4 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

The scheme has been described in detail elsewhere in this EIS. The scheme will involve the following:-

1. Construction of a new treatment plant at Leamore on a site in agricultural use

2. Trench excavation for the provision of a collection sewer system along roadways, through agricultural land and associated hedgerow, scrub and woodland habitats

3. Trench excavation and limited tunnelling for provision of a marine outfall pipeline which traverses a sensitive wetland area subject to conservation designations under national and EU legislation

The scheme will result in the elimination of significant point sources of pollution to receiving streams, all of which flow into Kilcoole Marshes.

Impacts on flora and fauna arise through trench excavation for pipe-laying, tunnelling through the shingle ridge to complete the outfall pipeline, and the construction of the new treatment plant. There is a potential for the proposal to impact adversely on priority Annex 1 listed habitats in the Morrough Wetlands SAC and Blackditch Reserve, in the event of trenching work on lands nearby resulting in alternation of hydrological regimes and gradients associated with the protected habitats.

10.5 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

10.5.1 Leamore Treatment Plant Site

10.5.1.1 Potential Impacts

It is proposed to construct the new treatment plant at Leamore, on agricultural land. The site is a relatively low-lying field which is liable to some waterlogging. Wet woodland lies along the eastern site boundary, and a hedgerow with mature ash trees and badger setts along the northern boundary.

Potentially significant impacts are damage to woodland and hedgerow during construction, and pollution of watercourses draining into Kilcoole Marshes through spillages on the construction site. Common plants of cultivated land will be lost through replacement with buildings and paved surfaces; this impact is not significant.

10.5.1.2 Mitigation Measures

The woodland and drainage ditch along the eastern boundary of the new treatment plant site at Leamore will be fenced off before construction work starts. Hedgerows around the perimeter of the field will be similarly protected, with fences located at a minimum 3m distance from the base of hedgerows and outside the tree canopy width where trees are present, to minimise soil compaction over root systems. Access to the construction site will be along an existing farm access, and across fields. Access routes will be fenced off, with fencing at a minimum 3m distance from the base of hedgerows, to minimise soil compaction over root systems. All hedgerow and access road protective fencing will be post and wire type fencing, with the lowest strand at least 500mm above ground level, in order to facilitate movement of wild mammals particularly badgers through the area. It is not envisaged that any trees will be felled in order to carry out this element of the proposed scheme.

Site landscaping will include tree and shrub planting, including native species which occur in the area of the site. Suitable species are alder, willow cultivars, and silver birch on wetter ground, with ash, hazel, oak, holly, wild cherry, hawthorn and blackthorn on drier ground.

Strict site management with regard to storage and handling of fuels, oils, cement and other potentially toxic and hazardous substances will minimise the risk of pollution. An emergency plan to contain any accidental spillages will be put in place before construction work commences.

Surface water run off from buildings and paved surfaces will be managed according to best practice using sustainable urban drainage systems.

Water quality in the stream will be protected by strict site management. Fuels and oils will be stored in designated areas. All re-fuelling and maintenance work on machinery will take place in designated areas, which will be agreed and sited to minimise any risks of surface run-off or spillage to watercourses.

10.5.2 Collector Sewers

10.5.2.1 Impacts

Much of the pipeline route lies on intensive grassland and arable land, with some sections on existing roadways. There is some hedgerow with significant lines of mature trees, including oak trees, in the route corridor. The main ecological impacts relate to impacts on hedgerow trees, flora and fauna. Collector sewer routes also cross streams, with potential impacts on aquatic flora and fauna arising from siltation, and spillages of fuels and oils. Badger setts are present along the route corridor, requiring licences to deter resident badgers from using setts prior to trench excavation works, if impacted. Any felling of mature trees has the potential to impact on bat roosts and bats present within roosts.

The route has been selected to reduce impacts on flora and fauna. Impacts on broad-leaved plantation woodland have been largely eliminated by routing the pipeline through intensive grassland.

Impacts arise during trench excavation, when surface vegetation of intensive grassland and arable land will be removed. This impact is not significant with regard to flora and fauna. Impacts to hedgerow vegetation and fauna are potentially locally significant in the medium to long term.

Where the sewer network passes streams there is a potential for water quality impacts during construction work.

10.5.2.2 Mitigation

Final details of pipeline route selection across agricultural land will minimise impacts on hedgerows, particularly with mature trees, and streams. Where running parallel to hedgerows and treelines, trenches will be located outside the canopy width of trees or at least 3m from the base of hedges. Where pipeline routes cross hedges, treelines, and streams, they will be tunnelled/bored as appropriate to minimise loss of mature trees and disruption and siltation to streams. Final details of pipeline routes will be agreed on site with an ecologist, so that badger setts and other significant features such as mature treelines are not impacted by construction. Construction strips 30m wide through intensive grassland and arable land will be fenced off before work starts. Any trees and shrubs removed will be replaced, replanting the species lost.

Where tree and shrub felling cannot be avoided, clearance work will be carried out between September and February inclusive, to minimise impacts on vegetation, and potential impacts on protected bat species, and on breeding birds. Specific mitigation measures are given for bats and badgers below.

Water quality in streams will be protected by strict site management. Fuels and oils will be stored in designated areas. All re-fuelling and maintenance work on machinery will take place in designated areas, which will be agreed and sited to minimise any risks of surface run-off or spillage to drains and watercourses.

The pipeline route from Kilpedder and Garden Village to Ballygarret passes through a broad-leaved semi-natural woodland and scrub in the former gravel pit and along the stream which will be impacted, since it is an objective of the scheme to collect sewage from Garden Village. To reduce impacts, the pipeline construction strip will be a maximum of 10m wide as it passes through woodland and scrub areas. The route will be to the south (right bank) of the stream to minimise impacts on woodland, which has a longer recovery time than scrub habitat. Tree and scrub clearance will be carried out between November and February inclusive, and the construction strip fenced before clearance and construction work commence. Topsoil will not be mixed between scrub, woodland or farmland habitats. Ash and birch trees will be replaced in the woodland area; within scrub the construction site will be roughly levelled and left to revegetate naturally.

10.5.2.3 Specific Mitigation for Bats

All bat species are legally protected. A bat survey will be carried out immediately prior to tree/hedgerow removal to determine the likelihood of any trees scheduled for felling being used as roosts. Bat survey work must be carried out during the summer months, i.e. between the middle of May and the middle of August.

During tree felling operations the following mitigation measures will be implemented:

- Tree felling will be carried out during autumn (September to November inclusive), as this will avoid the breeding period when young bats incapable of flight are likely to be present, and the winter period when bats are likely to be in hibernation.

- Any trees which show crevices, hollows, dead limbs or other features such as ivy cover that could be in use as bat roosts, will be removed under supervision of a bat specialist who is licensed to handle bats.

- Large trees will be felled carefully, essentially by dismantling by tree surgeons, under supervision of a bat specialist.

- Any Ivy-covered trees should be left to lie for 24 hours after cutting to allow any bats concealed in the Ivy to escape.

10.5.2.4 Specific Mitigation for Badgers

Badgers are a protected species so any setts affected by the proposed development will be disturbed only in accordance with the requirements of and in consultation with the National Parks and Wildlife Service. The development site will be re-surveyed closer to construction to determine whether setts identified in the earlier survey are still active, and also to ensure that no further setts have been dug elsewhere on site. The optimal time to carry out such a survey is during winter when the vegetation has died back, i.e. middle of December to the end of March. Final selection of pipeline routes will seek to avoid impacts on setts.

10.5.3 Long Sea Outfall

10.5.3.1 Impacts

The construction of a marine outfall pipeline from the proposed treatment plant at Leamore involves the following construction activities:

- Excavation of a trench to accommodate the outfall pipe and an emergency overflow pipe. The temporary construction area along the pipeline will have a maximum width of 30m.

- Tunnelling through the shingle ridge in the underlying clay under the railway line, and construction of a sleeve through which the marine outfall pipe can be pulled

- Provision of a temporary 2ha pipeline assembly site along the outfall route to facilitate bottom-pulling into place of the marine section of the pipeline

- Provision of a temporary construction site including a coffer dam on the foreshore. It is estimated that construction work on the foreshore, tunnelling through the shingle ridge, and laying the marine section of the pipeline will take between two and three weeks to complete. Calm summer weather will be needed, during June, July or August.

The potential impacts of these activities are short term disruption to the little tern breeding colony, short to medium term damage to wetland habitats in construction sites, and potential long term impacts on hydrological regimes. Hydrological investigations carried out recently in, and in the vicinity of, the BirdWatch Ireland reserve at Blackditch have confirmed that these lands drain northwards towards The Breaches; there is a potential for hydrological impacts on wetland habitats within the reserve and SAC, which include priority Annex 1 listed Cladium fen, associated with excavation of a trench to accommodate the outfall and emergency overflow pipes. There is a potential for some influx of salt water associated with tunnelling through the shingle ridge, depending on outfall location. Short term impacts are the loss of vegetation and habitat along a 30m wide construction strip, and within the 2ha pipeline assembly area. Disturbance to breeding and wintering birds will occur over a larger area adjoining the temporary construction site. There is a potential for spillages or run-off of fuel and oils into watercourses and wetland habitats. These impacts are assessed as nationally, because of the conservation status of the habitats and species involved.

10.5.3.2 Mitigation

The principal mitigating measure is the selection of the outfall pipeline route. It is proposed to route the outfall pipe through the least sensitive habitats in the Murrough coastal wetland complex. While an indicative route for the outfall has been given in Figure 2.1 an ecological survey of the marshes will be carried out at an appropriate time of year (summer) prior to construction to determine most suitable route, based on habitat sensitivity. Ecological surveys, and the site investigation surveys referred to below, will be co-ordinated because it will be necessary to share information and consultation, to properly inform the final design.

Short term impacts are the loss of vegetation along a 30m wide construction strip. Topsoil will be removed and stored for replacement after the pipeline is laid; intensive grassland and cultivated wet grassland areas will be reseeded with ryegrass and field boundaries reinstated.

A 2ha pipeline assembly area will be constructed on unused improved wet grassland. Topsoil will be removed and stored for subsequent replacement. It will probably be necessary to create a firm working surface of broken stone or gravel, which will be laid over a geotextile to facilitate removal of the working surface after pipeline laying is complete. The assembly area will be restored to its existing contours. No

long term impacts on this habitat are envisaged. If reseeded, vegetation similar to that on unimpacted unused improved wet grassland is expected to establish within five years. Water quality in watercourses and wetland areas will be protected by strict site management. Fuels and oils will be stored in designated areas. All re-fuelling and maintenance work on machinery will take place in designated areas, which will be agreed and sited to minimise any risks of surface run-off or spillage to drains and watercourses.

From unused improved wet grassland, the pipeline will run in a tunnel at some depth under the coastal grassland and shingle ridge vegetation, to a coffer dam construction site on the foreshore close to Six Mile Point. This location is about 1 kilometre south of the usual southernmost extent of the little tern colony. Since construction work on the foreshore is weather dependent, it may coincide with breeding activity at the tern colony. Close liaison will be arranged with the BirdWatch Ireland tern protection scheme wardens, and with Dúchas - National Parks and Wildlife, during the year when construction will take place. Little terns will be deterred from any attempted nesting in the vicinity of the construction site through the use of agreed procedures, and encouraged to nest at the usual colony site at The Breaches. Procedures will be agreed and operational by the end of April, when little terns normally start to arrive, in the construction year.

The BirdWatch Ireland Blackditch reserve, and SAC area between Five Mile Point and Newcastle Station Road, contain a mosaic of reedbed, willow, the priority habitat *Cladium* fen, and an area of wet woodland which is habitat to a number of rare species of fly. Reedbeds and marshy grassland bordering this wetland complex extend to within 50m of the Newcastle Station Road; no construction work will take place to the south of the road in order to protect these habitats. Hydrological, flora and habitat surveys of the Blackditch reserve have been completed recently, and have confirmed that drainage from this complex is towards the north, through the drainage channel which runs between the airstrip at Newcastle and the railway line. The outfall pipeline will pass under this drainage channel and through the shingle ridge below sea level, thus there may be a potential for impacts on existing hydrological gradients in the area. Site investigations including boreholes will be carried out to type the sediments and assess hydrological gradients along and across the pipeline route before construction work starts, and the scope of this work will be informed by the findings of the Blackditch investigations. Investigation results and any implications for upstream wetlands will be subject to ecological assessment, and consultation with Dúchas - National Parks and Wildlife and with BirdWatch Ireland, so that detailed monitoring/mitigation and tunnel design and construction methods can be put in place as appropriate to safeguard important habitats.

10.6 RESIDUAL IMPACTS

Residual impacts after mitigation of the outfall pipeline route through the coastal wetland will be short term displacement of improved grassland which is developing a more wet grassland character, and small numbers of breeding birds from the pipeline assembly area. The species involved include meadow pipit, skylark and reed bunting. The pipeline will not traverse the main area of Kilcoole Marshes used by wintering waterfowl, or the cultivated wet grassland areas currently used by whooper swans, but there may be some minor disturbance impacts to waterfowl if construction work is in progress between November and mid-April inclusive. These residual impacts are assessed as being of slight short term local significance. No adverse long term impacts on wetland habitats are anticipated after implementation of all mitigation measures detailed above.

11 MARINE AND FRESHWATER ENVIRONMENT

A. MARINE

11.1 INTRODUCTION - MARINE

The proposed scheme will require the construction of an outfall pipe along the coast between The Breaches and Six-Mile Point on the Wicklow coast. The scheme may impact on marine, freshwater and terrestrial habitats, their fauna (including fisheries), flora and water quality. This chapter assesses the possible impacts of (a) the construction of the pipeline and (b) the operation of the scheme on the marine habitats and species and secondly to recommend mitigation measures to minimise the impact on the marine environment. To achieve this the marine habitats and species present in the area were surveyed.

In addition existing information was reviewed to assess the impact on local fisheries, in particular mussels (*Mytilus edulis* L.) and whelks (*Buccinum undatum* L.).

11.1.1 Study Area

The site for the construction of the pipeline is between the Breaches (53.091°N 06.038°W) and Six Mile Point (53.069°N 06.033°W), County Wicklow. The coastline consists of a linear shingle and gravel beach. To the north of the area, the beach is backed by an area of intertidal marsh which has been canalised and drained by the construction of earth embankments. The marsh is separated from the beach by the railway line. The marsh behind these embankments is not fully open to the tide and is a mixture of brackish and fresh water.

At present some existing untreated and partially treated sewage effluents from the Kilcoole area is discharged into the marsh via small streams and enters the sea via the Breaches. Periodically the Breaches (a break in the beach where the marshes drain) are blocked by shingle built up during periods of stormy weather. At these times the marsh floods as freshwater is dammed behind the shingle bank. The Breaches open when the water breaks through the shingle bank or when local farmers break down the bank.

Offshore from Six Mile Point the seabed slopes away to a maximum depth of approximately 25 m below chart datum (BCD) 2 km east of the shore. Offshore from the Breaches the seabed slopes more gently attaining a depth of 15 m BCD at the same distance offshore. To the north is the Breaches shoal which has a minimum depth of 5 m BCD. The area is subject to strong tidal streams reaching 2-3 knots offshore from the study area (Admiralty Chart 1468).

11.2 METHODOLOGY

11.2.1 Marine Communities

A previous investigation carried out in 1985 (Irish Hydrodata 1985) surveyed the subtidal seabed. Thirteen stations were sampled using a 0.1 m^3 Day grab or a Forsters anchor dredge. The dredge was used if the substratum was too coarse for a sufficient penetration (greater than 15 cm) by the grab. The location for siting the pipeline was not finalised following this study and further investigations were

required to assess the likely effect of the sewerage scheme on the subtidal and intertidal environment should the outfall be located further north or south.

On 12th May 1998 the open coast shoreline was surveyed as part of the SensMap project. The marine biotopes (see glossary) of the shore between High Water Springs (HWS) and Low Water Springs (LWS) were mapped following the methods of *Emblow et al.*

11.2.2 Fisheries

Irish Hydrodata (1985) described major fisheries for seed mussels (juvenile *Mytilus edulis*) and whelks (*Buccinum undatum*) in the area. The seed mussels are dredged by the Wexford fleet and are transported to Wexford harbour for sowing in the harbour where they are grown on and harvested. The Breaches Buoy bed which was surveyed in 1974 (Meaney and Lee 1974 and Meaney 1976) was noted as being of commercial importance. It was found to be approximately 636 acres in area and the average catch of mussels was 5.75 tonnes/hour recorded during fishing trials. According to local fishermen, who dredge mussels, the area of seabed off Kilcoole Marshes is one of the most important areas for seed mussels.

Whelks are taken in pots baited with dogfish. The fishery attracts boats from Dublin and Arklow. Currently over 40 boats fish for whelks each with up to 300 pots (M. Purcell, pers. comm.). The meat is transported to Wexford were it is processed and exported to the European and Japanese markets. It is cooked and frozen before being sent to Europe and exported uncooked frozen to Japan.

Irish Hydrodata (1985) concluded that while water quality in the area may be diminished this is not significant from the point of view of the mussel fishery as they were not for direct human consumption but for relaying. They also concluded that the discharge would also affect the locations fished for whelks, although the magnitude of these effects was not known.

11.2.3 Marsh

Seven sites were examined along the main drainage channel running parallel to the shore south of the Breaches on 15th February 1999 (**Table 11.1**). The temperature of the water was recorded at each location. Samples from the bottom of the channel were collected in a pond net at each location and conspicuous fauna and floral species recorded. Species which could not be identified *in situ* were preserved in 70 % Industrial Methylated Spirits (IMS) and returned to the laboratory for identification and counting. Specimens were identified to the lowest possible taxonomic level possible and a voucher collection of representative material made.

11.2.4 Subtidal

Nineteen subtidal sites were surveyed on the 18 and 19th February 1999. Samples were taken using a biological dredge fitted with a 1 cm mesh. The dredge was deployed for between three and eleven minutes (Table 5.2). Material collected was sorted on board and the relative abundance of conspicuous fauna and floral species recorded. Species which could not be identified *in situ* were preserved in 70 % Industrial Methylated Spirits (IMS) and returned to the laboratory for identification and counting.

Specimens were identified to the lowest possible taxonomic level possible using the following literature: For mysid crustaceans, Makings (1977), crabs, Crothers and Crothers (1983), shrimps and prawns, Smaldon (1993), Barnes (1994) and Hayward and Ryland (1995), for marine molluscs, Graham (1988) and Picton and Morrow (1994), for echinoderms, Picton (1993), for marine fish, Wheeler (1978), and for freshwater invertebrates, Croft (1986), Fitter and Manuel (1986) and Macan (1976). A voucher collection of representative specimens was made. Biotopes were identified following Connor *et al*. (1997a,1997b).

Table 11.1: Location of Sites and Temperature of Water at Each Site

No.	Location	Temp °C
1	53° 04.732N 006° 02.149W	7.4
2	53° 04.873N 006° 02.164W	-
3	53° 05.056N 006° 02.198W	7.4
4	53° 05.155N 006° 02.202W	-
5	53° 05.252N 006° 02.244W	7.5
6	53° 05.282N 006° 02.236W	7.7
7	53° 05.342N 006° 02.262W	7.9

Table 11.2: Site Locations and Details of Subtidal Dredge Sites

No.	Date	Position (Start)	Position (End)	Start time	End time	Total time - h:min
1	17-Feb-99	53.0623N 6.0318W	53.0567N 6.0335W	12:08	12:10	0:02
2	17-Feb-99	53.0478N 6.0253W	53.0452N 6.0262W	12:35	12:40	0:05
3	17-Feb-99	53.0480N 6.0177W	53.0452N 6.0192W	13:36	13:39	0:03
4	17-Feb-99	53.0418N 6.0102W	53.0355N 6.0105W	14:03	14:07	0:04
5	17-Feb-99	53.0712N 6.0175W	53.0685N 6.0167W	14:55	14:58	0:03
6	17-Feb-99	53.0735N 6.0195W	53.0707N 6.0192W	15:21	15:24	0:03
7	17-Feb-99	53.0733N 6.0287W	53.0710N 6.0278W	15:42	15:45	0:03
8	17-Feb-99	53.0915N 6.0333W	53.0907N 6.0332W	16:12	16:15	0:03
9	17-Feb-99	53.0913N 6.0157W	53.0898N 6.0150W	16:30	16:33	0:03
10	17-Feb-99	53.0922N 6.0002W	53.0910N 6.0008W	16:50	16:53	0:03
11	18-Feb-99	53.0684N 5.9998W	53.0673N 6.0001W	11:59	12:10	0:11
12	18-Feb-99	53.0736N 6.0002W	53.0701N 6.0009W	12:23	12:28	0:05
13	18-Feb-99	53.0705N 6.0045W	53.0668N 6.0052W	12:39	12:46	0:07
14	18-Feb-99	53.0721N 6.0211W	53.0694N 6.0205W	13:13	13:16	0:03
15	18-Feb-99	53.0700N 6.0307W	53.0678N 6.0308W	13:44	13:48	0:04
16	18-Feb-99	53.1011N 6.0357W	53.0998N 6.0345W	14:27	14:30	0:03
17	18-Feb-99	53.1001N 6.0226W	53.0966N 6.0229W	14:46	14:50	0:04
18	18-Feb-99	53.1024N 6.0047W	53.0956N 6.0025W	15:13	15:18	0:05
19	18-Feb-99	53.1064N 6.0232W	53.1030N 6.0233W	15:43	15:47	0:04

11.3 DESCRIPTION OF EXISTING ENVIRONMENT

11.3.1 Marsh

Seven sites were surveyed and 17 species were recorded in the marsh (**Appendix D**). Towards the southern end of the marsh common species included the freshwater water boatman *Sigara concinna*, the snail *Lymnaea peregra*, the common frog *Rana temporaria* and cased caddisflies (Trichoptera). Towards the northern end, near the Breaches, marine species including the mysid *Neomysis integer* and prawn *Palaemonetes varians* were more common.

The sites surveyed at the southern end of the marsh supported species typical of more freshwater environment. The species recorded towards the north and the opening at the Breaches were more

typical of estuarine or marine conditions. A temperature gradient was recorded from the south to the north further suggesting a salinity gradient from the colder freshwater to warmer seawater.

The presence of a number of juvenile flatfish species (flounder and plaice) indicates that the channel may be a nursery area for these species.

Of the species recorded only the frog *Rana temporaria*, is legally protected. It is noted in the Irish Red Data Book (Whilde 1993) as being known to be endangered, vulnerable or rare but which is indeterminate. It is also listed in Annex 5 of the Habitats Directive (Council of the European Communities 1992) as being a species whose taking in the wild and exploitation may be subject to management measures. While none of the other aquatic fauna recorded were rare or of particular nature conservation importance only a limited range of aquatic fauna was surveyed and identified to species level. Sampling in the summer could have significantly increased the numbers of marine species.

The area is important as it is an example of a limited habitat on the east coast. The area is designated as a candidate Special Area of Conservation (cSAC), forming part of The Murrough, and Special Protection Area (SPA). These designations have been made on the basis of species of nature conservation importance

Currently sewage from the area is discharged into the marsh via small streams. The construction of the pipeline will remove this input of sewage into the marsh and improve the water quality.

11.3.2 Subtidal

Nineteen stations were sampled and 121 species or higher taxa were recorded (**Appendix A, Volume 2**). Three main biotopes were identified from the species recorded. Inshore (stations 7, 8, 15 and 16) the substratum was predominantly mobile sand and gravel with very little infauna or epifauna (biotope IGS.Mob), although towards the north of the Breaches clay was noted in the dredge samples. Small stones and pebbles supported erect bryozoans *Flustra foliacea* and *Alcyonidium diaphanum* (not present at station 7).

Away from the shore species recorded were more characteristic of mobile cobbles and boulders. Typical was the dense cover of the barnacle *Balanus crenatus* with the tubeworm *Pomatoceros triqueter* forming biotope ECR.PomByC (stations 12 and 17).

Most of the seabed in the survey area appeared to consist of large boulders and stones dominated by the erect bryozoan *Flustra foliacea* and hydroids, in particular *Hydrallmania falcata*, *Sertularia argentea* and *S. cupressina* and *Halecium* spp. (biotope MCR.Flu.SerHyd), stations 1,3,4,5,6, 9 and 18).

When a dredge drags along the seabed it can sample several biotopes. Thus samples may contain mixtures of biotopes. In addition to the biotopes named above, some samples indicated the presence of kelp (MIR.Lhyp, stations 2 and 14), and mussel bed (MCR.MytHAs, stations 13 and 18) biotopes.

The biotopes recorded were typical of the east coast subtidal environment (authors unpubl. data). The previous survey in the area (Irish Hydrodata 1985) was not able to identify particular biotopes probably because it used different sampling methods at different sites and the BioMar guide to marine biotopes by Connor *et al.* (1997b) had not been published. However, similar to the present study, they recorded a bryozoan-hydroid dominated epifauna on cobbles near shore, and a mobile sandy-gravel habitat at their most offshore sites.

A rarely recorded species was the sea squirt *Distomus variolosus*. It is typically a southern species in Britain and Ireland. Millar (1970) considered records from north of southern England doubtful because of possible confusion with the solitary sea squirt *Dendrodoa grossularia*, also recorded on the survey.

Distomus variolosus has also been recorded adjacent to a sewage outfall at Wicklow (authors, unpublished data), the Saltee Islands and Roney Point, Co. Wexford (Picton and Costello in press). It is likely that this species has been under recorded rather than having a limited distribution.

Maerl, a calcareous red seaweed was recorded at several sites although it was not identified to species level. This is the first record of living maerl on the east coast of Ireland. Two maerl species, *Phymatolithon calcareum* and *Lithothamnion coralloid*es, are listed under Annex 5 of the Habitats Directive (Council of the European Communities 1992) as species 'whose taking in the wild and exploitation may be subject to management measures'. Where maerl occurs on the West coast of Ireland it can form dense growths on the seabed (authors, unpublished observations). At these locations the maerl supports a rich diversity of species. The records from the current survey are of sparse individual pieces on gravel and cobbles. It does not form a maerl biotope that would be sufficiently abundant for harvesting. Disturbance to these scattered pieces of maerl during the pipeline construction would not be exploitation and would not damage a rich associated fauna and flora.

The distribution of subtidal algae in the area is primarily determined by available substrata and secondarily by available light. The high mobility of the substratum and low light available restricts the algae to such an extent that algae do not form a major component of the subtidal biotopes. Short term increases in suspended sediments caused by construction works are thus unlikely to significantly limit plant growth.

11.3.3 Seashore

The open coast adjacent to the proposed outfall was previously surveyed by the authors and was characterised by barren gravel and sand. No species were recorded (biotope LGS.BarSh see). On the open coast, algae are limited to ephemeral species likely to colonise the more stable areas of the beach during the summer. These are widespread species which will recolonise suitable habitats if disturbed. The barren shingle biotope recorded on the open coast site is typical of the stretch of coastline between Greystones and Wicklow (authors, unpublished observations). The biotope is also typical of the east coast and generally has a low biodiversity of marine species (Connor *et al.* 1997a). It is seasonally disturbed by storms, such that physical disturbance by man will have a minimal effect on the marine biotopes present.

At the railway bridge, over The Breaches, there is a small patch of *Fucus ceranoides* which is characteristic of hard substrata subject to variable salinity (biotope SLR.Fcer). Here the water from the marsh flows into the sea. This is more or less the only hard substrata feature along the south of Greystones to Wicklow. The seashore is very mobile and the shore steeply inclined and prone to erosion. Along the top of the shore, gabions are used for coastal defence measures. No species of nature conservation interest were recorded here.

11.3.4 Fisheries

The study area is important for the seed mussel and whelk fisheries. There is a potential decrease in water quality due to the construction and operation of the pipeline, and subsequent increase in bacteria due to sewage discharge. Mussels feed on particles from the water, including sewage derived material, and thus could contain bacteria and viruses of public health concern. However, these impacts will not be relevant to the mussel fishery in terms of the EU directive for the production and placing on the market of live bivalve molluscs (Council of the European Communities 1979) as the mussels are not sold for human consumption but for sowing and on growing.

However, water quality studies indicate that existing bacterial levels in shellfish between 600 m and 1250 m from the shore are low, but consistent with levels in waters exposed to coastal effluent discharges. These discharges currently include untreated sewage at Shanganagh, Bray and Wicklow and treated effluent at Greystones.

The proposed discharges will also affect the areas where whelks are fished. In contrast to mussels, whelks do not filter particles from the water and are thus less likely to become contaminated by sewage. However, since there will be an increased bacteriological load, monitoring of whelks after construction of the scheme is proposed to verify that no contamination is occurring.

11.3.5 Water Quality

At present some existing untreated and partially treated sewage effluents from the Kilcoole area is discharged into the marsh via small streams and enters the sea via the Breaches. Two sites were sampled in 1999 to assess shoreline water quality. These are also shown in **Figure 11.1.**

Sampling in 1999 showed low-level bacteriological contamination with faecal coliforms in most samples. Elevated levels were shown in two samples however only 1 of 8 results were outside compliance with the Bathing Water Mandatory Standards. Water quality requirements are set out in the Quality of Bathing Waters Regulations 1992 and subsequent amendments as transposed from the European Council Directive concerning bathing water quality (76/160/EEC).

Further sampling was carried out in 2005 to assess the current water quality. Two rounds of sampling were carried out on 27th June and 6th July 2005 at locations E1 and E2. Bacteriological results for both sites were within mandatory limits of the Irish Regulations but also within the more stringent guide limits of the Directive. However on the second sampling suspended solids were elevated at both sites (24-37mg/l). BOD levels were acceptable (<2-3 mg/l), however ammonia levels were slightly elevated at E2 (0.4mg/l NH_3).

A sample was also taken on the freshwater side of the breaches on 27th June 2005 at site E3. Faecal coliforms were 242 number/100ml with total coliforms 550 number/100ml. These levels both exceeded the EC Directive guide levels of $\leq$100 and $\leq$500 for faecal and total coliforms respectively. This indicates impact of a sewage discharge upstream.

11.4 IMPACTS

In the short term, water quality in the marsh, on the seashore and in the subtidal may decrease through the inevitable release of sediment or accidental release of pollutants (e.g. oil and chemicals) during the construction of the pipeline and from adjacent infrastructure **(Table 11.3)**. This may cause a temporary decrease in water quality and smother existing habitats. The Contractor will be obliged to comply with the Water Pollution Act and undertake rigorous environmental management as regards prevention of such pollution.

In the long term, improved water quality in the marsh, the area of most conservation importance, is predicted because the sewage will no longer discharge into the marsh. On the seashore and in the subtidal a decrease in water quality is predicted once the sewerage scheme is operational. In particular an increase in bacteria is predicted and close to the discharge, slight increase in turbidity and particulate matter is predicted. However, computer simulations for satisfactorily treated effluent predict that it will perform satisfactorily and result in minimal contamination of the marine waters. (Chapter 4).

Fishing will temporarily be prevented within the location of the marine construction site. Disturbance of the seabed may damage the seed mussels and the habitat in which they live, locally in the area of the work also.

Table 11.3: Impacts of the Proposed Development on the Three Main Habitats Surveyed in this Study

Impact Type	Marsh	Seashore	Subtidal
Sedimentation	short term effect	short term effect	short term effect
Change in water quality	improved	no effect	potential decrease
Alteration to hydrology	No effect	no effect	no effect
Habitat disturbance	Possible	short term effect	short term effect
Damage to fisheries	No effect	no effect	possible

11.5 MITIGATION MEASURES

11.5.1 Pipe Location

The pipeline is located to minimise the impact on the marsh and marine environment taking into account the importance of terrestrial habitats and species. The pipeline will have a similar impact on the seabed wherever it is located within the survey area. The exact pipeline location will be selected to minimise the impact on the hydrography and ecology of the marsh.

11.5.2 Operational Standards

Sewage treatment will be undertaken at a level which maintains EU water quality standards for bathing and shellfish directives, to minimise adverse future impacts to the marine environment.

11.5.3 Long-Term Monitoring

Long term monitoring will be put in place to verify the plant performance and impacts to include:

(i) The bacteriological status of the water, including areas which are fished for whelks and used for bathing, in order to ensure that standards are maintained. Monitoring of the bacteriological quality of the whelks will be carried to verify the lack of contamination.

(ii) Water quality and biodiversity of the marsh fauna and flora;

(iii) The subtidal fauna and flora.

Table 11.4: Summary of Suggested Mitigation Measures to Minimise the Impact of the Development on the Marine Environment

Impact	Mitigation Measures
Sedimentation	Minimise the duration of construction works and the area affected.
Decrease in water quality	Minimise the risk of accidental spills of oil, fuel and other chemicals. Remove all wastes from the area.
Habitat disturbance	Minimise the area of marsh, seashore and seabed affected by the outfall construction.
Damage to fisheries	Minimise the area of seabed affected by the outfall construction. Buoy fixed at the outfall to alert fisheries to its location.

11.6 CONSTRUCTION AND MITIGATION

Due care and vigilance will be followed to prevent accidental contamination of the site and surrounding environment during the construction of the pipeline and infrastructure. In particular measures will be taken to prevent the contamination of the stream entering the watercourse draining into the marsh. Disturbance to the freshwater and marine water flows into the marsh will be minimised, and the hydrographic regime restored if affected.

11.7 RESIDUAL IMPACTS

There may be a slight decrease in marine water quality due to the outfall discharge resulting in negligible contamination of the marine environment.

B. FRESHWATER

11.8 INTRODUCTION - FRESHWATER

The catchment area potentially impacted by the proposed development is drained by four small rivers, denoted A, B, C, D. These streams are characterised by very low summer flows, making them relatively unsuitable for effluent disposal, however they are currently being impacted by discharges from existing wastewater treatment systems. Furthermore, all streams discharge to the Kilcoole inter-tidal marshes and to the sea. Therefore, there is also the risk of pollution to the inter-tidal waters at the marshes. The proposed scheme will enable these stream discharges to cease and this should result in improvements in water quality of the freshwater streams and also the marsh.

11.9 EXISTING ENVIRONMENT

11.9.1 Receiving Waters

The four small rivers draining the catchment area, **(Figure 11.1)** are characterised as follows:

- **Stream A** drains the Kilpedder and Kilcoole areas and receives treated effluent from the **Kilpedder** package works. The Kilcoole treatment works which previously discharged is now pumped to Greystones.
- **Stream B** flows through Newtownmountkennedy Demesne and via Garden Village, Kilquade, Druids Glen and Kilcoole Golf Clubs. It receives effluent from **Garden Village** and **Kilquade Hill**.
- **Stream C** is a larger stream which drains a hilly catchment to the west of Newtownmountkennedy with two significant branches converging near the town before flowing under the N11. It previously received effluent from Newtownmountkennedy, with minimal treatment, resulting in significant pollution however this is now pumped to Greystones.
- **Stream D** drains the catchment to the south of Newtownmountkennedy including Killadreenan, before flowing easterly through Newcastle, to the Kilcoole marshes, receiving the effluent from **Newcastle** wastewater treatment works to the east of the village.

11.9.2 Historical Water Quality

In 1992 and 1993, there was extensive sampling of these streams and further sampling was carried out in early 1999. The results confirmed that the treatment plants of Kilpedder, Kilcoole and Newtownmountkennedy caused significant pollution of the receiving waters. The Kilpedder and Kilcoole plants, which provide extended aeration treatment, were not operating satisfactorily, with only limited reduction in BOD_5, ammonia and phosphate. The Newtownmountkennedy plant has since been decommissioned and flows are transferred to Greystones WWTW via Kilcoole under the Interim Scheme.

The river water quality in 1999 reflected the discharges from these plants and was highly polluted downstream in each case (see **Appendix A**). Flow and chemical parameter measurement at the outfalls to the marsh suggested average daily loadings of 120kgs of BOD_5 per day (population equivalent = 2,000), 21kgs of ammonia (as N) and 11.7kgs of phosphate (as P). These results are something of an underestimation, since the package plants to stream B were not discharging, when the samples were taken.

11.9.3 Current Water Quality

Further sampling was carried out in 2005 to assess the current water quality. Two rounds of sampling were carried out on 27th June and 6th July 2005 at the locations in **Table 11.5**. These are also shown in **Figure 11.1.** The samples were taken from the same locations as the previously samples.

Table 11.5: Freshwater Sampling Locations

Sample Reference	Sample Location
A1	u/s Kilpedder Plant
A2	d/s Kilpedder Plant
A3	u/s Kilcoole Pump Station
A4	d/s Kilcoole Pump Station
B1	u/s Garden Village
B2	d/s Garden Village, u/s Kilquade
B3	d/s Kilquade Plant
C1	u/s N'kennedy Pump Station
C2	d/s N'kennedy Pump Station
C3	1.5km u/s Kicoole Marsh
D1	Northern branch d/s N11
D2	u/s Newcastle Plant
D3	d/s Newcastle Plant

The following parameters were monitored: Dissolved oxygen, pH, conductivity, temperature, BOD, suspended solids, total phosphorus, orthophosphate, nitrate, nitrite, ammonical nitrogen, total nitrogen and total and faecal coliforms. Detailed results are included in **Appendix A**. To assess current water quality, sampling results were examined against legislative requirements including The Local Government (Water Pollution) Act, 1977 (Water Quality Standards for Phosphorus Regulations 1998), Salmonid Regulations1988 (S.I. No. 293 of 1988),

At sites A1 and A2 up and downstream of the Kilpedder treatment plant results are within statutory limits for the key parameters, indicating unpolluted conditions. Results included BOD < 2mg/l, suspended solids <10mg/l, ammonical N <0.2mg/l and <ortho-P <0.03mg/l at the downstream site. However there was an increase in faecal and total coliforms downstream of the plant. Conditions are significantly improved from 1999 where the stream was grossly polluted. BOD has reduced from 5.8-10.3mg/l to <2mg/l.

Between sites A3 and A4 up and downstream of the Kilcoole works there is no deterioration in water quality as this is now pumped to Greystones. Water quality for key parameters (BOD, suspended solids, ammonia and ortho-p) have significantly improved at site A4 from the situation in 1999 where results indicated grossly polluted conditions. BOD has reduced from 14.4-16.4mg/l to <2mg/l. However a BOD level of 13mg/l was recorded upstream on the 2nd sampling round. Also there are elevated nitrite levels 0.06-0.14mg/l NO_2 up and downstream of the works indicating pollution from another source. Excess nitrite levels are toxic to fish.

The discharge from the treatment plant at Garden Village (site B2 on stream B) is causing significant pollution of stream B. Orthophosphate levels increased from <0.03mg/lP upstream to 0.53-0.89mg/lP downstream indicating seriously polluted conditions. However BOD and suspended solids are satisfactory. Ammonical N was 1.8mg/l on the 1st sampling. In comparison to 1999 the situation has disimproved with regard to ammonia and also phosphate where levels were 0.02-0.17mg/lP in 1999.

The Kilquade treatment plant discharge is <1km downstream from Garden Village. Therefore water quality upstream of Kilquade is already seriously impacted due to the Garden Village discharge.

However at site B3 downstream of Kilquade, orthophosphate levels also increased from 0.53-0.79mg/lP, showing continuing serious pollution. Suspended solid levels were also unsatisfactory (24mg/l).

Newtownmountkennedy treatment works is now a pump station, which pumps effluent to Greystones. Conditions were satisfactory in June/ July 2005 for BOD, ammonia and suspended solids as there is no discharge. However results show existing pollution from other sources along stream C with elevated orthophosphate and nitrite levels. Concentrations also increased further downstream at site C3 (1.5km u/s Kilcoole Marsh) for both parameters. Since 1999 with the removal of the discharge, conditions have improved significantly where gross pollution was recorded downstream of the plant. BOD levels downstream were 14.4-24.0 mg/l and ammonia 2.7-3.0mg/lN and orthoP 0.9-1.2mg/l.

Stream D is the receiving water for effluent from the Newcastle treatment plant. On the first sampling occasion conditions upstream of the plant were extremely unsatisfactory with orthophosphate levels from 0.16-0.18mg/lP indicating serious pollution or enrichment. Downstream of the plant increased slightly to 0.19mg/lP. Nitrite also increased from 0.06- 0.26mg/l NO_2, where the limit in the Salmonid Regulations is 0.05mg/l. Conditions were satisfactory for other parameters. On the second sampling orthophosphate levels increased from 0.04 to 0.41mg/lP indicating serious pollution downstream of the discharge.

In summary where discharges have been removed between 1999 and 2005 at Newtownmountkennedy and Kilcoole water quality has improved significantly. The discharges at Garden Village, Kilquade and Newcastle are currently having a detrimental impact on water quality downstream. Although there are other pollution sources to these watercourses it is expected that the proposed scheme will have a significant positive impact on the freshwater systems due to removal of the discharges to the streams.

12 SOILS, GEOLOGY AND HYDROGEOLOGY

12.1 INTRODUCTION

This chapter assesses the impact of the scheme if any on the soils, geology and hydrogeology of the area and should be read in conjunction with the site layout plans for the proposed development and the project description sections of this EIS. In the assessment, particular attention is focused on likely sensitive receptors, such as vulnerable aquifers or water supplies close to the proposed scheme.

The scheme concerns the provision of a wastewater treatment plant serving the communities of Newtownmountkennedy and Kilcoole in County Wicklow. Two other residential developments at Garden Village and Kilquade will also be served. The scheme will also provide additional capacity for future development.

This chapter is based on a summary of the available and relevant data on the area:

- MCOS, 1999. Newtownmountkennedy and Kilcoole Sewerage Scheme. Environmental Impact Statement. Main Report and Technical Appendices.
- Geological Survey of Ireland (GSI), 1995. “Geology of Kildare-Wicklow”. Sheet 16. Scale 1:100,000.
- GSI, 1994. “Geology of Kildare-Wicklow. A Geological Description to accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 16, Kildare-Wicklow.
- GSI and Wicklow County Council, November 2001. Wicklow Groundwater Protection Scheme.
- GSI, well records database.
- GSI on line groundwater maps at www.gsi.ie.

This environmental impact assessment was prepared in accordance with guidelines on the information to be contained in Environmental Impact Statements (EPA 2002) and Geology in Environmental Impact Statements, A Guide by the Institute of Geologists in Ireland (IGI, 2002).

12.2 DESCRIPTION OF THE EXISTING ENVIRONMENT

12.2.1 General

The area under study borders on the coastline of the Irish Sea. The shoreline is separated from the land area by the Dublin-Wexford railway line. The coastal strip from Kilcoole to Newcastle is an important amenity and conservation area. The designated protected areas are included on **Figure 2.1**.

The Kilcoole marshes, between Kilcoole and Newcastle, are a proposed Natural Heritage Area (NHA). Between Kilcoole station and Leamore Lower, the marsh area is a designated Special Protection Area (SPA) under the EU Birds Directive. In this area, the ecology and environment must be protected and this designation would effectively prohibit major development work, unless absolutely unavoidable. Further south, the area bordering on the railway line is generally designated as a Special Area of Conservation (SAC).

The Kilcoole Marshes comprise an inter-tidal area, which is cut off from the sea by the railway line. It is subjected to normal tidal exchange when the outlet at “The Breaches” is open. The breaches is a break in the beach where the marshes drain to the sea. Because of the mobility of the beach, the breaches are regularly closed by south-easterly storms. At these times, the fresh water levels rise until they are

balanced by seepage through the sands. As a result, the area can be occasionally converted to a freshwater lake. It can be opened by natural processes or regularly using machinery by local farmers.

Over the years, the area of the marshes has been reduced by the construction of embankments and other drainage protection works. This has considerably diminished the area affected by tides and thus improved stability of the area. To the south of the SPA area, the land is used for a private airstrip and the particular marsh ecology and its associated flora and fauna are not in evidence.

12.2.2 Bedrock Geology

Bedrock underlying the area is described as greywacke sandstones and quartzites of the Bray Head Formation (McConnell, et. al., 1994) and are Lower Palaeozoic in age.

12.2.3 Subsoils

12.2.3.1 Mainland

The overlying Quaternary deposits (subsoil) are predominantly comprised of till (boulder clay derived from Cambrian greywackes and slates) and gravels of Lower Carboniferous Limestone origin. Significant gravel deposits occur in the Kilcoole/Kilpeddar area. The deposits reach from 10m to 30m thick and extend to an area estimated to be 11km^2 (Looby, Woods & Wright, 2001). The extent of the deposit is shown on **Figure 12.1** (Lg – Locally important sand and gravel aquifer).

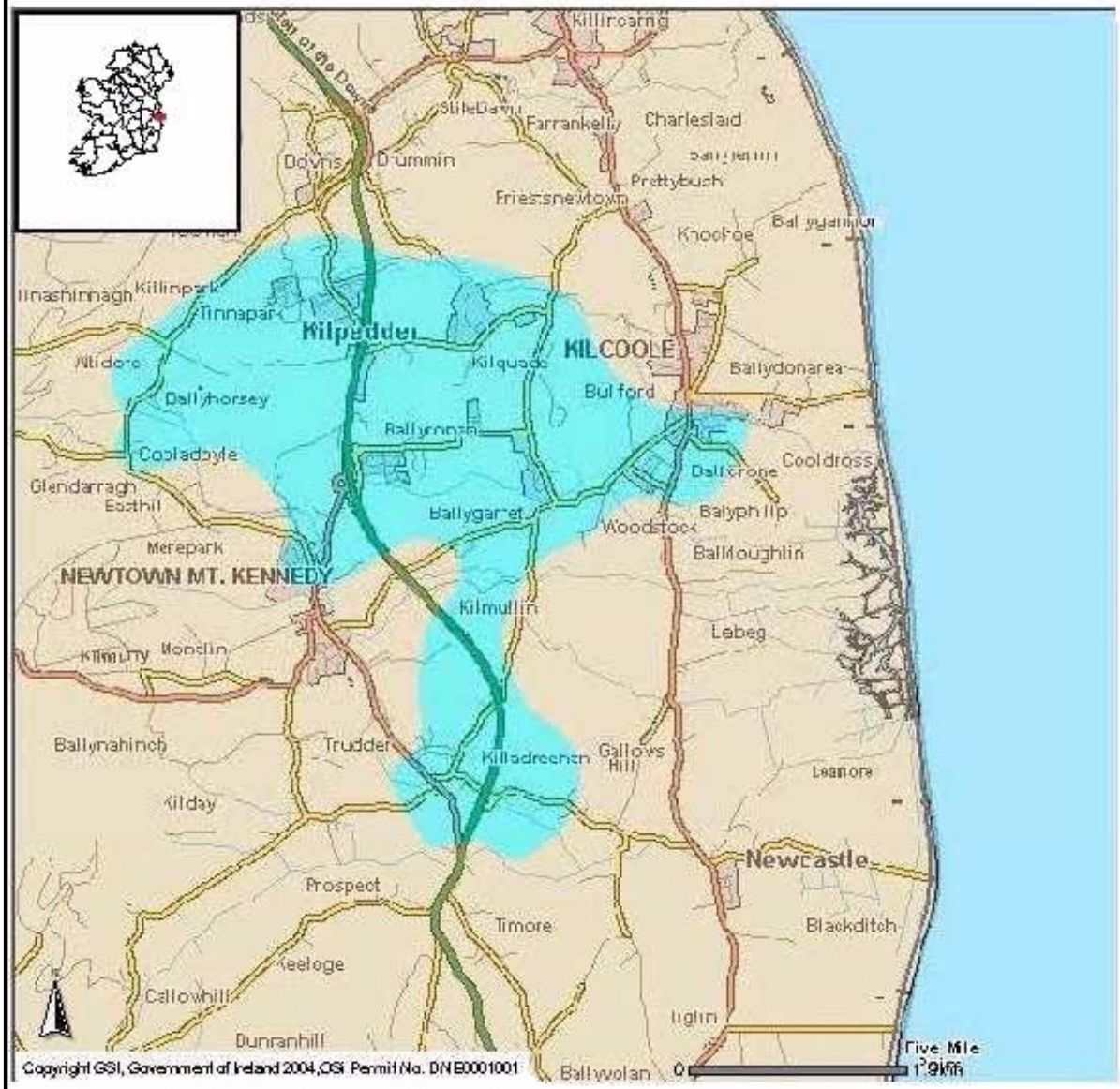
Geotechnical investigations were carried out at the site of the proposed wastewater treatment plant (WwTP) within the Kilcoole marsh area, along the railway track and along the land route for the outfall pipe. Twelve boreholes were drilled at the locations shown in **Figure 12.2.** The proposed WwTP site is generally underlain by medium dense to dense sand and gravels interbedded with stiff to very stiff gravely clays. Along the railway track, mixed deposits of sandy gravel, organic silt, stiff gravelly clays and dense granular deposits were encountered. In the marsh area, soft peat and organic silt deposits to depths of up to 3.6m overlie the gravel sub-strata. Rock was not encountered in the area within 10m of the surface.

12.2.3.2 Coastal

Alluvium overlies the till along the coastal strip.

The shoreline fronting Kilcoole Marsh forms a typically steep linear beach comprised of shingle and gravel. A study of beach movement at Kilcoole Beach was carried out and is reported in Appendix A, Volume 2 of the original EIS. As a whole, this stretch of shoreline is relatively stable though localised areas of erosion of up to 1.5m per annum have been recorded.

Locally, changes in the beach profile result from storm wave action associated with north east, east and south east winds. The beach material comprises fine to coarse rounded sandy gravel. The profile of the beach and crest position are continually in motion in response to wave action. This is most readily observed at “The Breaches” where a channel pattern can be completely changed in a matter of hours.



Legend

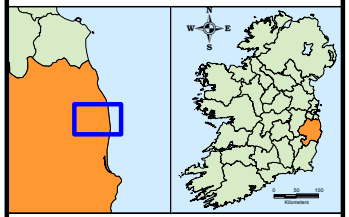
Wicklow Aquifers

- Lg - Locally important. sand/gravel aquifers
- Pl - Poor aquifer. generally unproductive except in local zones

1:50K OS Web Mapping

County Boundaries

Data Source:
The map has been downloaded from GSI (Geological Survey of Ireland) website.
www.gsi.ie



Wicklow County Council

Project
Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title

Aquifers

Figure 12.1

RPS mcos
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie

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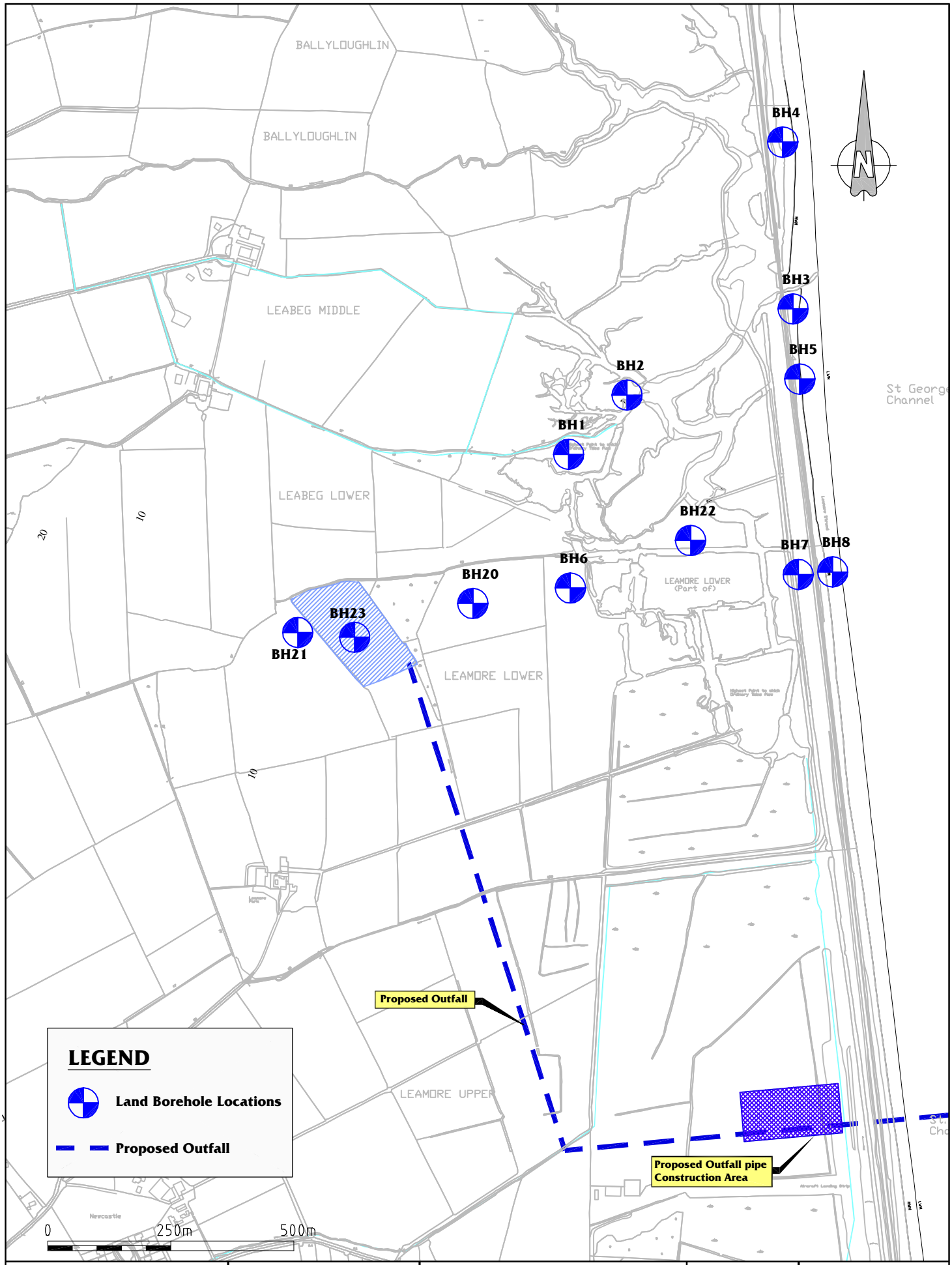


Client: WICKLOW COUNTY COUNCIL	RPS MCOS RPS-MCOS Ltd., West Pier Business Campus, Dun Laoghaire, Co. Dublin, Ireland. T: +353 1 288 4499 - F: +353 1 283 5676 E: rpsmcos@rpsgroup.ie W: www.rpsmcos.ie	**Project:** NEWTOWNMOUNTKENNEDY & KILCOOLE SEWERAGE SCHEME **Title:** Land Borehole Locations	**Issue Details** Drawn: DB Checked: AG Approved: JC Scale: 1:10,000 @ A4 Date: March '05	**Office Use Only** Job No. MDW0135 File Ref. MDW0135SK0108D01 Fig No. Fig. 12.2 Rev. D01

12.2.4 Seabed

Geophysical surveys were carried out on the seabed to establish the superficial seabed sediments of the proposed pipeline route. In addition boreholes were drilled beneath the seabed. These indicate that the sub-seabed sediments vary in composition and degree of compaction.

At the landfall end, the sediments are generally compact with occasional soft pockets. In this area, the material encountered was boulder clay: a mixed lithology containing clay, silt, sand and gravel in varying proportions. The upper horizons are predominantly gravel, with occasional silt or sand pockets on the seabed surface. This type of sediment appears to characterise the seabed composition for approximately 900m from the landfall which covers most of the length of the proposed outfall.

Beyond 900m, for a distance of approximately 200m, the upper layers comprise soft silty clay underlain by a thin gravel horizon.

Surveys were carried out further from the shoreline but these are not considered to be relevant given that a 1000m long outfall is proposed.

A total of six marine boreholes (BH9 to BH14) were carried out along the original route selected for the outfall at the locations shown in **Figure. 4.1** (directly offshore from the treatment plant site). Briefly, these boreholes included the following:-

- ***Borehole No. 9;*** *90m offshore at sea bed level 5m below chart datum (bcd); drilled to 6m below the seabed level. Encountered medium dense silty fine to coarse sandy gravel with occasional thin layers of sandy clay overlying stiff silty clay at 5m depth.*

- ***Borehole No.10;*** *265m offshore at seabed level 8.0m (bcd); drilled to 5.1m below sea bed; encountered firm grey silty clay and sandy gravel to 1m depth overlying stiff brown silty clay with some sand and coarse gravel. This in turn was underlain by a sandy silty clay at 2m containing seams of coarse gravels.*

- ***Borehole No.11;*** *607m from the shoreline at 9.8m bcd; drilled to 10m below the sea bed; indicated shallow layers of fine to coarse gravel and silty clay overlying fine to coarse sand with some silt and gravel to 4.5m depth overlying stiff sandy clay with boulders at 8 m and a very dense sand to 10m.*

- ***Borehole No.12;*** *990m offshore at 11.8m BCD and drilled to 5.4m below sea level, indicated soft grey silty clay to 2.2m depth overlying medium to coarse sandy gravel*

- ***Borehole No. 13;*** *1,207m offshore at 12.9m BCD and drilled to 7.5m below the sea bed, indicated medium to coarse sandy gravel, ultimately changing to coarse sand below 2.7m depth*

- ***Borehole No. 14;*** *at 1,510m offshore at 15.1m BCD and drilled to 10m below sea bed, indicated medium to coarse sandy gravel over fine to medium gravelly sand to 3.9m, overlying silty clay at 3.9m with silty fine sand and fine sandy silt to stiff silty clay at 6.2m. Stiff clay and gravel were encountered to the end of the borehole.*

Boreholes 15 and 16 were drilled at 1960 and 2325m offshore but are not relevant for the purposes of this report as the proposed pipeline outfall is 1km offshore.

12.2.5 Hydrogeology

The rocks of the Bray Head Group are essentially impermeable and are classified by the Geological Survey of Ireland as poor aquifers, i.e. bedrock which is generally unproductive except for local zones.

The Kilcoole-Kilpeddar sand and gravel deposits are classified as a locally important aquifer.

The till and alluvium deposits are characterised by low permeability. Water ingress in the till deposits is associated with granular layers.

The low storage in the bedrock strata is balanced by the higher rainfall of the uplands. However, during long dry spells baseflow to streams can be significantly reduced as many of the springs and seepages which feed them dry up. There are four small rivers draining the catchment area **(Figure 2.1).** All four streams receive sewerage effluent. Streams A and C are polluted as a result of the combined effluent discharges and low base flows.

Groundwater is widely used in the area as a source of supply. Water is abstracted from the overburden gravels as well as from bedrock (refer **Figure 12.3**). Well yields vary but are typically poor (<40m^3/d) to good (100-400m^3/day). A well yield of 435m^3/day (which is classified as excellent) was obtained in a well for a factory near Kilcoole.

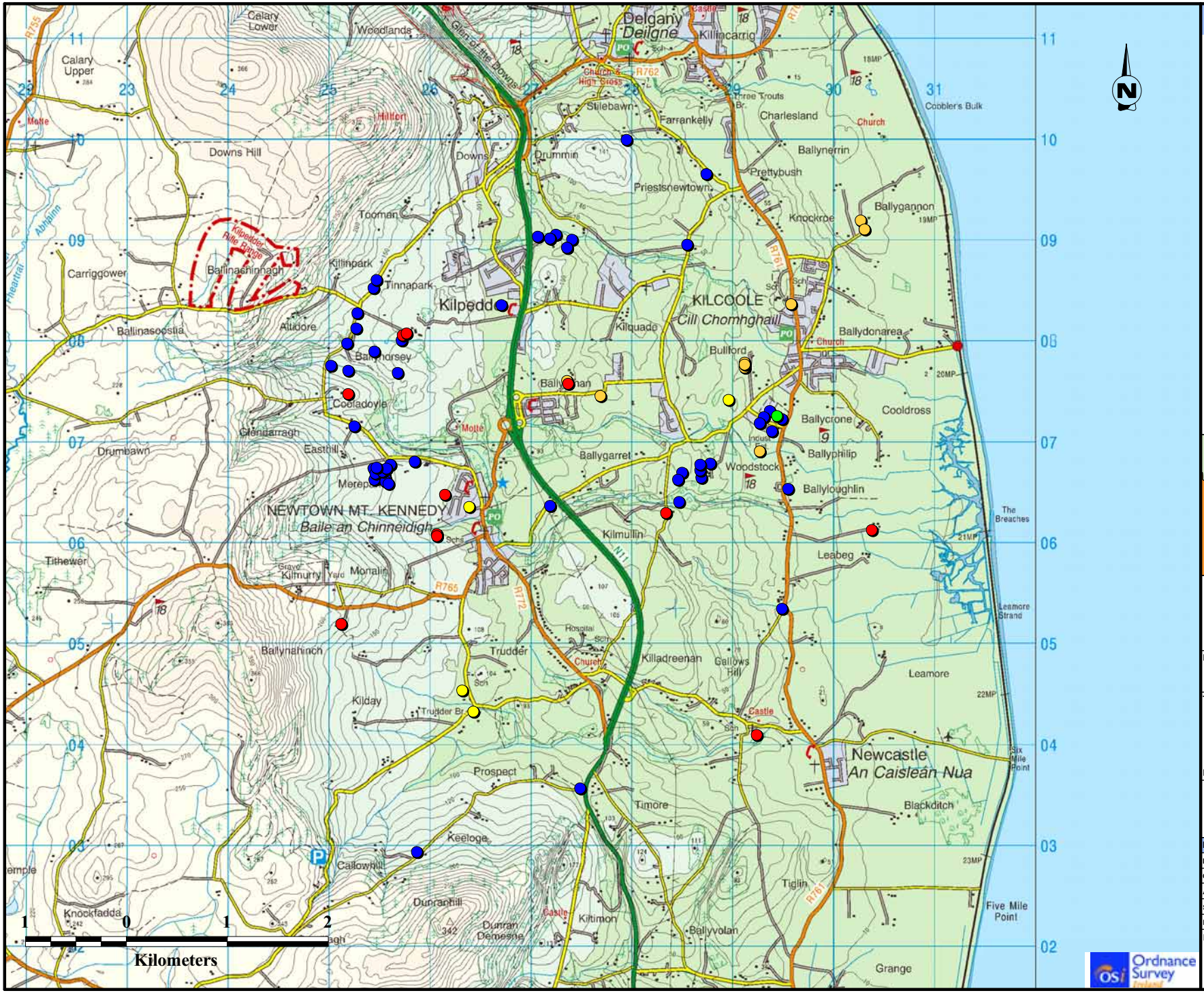
According to the GSI Vulnerability map for the area, the vulnerability of groundwater in the bedrock varies from low to extreme (refer **Figure 12.4**). The vulnerability of the gravel aquifer is high. This classification is derived from the vulnerability mapping guidelines presented in **Table 12.1**.

Table 12.1: Vulnerability Mapping Guidelines

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) and Thickness)			Unsaturated Zone	Karst Features
	High permeability (sand/gravel)	Moderate permeability (e.g. sandy subsoil)	Low permeability (e.g. clayey subsoil, clay, peat)	(Sand/gravel aquifers only)	(<30m radius)
Extreme (E)	0 – 3.0m	0 – 3.0m	0 – 3.0m	0 - 3.0m	-
High (H)	>3.0m	3.0 – 10.0m	3.0 – 5.0m	>3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0 – 10.0m	N/A	N/A
Low (L)	N/A	N/A	>10.0m	N/A	N/A

12.3 CHARACTERISTICS OF THE PROPOSAL

The proposal scheme is indicated in plan in **Figure 2.1** and comprises the construction of a new central wastewater treatment works at Leamore, near Kilcoole, County Wicklow to serve the regional needs of the area. This plant will be capable of accommodating all of the existing developments plus residential and commercial development as indicated by the adopted settlement strategy for the area. The development should be advanced on a phased basis with an initial stage being construction to a design capacity of 22,500 P.E. with secondary treatment followed by final development to 45,000 P.E. as required. Associated with this development there will be a long sewer outfall to discharge treated effluent to the Irish and a sewer network to transfer wastewater to the plant. Furthermore there will be an access road to the plant.

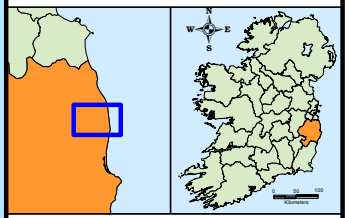


Legend

Yield Class

- Poor (<40m3/d)
- Moderate (40 - 100m3/d)
- Good (100 - 400m3/d)
- Excellent (>400m3/d)
- Unknown

Data Source:
Geological Survey of Ireland



Wicklow County Council

Project
Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title

GSI Well Locations

Figure 12.3

RPS mcos
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie

Issue Details			
Drawn:	SK	Project No.	MDW0135
Checked:	AG	File Ref.	
Approved:	JC		MDW0135MI0103D02
Scale:	1:50,000 @ A4	Drawing No.	Rev.
Date:	04/02/2005	MI0103	D02

Notes

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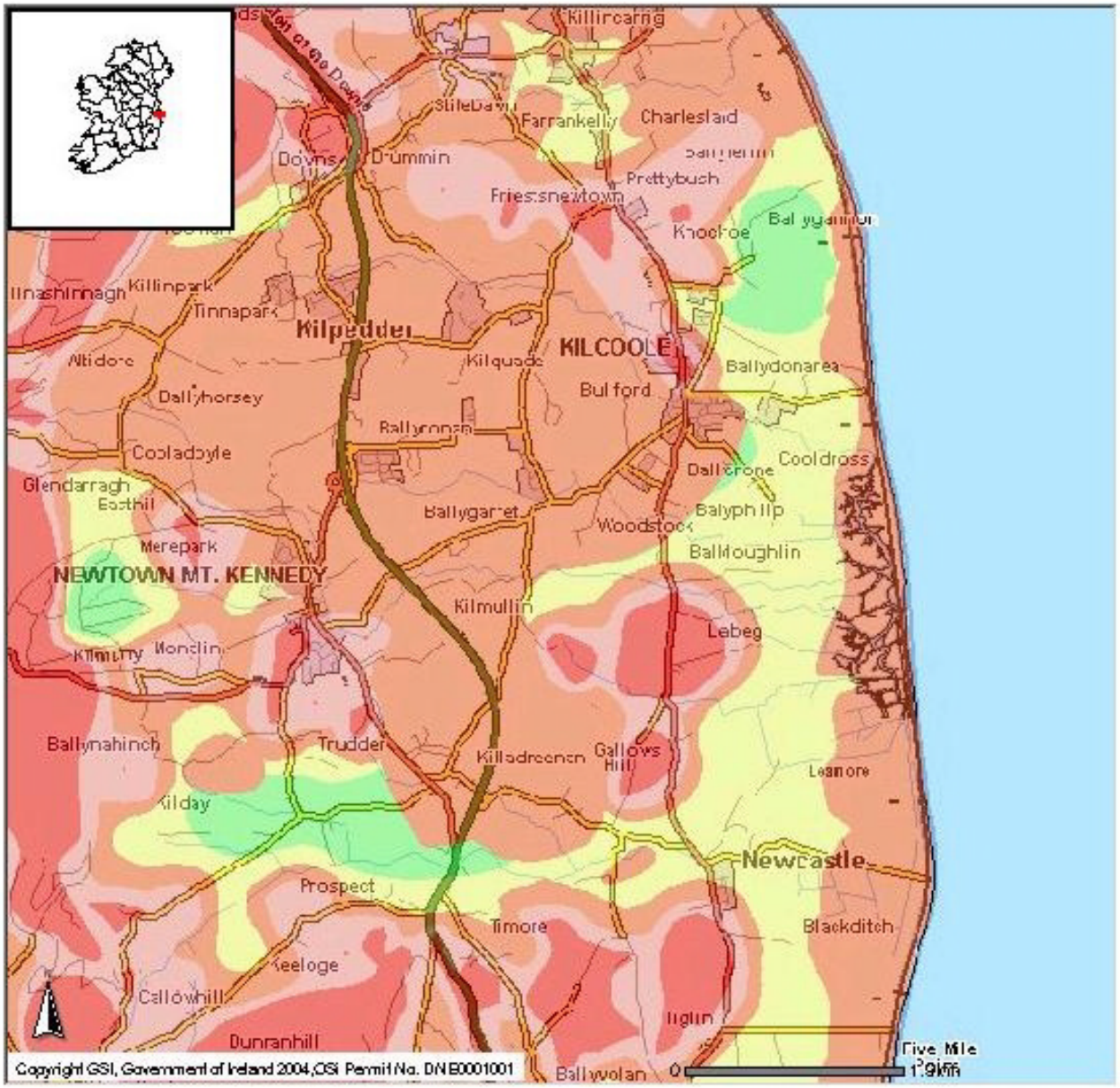


Legend

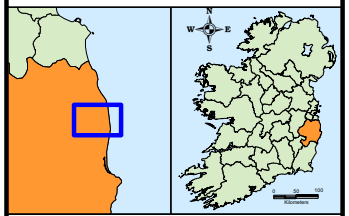
Wicklow Vulnerability

- E(Karst/Rock_near_surface)
- E - Extreme
- H - High
- M - Moderate
- L - Low

1:50K OS Web Mapping

County Boundaries

Data Source:
The map has been downloaded from GSI (Geological Survey of Ireland) website.
www.gsi.ie



Wicklow County Council

Project
Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title

Aquifer Vulnerability

Figure 12.4

RPS mcos
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie

Issue Details			
Drawn:	SK	Project No.	MDW0135
Checked:	AG	File Ref.	MDW0135MI0102D02
Approved:	JC		
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Date:	04/02/2005	MI0102	D02

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12.4 POTENTIAL IMPACTS OF THE PROPOSAL

12.4.1 Construction Phase

The proposed development will entail the removal of significant areas of topsoil and shallow subsoil from trenches to accommodate the laying of land pipelines and to accommodate the construction of foundations for the WwTP and access roadway(s). These are unavoidable aspects of the proposal that will impact the soil environment. The soils will require removal and are not expected to be contaminated.

The removal of topsoil and subsoil during construction will result in the potential for erosion of exposed soils and subsoils during the construction period.

During the construction phase, a limited amount of fuels and hazardous materials will be used to fuel vehicles and plant machinery, which will also have the potential to impact the soil environment if not stored and used in an environmentally sound manner.

The outfall pipeline will be constructed in tunnel under the railway line and will have at least 4-5m of cover. Continuation at this level under the inner shoreline area in tunnel will result in minimal disruption to the dunes section of the foreshore. Moreover, it will result in siting of the pipeline in the underlying stiff clay strata in the open cut beach trench where it will be surrounded in stone fill and backfilled. Due to the profile of the pipeline, therefore, the beach mobility currently experienced at this site will not uncover the pipeline. Impacts, therefore, will be of short duration and slight.

Subsoils will be removed from the seabed in order to form a trench for the marine pipeline. This will be undertaken by underwater dredging. The impact of this work is related to the prevailing geotechnical conditions in the seabed. In general, a trench depth of approximately 3m is likely and stable side-slopes are likely to vary from approximately 1:2 in stiff clays to 1:4 or 1:5 in sands. This will impact on the volume of excavated material removed from the trench. The removed subsoil material will be deposited near the trench. This material is not expected to be contaminated. It is expected that the excavated sands and gravels will be quickly dispersed by the vigorous tidal action in the area and that the sea-bed profile will be reinstated in a matter of weeks. The impact of the dredging activity on the water column will be short-term and localised and is likely to be small.

12.4.2 Operational Phase

The construction of a foul sewer network has the potential to contaminate soils and groundwater if the pipes were to leak. Similarly, the construction of the marine pipeline could cause local contamination of the shallow seabed subsoils if it were to leak.

Sewage sludge arising from the wastewater treatment plant will require disposal and has the potential to contaminate soils and groundwater if not disposed of appropriately. The volume of sludge generated in the works at ultimate load would be a maximum of 1,000-1,250 tonnes dry solids per year. This is a modest quantity of sludge in the context of the organic sludge volume produced in agriculture.

12.5 MITIGATION MEASURES

12.5.1 Construction Phase

Surplus spoil material (soils) will be re-used in reinstatement works and in re-shaping of the treatment plant site. Backfill material will be sourced locally.

A sediment erosion control plan will be employed during the construction phase. The plan will include the following measures:

- Interceptor drains, siltation ponds and silt traps will be employed to channel surface runoff from construction areas and trap silt prior to discharge to surface waters.
- Construction activities will be scheduled such as to minimise the area and period of time that soil will be exposed.
- Disturbed ground adjoining new access roadways will be regraded and revegetated on completion of roadways.
- Vehicular movement will be restricted to prevent unnecessary erosion.

A site management plan will be prepared for the control of pollution to soils during construction. Construction staff will be trained and an on site representative will be responsible for its implementation.

In order to prevent the accidental release of hazardous materials (fuels, paints, cleaning agents, etc.) during construction site activity, all hazardous materials should be stored within secondary containment designed to retain at least 110% of the storage contents. Temporary bunds for oil/diesel storage tanks should be used on the site during the construction phase of the project. Safe materials handling of all potentially hazardous materials will be emphasized to all construction personnel employed during this phase of the project.

The outfall pipeline will be constructed to the south of the SPA on land which is used for a private airstrip. The marsh ecology in this area is at its minimum in comparison to other areas and will result in the minimum level of impact on ecology.

The foul sewer collection system will be laid according to best practice standards incorporating adequate sealing of connections, inspection for defects and leak testing prior to commissioning.

The submarine pipeline will be backfilled with a granular stone material to protect it from wave action.

12.5.2 Operational Phase

Monitoring of sewage effluent discharges will be undertaken in strict accordance with planning conditions to include compliance with sample type, frequency, analysis and reporting.

The Sludge Management Plan for County Wicklow recommends that sludge treatment hub centres be located at Wicklow and at Greystones WWTW, however the plant at Greystones is a stand-alone plant and will not accept imported sludge.

Dewatering facilities will be incorporated into the design of the Leamore WWTW with the dewatered sludge then transferred by road to Wicklow hub centre for treatment and disposal.

Its treatment and disposal according to the relevant EU and National Standards will result in minimum impact on soils and geology.

12.6 PREDICTED IMPACT OF THE PROPOSAL

The proposed works will involve slight impacts on soil and geology, primarily associated with their construction. The construction of the outfall pipeline in tunnel under the railway line and inner shoreline area is expected to have a slight impact of short duration on beach mobility.

Long term permanent impacts will be negligible as regards the impact of the physical works and will be slight as regards the ultimate disposal of treated wastewater sludge from the plant.

12.7 MONITORING

Monitoring of sewage effluent discharges will be undertaken in strict accordance with the licence conditions to comply with sample type, frequency, analysis and reporting.

13 CLIMATE

13.1 INTRODUCTION

Climate can refer to both the long-term weather patterns in an area and also to the more localised atmospheric conditions, referred to as the microclimate. Climate has implications for many aspects of the environment from soils to biodiversity and landuse practices. In a global sense much of the concern with new developments is the additional emissions and the potential for increases in air pollutants, which may contribute to climate change.

13.2 EXISTING ENVIRONMENT

Casement Aerodrome was considered to be the most relevant climate station in the vicinity of the Newtownmountkennedy and Kilcoole Sewerage Scheme. It is located at Baldonnel, Co. Dublin, 16km south of Dublin City. The climate station was established in 1943 and is located 94m above mean sea level.

13.2.1 Wind

The prevailing wind direction for the area in the proximity of the scheme is between south and west. Wind characteristics vary between a gentle to moderate breeze throughout the year. Annual average wind speeds range between 4m/s and 7m/s with highest wind speeds occurring during winter months (December and January). Lowest wind speeds were recorded in the June, July and August period. On average there are approximately 20 days per year with gales.

13.2.2 Rainfall

The mean yearly precipitation level is 711.4 mm. Monthly precipitation data from Casement Aerodrome show that the highest levels of rainfall occur in December with an average of 73.1mm. The month showing the lowest level of rainfall is July with a level of 48.9 mm.

13.2.3 Temperature

The mean yearly temperature for the area is 9.3^0C. The month showing the highest average temperature is July with a temperature of 15.2^0C. The highest daily temperature of 30.5^0C was recorded in the month of August. The lowest average monthly temperature of 4.6^0C occurred in February. The lowest daily temperature of -12.4^0C was recorded in January.

The 30-year average meteorological data from the nearest meteorological met station at Casement are listed in **Table 13.1** below:

Table 13.1: 30-Year Average Meteorological Data from Casement Aerodrome (Annual Values from 1968-1996)

Parameter	30-Year Average
Mean Temperature	9.3 °C
Mean Relative Humidity at 0900UTC	83%
Mean Daily Sunshine Duration	3.64hrs
Mean Monthly Total Rainfall	711.4mm
Mean Wind Speed	11.0 knots

13.3 IMPACT ON CLIMATE

The potential on climate of the proposed scheme relates to emissions from the various treatment processes. Greenhouse gases occur naturally in the atmosphere (e.g. carbon dioxide, water vapour, methane, nitrous oxide and ozone) and in the correct balance, are responsible for keeping the lower part of the atmosphere warmer than it would otherwise be. These gases permit incoming solar radiation to pass through the Earth's atmosphere, but prevent most of the outgoing infrared radiation from escaping from the surface and lower atmosphere into the upper levels. However, human activities are now contributing to an upward trend in the levels of these gases, along with other pollutants with the net result of an increase in temperature near the surface.

The majority of Ireland’s energy requirements are derived from fossil fuels which means that any imported energy required to operate the plant will contribute to an increase in greenhouse gas emissions. The development of the plant is likely to be specified in terms of performance standards in a Design/Build/Operate contract type, by means of which alternative process options would be tendered for evaluation and selection of the most economically advantageous option. Therefore, the process selected may include energy recovery. However, the energy required to operate the plant will be kept to a minimum. The scheme will have a negligible effect on climate.

14 MATERIAL ASSETS

This section of the Environmental Impact Statement deals with Material Assets that will potentially be affected by the scheme.

These assets are grouped into:

- Material Assets: **Agricultural Properties** including all agricultural enterprises.
- Material Assets: **Non-agricultural Properties** including residential, commercial, recreational and
- Non-agricultural land

Material assets are generally considered to be the physical resources in the environment, which maybe of either human or natural origin. The object of the assessment of these resources is to identify the impact if any of the scheme on individual enterprises or properties and to ensure that natural resources are used in a sustainable manner in order to ensure availability for future generations. Agricultural enterprises interact, to a large extent, with the natural environment in terms of climate, air quality, soil, hydrology and hydrogeology. Some domestic animals, such as horses and milking cows, may be impacted by traffic-generated noise. In addition to agricultural enterprises, residential, commercial and private properties will be affected by land loss and severance as a result of the proposed scheme. Resources required for the proposed scheme include existing land, construction materials and energy required for the purpose of operating the proposed waste water treatment plant (WWTP).

14.1 MATERIAL ASSETS – AGRICULTURAL PROPERTIES

14.1.1 Introduction

A survey of the agricultural activities in the Kilcoole/Newcastle area of east Wicklow was carried out in the spring of 2005 with a view to assessing the potential impacts on agriculture from the siting of a proposed WwTP and associated pipe network. The actual siting of the proposed plant will impact on one farm holding. A number of other farms will be potentially impacted by the laying of the sewer network to service the proposed plant. The potential impact from the landtake for the proposed facility will be permanent whereas the pipe laying operations, although potentially significant will be temporary. The proposed access to the facility was also addressed.

14.1.2 Methodology

Two methods were used to examine agriculture in the proposed site: -

1. Desktop study – Examining both aerial and ordinance survey maps.
2. On Site Study – The lands were surveyed in the spring of 2005 and the landowner whose lands will potentially be acquired for the facility was interviewed. This interview was conducted to identify the current enterprises practiced on the farm, potential issues and concerns identified by the landowner and the level of significance that the proposed facility may have on the current and/or future viability of the farm. The landowner whose land is being potentially affected by the access road was also interviewed.

14.1.3 Existing Environment

14.1.3.1 Wicklow

The average farm size in County Wicklow (Central Statistics Office, 2000) is 42.2 hectares (UAA) and there are approximately 2,410 individual farms. Specialist beef, sheep and a mixture of both animal enterprises account for 75% of the farming practices.

There is considerable variation in soil type, underlying geology and topography across the county. The central area of the county is mountainous, whilst the east of the county is considerably flatter. This is reflected in the type of farm enterprises across the county. In the more mountainous regions the primary enterprise is sheep whereas in the flatter areas to the east tillage becomes more commonplace.

14.1.3.2 Kilcoole/Newcastle Area

The lands between Kilcoole and Newcastle on the east coast of Wicklow are particularly level and the dominant farming enterprises are tillage and beef with some dairying. Farms in the general location of the proposed development appear to be well managed with large fields and substantial farm buildings. The proposed location for the proposed plant is in the townland of Leamore approximately midway between the villages of Kilcoole and Newcastle.

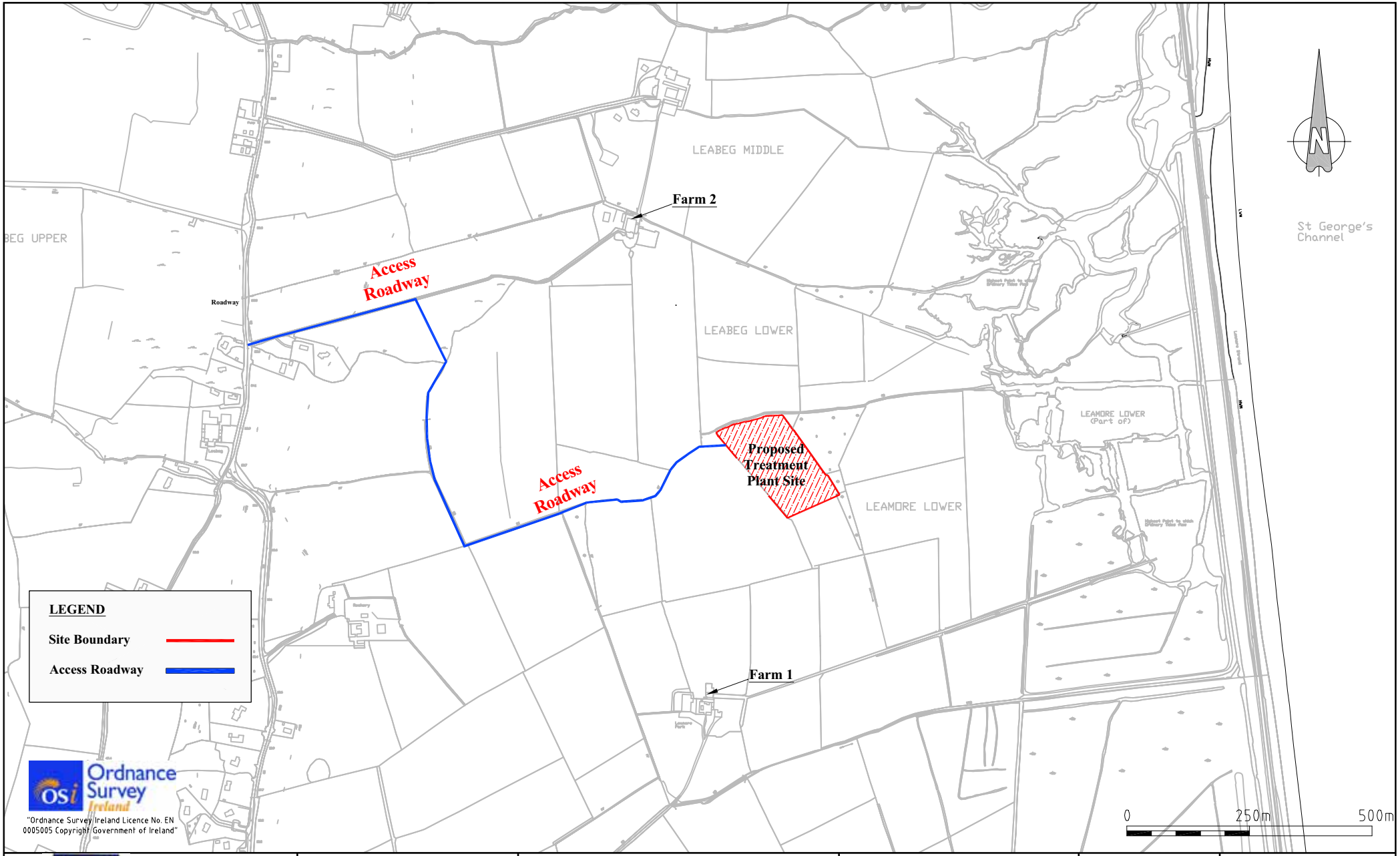
14.1.3.3 Proposed Site and Proposed Access Road

The lands pertaining to the proposed plant are currently being farmed and the enterprise mix is drystock and tillage. The actual field in which the proposed plant is to be located was in forage maize. The field is located on the northern boundary of the farm away from the farm buildings and entrance. **Figure 14.1** shows the extent of the site area. The proposed access road is also shown on **Figure 14.1**. The routing of the road is along the boundary ditch of a tillage and drystock farm. The proposed plant is located on land owned by farm 1 (**Figure 14.1**) and the access road is primarily owed by farm 1 (**Figure 14.1**).

14.1.4 Impacts on Agriculture

There are a number of potential impacts that may impose on agriculture in a region:-

- Loss of land which may reduce the holding to such an extent as to make it non viable;
- Severance of the holding by the proposed plant and proposed access road. This may range from a minor severance causing only slight inconvenience to a major severance that may threaten the practicability of current enterprises on the holding;
- Increased traffic levels in the environs of an agricultural holding causing problems with the day-to-day management, from moving stock to moving large machinery.
- Increased traffic and plant operations may also cause elevated noise and dust levels. These may cause disturbance and subsequent loss of performance in more sensitive stock such as horses and dairy cows.



Client: WICKLOW COUNTY COUNCIL

RPS MCOS
RPS-MCOS Ltd., West Pier Business Campus, Dun Laoghaire, Co. Dublin, Ireland.
T: +353 1 288 4499 - F: +353 1 283 5676
E: rpsmcos@rpsgroup.ie W: www.rpsmcos.ie

Project: Newtownmountkennedy & Kilcoole Sewerage Scheme

Title: Location Plan of Treatment Plant

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Checked:	AG
Approved:	JC
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Date:	March '05

Office Use Only	
Job No:	MDW0135
File Ref:	MDW0135SK0106D01
Fig No:	Fig. 14.1
Rev:	D01

14.1.4.1 Assessment of Impact

The degree to which a development impacts on an individual farm is based on the type of farm enterprise, land take, farm size, and removal of farm buildings and/or facilities. The degree of overall impact on a farm may be classified as follows:-

- Severe – Farming operations can no longer continue. No mitigation measures would overcome impact

- Major - Possible change in enterprise due to severance, land take or loss of buildings. This change would usually occur with dairy or stud farms changing to drystock or tillage. The impact would require a significant change in management practices with associated costs. This level of impact would require considerable mitigation measures and not all difficulties would be overcome.

- Moderate - Development causes a degree of severance that will cause a change in management practices. No changes will occur in current enterprises although there may be an increase in labour charges or machinery costs. Mitigation measures will overcome most difficulties.

- Minor - Development causes a small inconvenience but does not require a significant change in current management practices. Mitigation would overcome any problem.

- Not Significant - The development may encroach slightly on a boundary causing a slight inconvenience.

Dairy farms or any enterprises that require animal movements on a daily basis are particularly sensitive to severance from a new development. Dairy and equine livestock are also known to be more sensitive to noise.

Drystock enterprises (e.g. beef, sheep) are generally less severely impacted by severance as these animals are placid by nature and are not usually moved daily. Tillage farms are generally less severely impacted than dairy or drystock farms as only movement of machinery is required. However triangulation of fields or the reduction in field size may increase difficulties for tillage operations.

14.1.4.2 Operational Impacts

Landtake: The farm upon which it is proposed to site the plant is approximately 80 hectares in size and the area required for the facility is approximately 2.4 hectares or 3% of the overall holding. The field was used to grow forage maize last year and is one of the better fields on the farm. The loss of this field to the farm will not prevent the farm from continuing its current practices. However, as the area of landtake is considerable and the field is one of the better fields on the farm the overall impact on the farm is deemed moderate.

There will a landtake for the proposed road used to access the proposed development. The landtake for the proposed access road will be approximately 0.6 hectares. As this land take will be on the boundary of the farm the impact would be considered minor.

Severance: The actual location of the proposed WwTP site will not cause any severance nor will the proposed access road. The proposed access road follows existing boundaries in order to cause least disturbance.

Traffic: Traffic during the operational phase of the proposed plant will not have a significant impact on any of the farms in the area.

Noise and Air: There will be no air or noise impact from operational phase of the proposed plant.

Drainage: Drainage will not be impacted during the operational phase of the proposed plant.

14.1.4.3 Mitigation Measures

Landtake: Land take will be dealt with by compensation. Compensatory measures for loss of land, buildings and any other injurious affects will be agreed with property owners affected as part of the Compulsory Purchase Order (CPO) procedures. As negotiations for the CPO procedures take place after the publication of the EIS therefore the compensatory measure cannot be included as part of the EIS document.

Severance: If access is severed, alternative access will have to be provided for farm animals and machinery.

Traffic: Traffic in the area is not expected to increase significantly during the operational phase of this proposed plant therefore mitigation measures will not be required.

14.1.4.4 Construction Impacts

Landtake: There will be no landtake for pipe laying however wayleave notices will be served to landowners entitling the Local Authority the right to access for maintenance purposes. During the pipe laying period there will be a considerable impact on all farms over which the pipe is to be laid. For tillage fields this may mean a loss of production for one season over the pipe route and also in fields where triangulation is so severe as to warrant machine operation unfeasible. The land loss for pipe laying operations will not be a significant impact on livestock enterprises.

Severance: The influent and effluent pipe routes to the plant will cause severance for short periods and the impact of these pipe routes will be temporary. As the farms to the north and west of the proposed plant are in tillage and drystock the impact should be minor although there will be some inconvenience when moving cattle. There is a dairy farm to the south of the proposed plant over which it is proposed to lay the outfall pipe. This pipe may have an impact on the daily movement of dairy cows across the farm.

Traffic: There will be a considerable increase in traffic during the construction phase.

Noise and Air: The activity of earth moving machinery, transport lorries and other ancillary vehicles could generate significant noise and dust in the immediate vicinity of the construction. Noise could adversely affect livestock and in-calf cows may experience stress leading to difficulty calving or may cause calves to be aborted. The proliferation of dust also has a nuisance value. Livestock are at risk to eye irritations from high levels of wind blown dust particles. This stress could reduce productivity and increase management difficulties.

Drainage: Field drainage systems currently *in situ* may be disturbed and in places disabled during construction. These systems will be restored as part of the completed works, but there may be impaired drainage in the period of time between initial disturbance and final reinstatement of such drainage works. This damage may lead to wet or flooded fields during spells of wet weather, and the farm's productivity could be reduced.

14.1.5 Mitigation Measures during Construction

Adhering to the following mitigation measures will reduce the impact on agricultural activities during the construction phase. Good communications between landowners and the contractors will facilitate the farmers in organising their enterprise during construction. Communications will relate to access issues, possible relocation of sensitive animals during activities that could generate noise/vibration, dust or other nuisances and also temporary fencing requirements.

Severance: Access will be maintained to severed fields during construction. This would be particularly relevant for fields containing livestock. Tillage fields may remain severed for more extended periods depending on discussions with affected landowner. Temporary stockproof fencing will be erected as required to delineate the site boundary and to minimise disturbance to adjacent lands. Access to water for fields containing livestock will also be maintained at all times. This may be achieved with a water bowser or a temporary piped supply. Discussions should take place with local landowners to ensure that construction traffic does not interfere with movements of stock nor hinder farm operations such as silage/hay making and a traffic management plan implemented.

Noise and Air: Precautions will be taken by the contractor to control noise, vibration and dust on and off the site. Methods such as “wetting down” will be employed when required to minimise dust levels. Mitigation measures for dust are dealt with in Chapter 7. Mitigation measures for noise and vibration are dealt with in Chapter 8.

Drainage: All drainage likely to be affected or disturbed during the construction phase will be identified and reinstated as soon as possible. Delays in reinstatement may cause flooding and subsequent damage to crops. In cases where impeded drainage is causing obvious difficulty to a particular landowner, temporary measures will be taken to allow waters to drain to less critical areas and so minimise the impact. Less critical areas include land of poor agricultural quality that is not intensively farmed.

14.1.6 Residual Impacts

Residual impacts can only be assessed once compensation measures have been agreed. This will be finalised by a valuer/agronomist at a later stage.

14.2 MATERIAL ASSETS – NON AGRICULTURAL PROPERTIES

14.2.1 Introduction

This section of the EIS deals with the potential impacts of the proposed scheme on residential and commercial properties and non-agricultural land, as a result of land acquisition necessary for the scheme and all associated works.

As there are no commercial businesses affected by the construction of the plant or the sewage pipeline no further reference will be made to these enterprises. Noise and landscaping issues are dealt with in the relevant chapters and therefore no reference will be made to such issues here.

14.2.2 Description of the Existing Environment

The proposed location for the central treatment plant in Leamore townland approximately midway between the villages of Kilcoole and Newcastle. The area is rural in nature although due to its close

proximity to Dublin has become a dormitory area for the capital. The areas around Newtownmountkenney and Garden Village in particular due to the close proximity to the N11 national primary route have expanded rapidly in recent years.

14.2.3 Impacts

The only impact to non agricultural land/properties will be during the construction of the sewer network. This impact can be described as not significant. For the purpose of this EIS not significant is where a small part of a residential garden, business or recreational property is acquired, resulting in minimal or no change to the environment of the residence or property. The extent of the landowners affected is not yet known but it will minimised by confining where possible landtake to public lands.

Where sewers pass through private lands, it will not be possible to allow developments within 5m of the pipeline. However, the benefits of the scheme are that existing and future developments not already connected to a sewer network will be able to connect into it provided it is technically feasible. The Council will also require access to the sewer network for maintenance purposes.

There are no commercial properties impacted by the scheme. The sewer network will cross a natural heritage area just north of Newcastle village to provide for the marine outfall. This has been dealt with in detail elsewhere in this report and it is anticipated that any habitats affected by the construction will recover within 1 – 2 years.

14.2.4 Mitigation Measures

Where access to residential, commercial or recreational lands from public roads may be affected by the proposed scheme, alternative access arrangements will be provided at an appropriate location.

Compensation payments for loss of land, and other injurious affection will be agreed with property owners affected by landtake for the scheme during land purchase negotiations.

During the construction period the contractor will maintain good communication with landowners at all times to keep them informed of the works. Temporary fencing will be erected as required to delineate the site boundary and to minimise disturbance to adjacent lands.

14.2.5 Residual Impacts

Residual impacts will only be apparent once compensation measures have been agreed between individual landowners and the local authority.

15 CULTURAL HERITAGE

15.1 INTRODUCTION

This chapter comprises the results of an architectural and archaeological assessment of the proposed Newtownmountkennedy & Kilcoole Sewerage Scheme, Co. Wicklow. It includes information on sites and monuments of archaeological and architectural interest in proximity to the proposed areas of development identified by a previous assessment (Archaeological Assessment, Architectural & Estate Assessment, Proposed Routes, Newtownmountkennedy & Kilcoole Sewerage Scheme, Co. Wicklow, Valerie J Keeley Ltd, April 1999*)*, as well as including new information that has come to light during this assessment. The full report is contained in **Appendix B, Volume 2**.

15.2 METHODOLOGY

The aim of this assessment has been to identify the potential impact of the proposed scheme on the cultural heritage wherever possible. Where it is not possible to avoid adverse impacts, mitigations measures have been recommended. The archaeological and architectural assessments consisted of a desk-based paper survey and field inspection which was carried out for the earlier EIS in 1999. The data has been updated for the current study.

Paper Survey

The paper survey consisted of a document and cartographic search of a number of sources including:

- **Record of Monuments & Places**, National Monuments Service, *The Department of the Environment, Heritage and Local Government*. The Record of Monuments & Places (RMP) is a list of archaeological sites known to the National Monuments Service with accompanying RMP Maps, based on OS 6" Sheets, which indicate the location of each recorded site. The RMP list is based on **The Sites and Monuments Record** files housed in the National Monuments Services offices.

- **Topographical files** housed in the National Museum of Ireland are the National archive of all known antiquities recorded by the National Museum. It relates to artefacts and also includes references to monuments and has a unique archive of previous excavations. The find-spots of artefacts can also be an important indication of the archaeological potential of the related or surrounding area.

- **Maritime Sites and Monuments Record,** National Monuments Service, Dúchas: The Heritage Service. This is a record of all known shipwreck sites over a hundred years old or of historical importance, also included is a list of other known underwater sites surrounding our coast and inland waterways.

- **Literary sources.** The Urban Archaeological Survey of Co. Wicklow, Wicklow archaeology and history, vol. 1, JRSAI, the Excavations Bulletin, Local Journals, the published archaeological and architectural inventories, the National Inventory of Architectural Heritage (NIAH), Guide to the National Monuments (P Harbison 1975), O'Donovan's Ordnance Survey Letters and Wicklow County Draft Development Plan (2004-2010) were consulted.

- **Cartographic Sources** included all editions of the 6" Ordnance Survey Maps and the Down Survey Maps (1654-1659) housed in the Manuscript Building of the National Library. In addition to the OS 6" series, evidence obtained from earlier mapping was included through the inspection of the RMP files for each archaeological site.

- **Aerial photography** was examined

15.3 ARCHAEOLOGICAL AND ARCHITECTURAL LEGISLATION AFFECTING THIS PROJECT

15.3.1 Archaeology

15.3.1.1 National Monuments

The term 'National Monument' as defined by the 1930 National Monuments Act is, 'a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic, or archaeological interest attaching thereto' (The National Monuments Act 1930, Part 1, Preliminary and General, Section 2). This definition does not restrict inclusion based on dating and includes land adjacent to a national monument, which is required to preserve the amenities of the monument. It is possible that should the relevant authority feel a site or monument is sufficiently endangered it can be assigned this level of protection.

15.3.1.2 Preservation Orders, Registered Sites & Sites Listed in County Development Plans

In certain circumstances that threaten an existing monument *Dúchas* The Heritage Service has, by order, undertaken the preservation of the monument. The effect of these Preservation Orders makes it unlawful to interfere with the monument in any way without the written consent of *Dúchas*. The 'Register of Historic Monuments' was established by *Dúchas*, following the introduction of the National Monuments (Amendment) Act of 1987. As a result of this Act it is unlawful to carry out work on a Registered Monument, except in a case of urgent necessity and with the consent of *Dúchas*. The number of inclusions in the Register is growing steadily as it is to include all recorded sites (RMPs), which are known to *Dúchas*. The majority of these sites are generally listed in the County Development Plans as being protected. In certain circumstances the County Councils highlight certain archaeological sites in their respective areas for protection from development under the provisions of the National Monuments (Amended) Acts.

None of the archaeological sites included in this report are currently protected by Preservation Order or are included in the Register of Sites for Co. Wicklow. However, these methods of protection can be applied at any stage should the relevant authorities feel a site or monument is in sufficient danger.

15.3.1.3 Record of Monuments & Places

The Record of Monuments and Places (RMPs) was established under Section 12 of the 1994 National Monuments (Amendment) Act. Under the terms of this act, the Minister is required to establish and maintain a record of the monuments and places where the Minister believes there are monuments. This record gives protection to the monuments without having to establish a monument is in danger of falling into decay. The term 'monument' as used in this Act encompasses all artificial structures, regardless of date, whether or not they are of archaeological or architectural interest, but excludes buildings used for ecclesiastical purposes. All monuments, whether or not they are in state ownership or care, or be designated or subject to any legal protection, could potentially be classed as ' National Monuments'. A 'Historic Monument' includes 'a prehistoric monument and any monument associated with the commercial, cultural, economic, industrial, military, religious or social history of the place where it is situated or of the country'. Any monument dating prior to A.D.1700 is automatically a historic monument, but monuments post-dating A.D.1700 may also be included.

15.3.1.4 Architectural Heritage

The 2000 Planning Act introduced a range of new measures for the protection of architectural heritage, including the provision for a Record of Protected Structures. This record will replace the system of listing buildings, which was in operation prior to 2000. The National Inventory of Architectural Heritage (NIAH) was set up to assist the local authorities in the compilation of the Record of Protected Structures. It is the policy of each County Council to seek the preservation of items listed in the Record of Protected Structures. No building or structure listed in this record may be demolished or materially altered without grant of permission under the Planning Acts. These sites include country houses, vernacular houses, churches, mills, bridges and other buildings of note. The NIAH for Wicklow has not been conducted to date.

Part A – Archaeology

15.4 DESCRIPTION OF THE EXISTING ENVIRONMENT- ARCHAEOLOGY

15.4.1 General Archaeological Background

The County of Wicklow contains a variety of small towns and villages, which illustrate the urban history of Ireland. Wicklow has a settlement of Viking origin. Unfortunately there is no evidence to indicate that this place actually functioned as a town in the Viking period but it is likely that it was a coastal village of some description. It was certainly of sufficient importance to attract the Anglo-Normans in the late twelfth century. The Anglo-Normans expanded and developed settlements in the surrounding areas including Newcastle.

Newcastle was known in medieval documents as a royal manor, which appears to have been selected as a place of defence in order to protect the coastal route between Bray and Arklow. The castle was in existence by about 1210 (Orpen 1908,129) and it was to be an important base in the later thirteenth century for launching attacks on the Irish of Wicklow. Newcastle is an example of a deserted Anglo Norman borough, the archaeological and documentary evidence indicates that it was the scene of occupation in the thirteenth and fourteenth centuries, after which it is likely that it was abandoned. The future archaeological excavation is likely to be the principal means of gaining additional knowledge.

The county of Wicklow has over one hundred and twenty known wreck sites over one hundred years old along its coast. There are ten of those sites listed below, some of them lying in very close proximity to the outfall area, others their exact location is not recorded so caution is always required.

The area proposed for the scheme is bounded on the east side by the coastline. The Wicklow mountains lie to the west. There are several narrow streams running through this land. The study area is characterised by the hilly ground of the foothills of the Wicklow Mountains on the more western side and more gently rolling ground declining towards the sea to the east. There are several narrow streams, which pass through this land, and narrow stream valleys.

The area under assessment is part of a landscape and seascape rich in archaeological and historical material. The vicinity has attracted settlement from early times as is shown by the presence of monuments dating back to the prehistoric period. Continuity of settlement is shown by the wide array of monuments and finds ranging from the bronze age, the Viking period up to medieval times

15.4.2 Survey Findings

Twelve archaeological sites recorded in the Record of Monuments and Places are found within the environs of the proposed development route (**Figure 15.1**). However it should be noted that none of these monuments are within the site of the proposed plant but may be impacted by the sewer network.

SITE A1

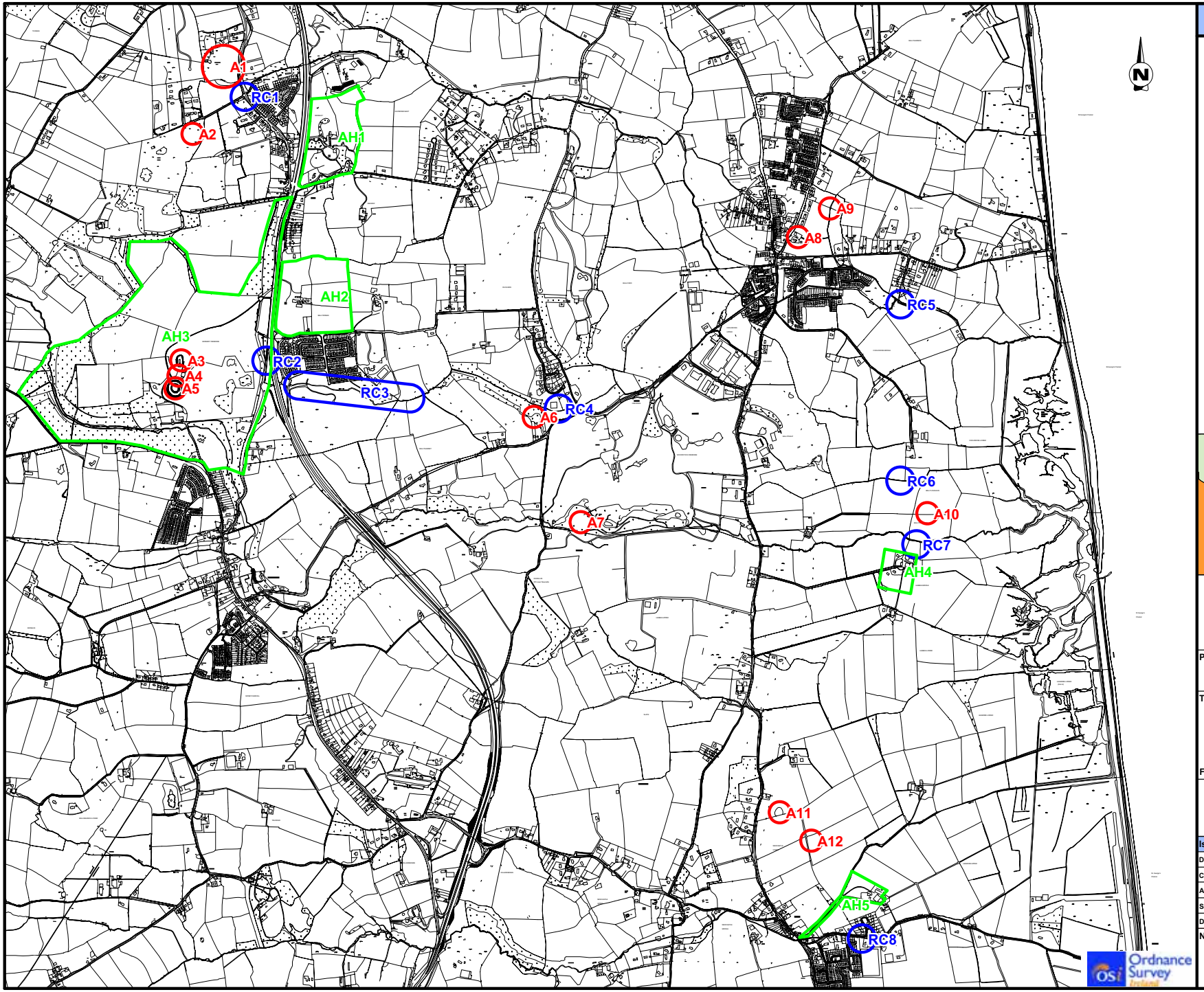
TOWNLAND	Killickabawn
OS 6" SHEETS/ PLAN/ TRACE	13-
NATIONAL GRID REFERENCE	32645/ 20921
IDENTIFICATION	Cartographic/Literary
TYPE	Medieval Town (Site of)
RMP NO	13:16
PROXIMITY TO ROUTE	

The SMR files indicate this location as the site of a medieval town. The site is now occupied by Holywell House (derelict) with associated house and outbuildings. There are ornamental walled gardens to the north of the house.

SITE A2

TOWNLAND	Tinnpark Demesne
OS 6" SHEETS/ PLAN/ TRACE	13-
NATIONAL GRID REFERENCE	32626/ 209857
IDENTIFICATION	Cartographic/Literary
TYPE	Cemetery
RMP NO	13:14
PROXIMITY TO ROUTE	

The SMR files indicate this location as the site of a cemetery consisting of long stone cists. Between 1944 and 1967, 7 extended burial in long stone cists were discovered on a low hillock. Apart from skeletal remains, no associated finds were present.

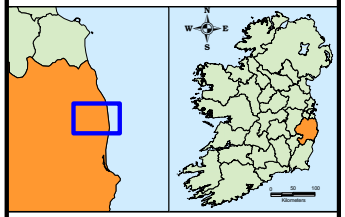


Legend

- Architectural Site
- Archaeological Site
- River Crossing Site

Data Provided by:

Valerie J. Keely Ltd.
Archaeological Consultancy
Brehon House Castlecomer,
Co. Kilkenny
Tel: +353 (056) 4440236
Fax: +353 (056) 4440237
Email vjk@vjk.ie



Wicklow County Council

Project
Newtownmountkennedy & Kilcoole Regional Sewerage Scheme

Title
Location of Architectural, Archaeological and River Crossing Sites

Figure 15.1

RPS mcos
West Pier Business Campus
Dun Laoghaire
Co. Dublin
Ireland
Phone: 01 - 2884499
Fax No. 01 - 2835676
rpsmcos@rpsgroup.ie

Issue Details

Drawn:	SK	Project No.	MDW0135
Checked:	XX	File Ref.	
Approved:			MDW0135MI0107D01
Scale:	1:15,000 @ A4	Drawing No.	Rev.
Date:	04/02/2005	MI0107	D01

Notes

1. This drawing is the property of RPS-MCOS. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. NOT TO SCALE, use figured dimensions only, if in doubt ask.
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Ordnance Survey Ireland

SITE A3

TOWNLAND	Mountkennedy Demesne
OS 6" SHEETS/ PLAN/ TRACE	13-
NATIONAL GRID REFERENCE	32627/ 20732
IDENTIFICATION	Cartographic/Literary
TYPE	Rectilinear Enclosure
RMP NO	13:24
PROXIMITY TO ROUTE	

The site consists of a large mound, 90 north- south by 50m east- west by 4m high. Its top is flat and a small tea- house is located at the southern end. It has been suggested to be a landscape feature or folly.

SITE A4

TOWNLAND	Mountkennedy Demesne
OS 6" SHEETS/ PLAN/ TRACE	13-
NATIONAL GRID REFERENCE	32630/ 20724
IDENTIFICATION	Cartographic/Literary
TYPE	17th Century House
RMP NO	13:25
PROXIMITY TO ROUTE	Crosses Avenue leading to the house

The Kennedy family built a large mansion at this location in 1670, which was subsequently destroyed during the Williamite War. The house that stands here now was built in 178 although various phases of alteration and restoration have since been undertake.

SITE A5

TOWNLAND	Mountkennedy Demesne
OS 6" SHEETS/ PLAN/ TRACE	13-
NATIONAL GRID REFERENCE	32626/ 209857
IDENTIFICATION	Cartographic/Literary
TYPE	Motte
RMP NO	13:26
PROXIMITY TO ROUTE	

The site consists of what the SMR files describe as a natural hill with motte type feature, concurring with Leask's surmisal that this was a natural ridge modelled into a motte and bailey. Regarding the

earthwork itself, its sides are steep and at midway towards the summit there is a wide berm c.9m. Its flat summit has a diameter of 28.5m. This site could represent a natural hill modelled into a motte and consequently converted into a landscape feature by the occupiers of Mountkennedy House in the 19th century.

SITE A6

TOWNLAND	Kilquade
OS 6" SHEETS/ PLAN/ TRACE	13-10-5
NATIONAL GRID REFERENCE	36975 28425
IDENTIFICATION	Cartographic/Literary/Field Inspection
TYPE	Possible Enclosure
RMP NO	13:28
PROXIMITY TO ROUTE	c.15m

It consists of a possible enclosure on the north- east facing slope of the stream valley. The area at the time of the original field inspection was very overgrown and the south side was not accessible. It is a steep sided natural hillock. A narrow berm runs around the north side of the base. A shallow ditch with an external bank 1.3 - 2m wide contains this line on the north east side. Near the domed summit there are several hollows. While it is possible that this is an archaeological site the defining feature looks like a modern boundary. The diameter is c.40m. The site extends over the steep valley of a stream.

SITE A7

TOWNLAND	Woodstock Demesne
OS 6" SHEETS/ PLAN/ TRACE	13
NATIONAL GRID REFERENCE	32874/ 20645
IDENTIFICATION	Cartographic/Literary
TYPE	Megalith (possible)
RMP NO	13:33
PROXIMITY TO ROUTE	

It was attested to be a megalith but a report in the SMR files says it is a natural rock outcrop (25-09-90). Nevertheless the site has not been delisted and is still treated as an RMP site.

SITE A8

TOWNLAND	Kilcoole
OS 6" SHEETS/ PLAN/ TRACE	13/10/3
NATIONAL GRID REFERENCE	32978 26801
IDENTIFICATION	Cartographic/Literary/Field Inspection
TYPE	Ecclesiastical remains
RMP NO	13:29
PROXIMITY TO ROUTE	

This site is a church and graveyard situated on a gentle east-facing slope in Kilcoole village. It is built of rubble. There is a low segmental chancel arch with a tapering opening immediately above. There are simple round-headed windows. A large number of early eighteenth century grave stones. There is a font standing immediately inside the west door on the north side. It is a square block of granite with rounded edges with one corner missing. A church on an early church site. The origin of Kilcoole is ascribed to an early religious establishment founded here by St Comhgall, probably in the 6th century. The Ruins of an old church still remain and it is likely that this building occupied the site of the original church. Some early tombstones may be seen in the burial ground attached and amongst these is one dating from 1707. The nearest section of pipeline has already been constructed as part of the interim scheme.

SITE A9

TOWNLAND	Kilcoole
OS 6" SHEETS	13/11/1
NATIONAL GRID REFERENCE	32994 20813
IDENTIFICATION	Cartographic/Literary/Field Inspection
TYPE	Holywell
PROXIMITY TO ROUTE	c.200m
SMR NO	13:30

This holy well lies on level ground on the north west corner of a poorly drained area. It is a natural unmarked spring. The general public look upon it as the church well. The nearest section of pipeline has already been constructed as part of the interim scheme.

Site A10

TOWNLAND	Ballyloughlin
OS 6" SHEET/ PLAN/ TRACE	13/2/6
NATIONAL GRID REFERENCE	33054/20647
IDENTIFICATION	Cartographic/Literary
TYPE	Possible Enclosure
PROXIMITY TO ROUTE	c.10m
SMR NO	13:36

The site consists of two, roughly circular cropmark enclosures with a third rectilinear enclosure superimposed over the others. The largest circular/oval enclosure measures c.40m x 35m and is defined by a ditch, as is the second which is circular with a 25m diameter. Possible traces of a second defining ditch have been observed at this site. The rectilinear enclosure overlays the previous measuring c.50m x 45m. A gap at the south may indicate an entrance.

SITE A11

TOWNLAND	Newcastle Lower
OS 6" SHEET/ PLAN/ TRACE	19/2/3
NATIONAL GRID REFERENCE	32971 20473
IDENTIFICATION	Cartographic/Literary/Field Inspection
TYPE	Ringfort/ Rath
PROXIMITY TO ROUTE	c. 200m
SMR NO	19:6

It consists of an oval enclosure consisting of a platform and an oval bank around the perimeter, with an external ditch. It represents the site of a ringfort.

SITE A12

TOWNLAND	Newcastle Lower
OS 6" SHEET PLAN TRACE	19/2/3
NATIONAL GRID REFERENCE	32991 20460
IDENTIFICATION	Cartographic/Literary/Field Inspection
TYPE	Possible enclosure
PROXIMITY TO ROUTE	c. 50m
SMR NO	19:7

It consists of a circular cropmark enclosure identified from aerial photography. The diameter measures c.20m. It is defined by an annular ditch. No visible traces can be seen on the ground.

15.4.3 Areas of High Archaeological Potential

15.4.3.1 River Crossings

The importance of rivers in archaeology was given added recognition in 1998 with the issuing of a memorandum from *Dúchas* requiring the inclusion of water bodies and associated features in archaeological assessments. This was due to the fact "that linear developments particularly roads often cross rivers and impact on mills, fords, old bridges and findspots of archaeological material. Other sites such as castles and *longphort* (Viking settlements) are also found beside rivers" (Memo from *Dúchas* re. River Crossings and Bridges, 23/04/98). Rivers and waterways have always attracted human activity for a variety of reasons, from their obvious use as a source of water to their use as a means of transport, as a source of energy and for their spiritual, religious or ritual associations. Additionally, the former flood plains of large waterways provided a fertile, well-irrigated and relatively flat landscape suitable for agricultural practices from the earliest times of Irish farming (*c*.4000 BC).

Various rivers and their tributaries will be crossed by the proposed pipeline. Nine river crossings have been identified during the course of this work (**Table 15.1**). The locations of all of the sites in proximity to the proposed development areas is shown on **Figure 15.1.**

Table 15.1: Table of River Crossing Sites

SITE	STREAM	TOWNLAND
RC1	Stream "A"	Killickabawn
RC2	Stream "B"	Ballyronan/ Newtownmountkennedy Demesne
RC3	Stream "B"	Newtownmountkennedy Demesne/ Ballygarrett
RC4	Stream "B"	Kilquade/ Woodstock Demesne
RC5	Tributary of Stream "A"	Ballydonarea/ Cooldross Middle
RC6	Stream "Z"	Cooldross Lower/ Ballyloughlin
RC7	Stream "C"	Ballyloughlin/ Leabeg Middle
RC8	Stream "D"	Leamore Upper

15.4.4 Shipwrecks

The Shipwreck Inventory prepared by the Underwater Archaeological Unit of *Dúchas* provides a listing of inshore wreckings as noted from the middle of the eighteenth century, when systematic recording of such incidents in Irish waters began. There are records of two shipwreckings off the coast at Newcastle. The 406-tonne Italian brig Guerrera wrecked on 22/1/1885 while on route from Dublin to Cardiff. The location is given as Newcastle. The coalboat Trifylia was an iron screw steamer of 1336 tons and 258 feet long. It was wrecked on 12/11/1915 en route from Ayr to Rouen, when a gale drove the ship ashore. It is thought to have been wrecked in 10m of water some 2 miles south of Greystones. It has subsequently been scattered by storms.

15.5 IMPACTS

The proposed scheme involves sub-surface excavation with a potential impact on the environs of four recorded RMP sites (Sites **A4**, **A6**, **A10** & **A12**).

Nine river crossings (**RC1- RC9**) are also impacted by the scheme.

The pipeline as it approaches the marine outfall point will have a direct impact on the **intertidal foreshore** area under study.

The marine outfall route has a potential direct impact on the **seabed** and any **wrecks** which may be located at these locations.

The level of impact and mitigation regarding each archaeological feature that will be impacted has been outlined in **Table 15.2.**

15.6 MITIGATION MEASURES

Mitigation measures shall be undertaken in compliance with national policy guidelines and statutory provisions for the protection of the archaeological and cultural heritage, including National Monuments Acts 1930-2004, Framework & Principles for the Protection of the Archaeological Heritage (Department of Arts, Heritage, Gaeltacht & the Islands 1999) and Policy & Guidelines on Archaeological Excavation (Department of Arts, Heritage, Gaeltacht & the Islands 1999).

This report recommends that the proposed works avoid direct impacts with the identified elements of the known archaeological monuments. However, this may not be possible in the present case, a full programme of archaeological mitigation including investigative excavation and archaeological monitoring is offered and recommended. This should be followed by preservation *in situ* or by full-scale excavation where archaeological material is encountered.

15.6.1 Mitigation Measures – Prior to Construction

It is recommended that the following measures be undertaken in advance of the construction phase. This is aimed at allowing a satisfactory time frame in which the mitigation measures can be conducted and the results assessed without causing delays to the construction programme.

Field Inspection: Given the length of time since the original assessment and the implementation of new policies, guidelines, frameworks and principles in the protection of and approach to archaeological and to areas of archaeological potential, it is recommended that a field inspection of the route of the scheme be undertaken prior to construction of the facility. This shall involve a field inspection of the area of the proposed work. Field inspection is considered essential in determining the nature and extent of the remaining above ground evidence and in assessing the potential impact of the development on the archaeological landscape. It often leads to the discovery of hitherto unrecorded archaeological sites. Further recommendations will be made based on this field inspection and on the production of detailed works mapping.

Archaeological Investigation: Archaeological investigative excavation, in the form of controlled trial trenching is recommended for Sites **A4, A6, A10** and **A12**, the sites that are directly impacted or have their environs impacted by the proposed development. This involves sub surface work in an area within their environs and will aid in determining the nature, extent and significance of the archaeology present. Following investigation, further appropriate mitigation strategies should be provided if required. Such mitigation strategies may involve archaeological excavation of the archaeological remains (preservation by record) or preservation *in situ*. The results of the test trench investigation will enable the appropriate mitigation strategy to be undertaken with the approval of the DoEHLG.

Pre-Disturbance Bankside Inspection: It is recommended that a pre-disturbance bankside inspection and survey be undertaken on **RC1**, **RC2, RC3, RC4, RC5, RC6, RC7, RC8** and **RC9**. This inspection should be undertaken by a suitable qualified underwater archaeologist and will ascertain the

archaeological potential of these sites. Should it be established that archaeological potential does exist at this location further specific recommendations and ameliorative measures will be made.

Archaeological Underwater Inspection and Survey: Underwater inspection is recommended for waterbodies found to be of archaeological potential that will be directly impacted by the scheme. This may consist of a wading survey or dive survey depending on the depth of water, visual inspection and a metal-detector survey of the underwater environment. Underwater survey will determine whether further investigation is required.

Visual Inspection Dive Survey and Magnetometry Survey: Visual inspection dive survey and magnetometry survey by hand-held metal-detection should be employed to assess the archaeological potential of the seabed surrounding the proposed marine outfall areas.

Preservation in Situ: Strategies for the preservation *in situ* of archaeological remains should be considered on a case-by-case basis, in consultation with the Statutory Authority. Preservation in situ can be undertaken through:

- Avoidance of the confirmed feature in the development process, if possible
- Preservation of the confirmed feature through detailed design, for example blanketed under embankment.

Preservation by record (Archaeological Excavation): Preservation by record in the form of archaeological excavation and recording, to resolution, is recommended for sites where initial investigation has yielded evidence of archaeologically significant material or structures, and where preservation *in situ* is not feasible.

15.6.2 Mitigation Measures – During Construction

Mitigation measures at construction phase will be undertaken in compliance with national policy guidance and statuary provisions for the protection of the archaeological and cultural heritage.

Archaeological Monitoring: It is recommended that archaeological monitoring be undertaken during topsoil stripping of ground works associated with the scheme. This would include any associated earthworks and drainage works, where and as required by the Statutory Authority. There would be a provision for preservation *(in situ)* or preservation by record of any archaeologically significant material that was uncovered at this time.

Retention of an Archaeologist: It is recommended that an archaeologist be retained for the duration of the relevant earthworks. The time-scale for the construction phase will be made available to the archaeologist, at an early stage, with information on where and when topsoil stripping will take place.

Discovery of Archaeological Material: In the event of archaeological features or material being uncovered during the construction phase, the machine work will cease in the immediate area to allow the archaeologist to inspect any such material. Initial assessment will determine the nature, extent and significance of the archaeology present. As a result of the assessment, decisions on the most appropriate mitigation strategy will be taken with the approval of the DoEHLG. The discovery of any archaeological object will be reported to the Director of the National Museum of Ireland or the Garda Síochána within 96 hours of discovery (Section 23 of the National Monuments Acts 1930 (as amended)).

Fencing: Fencing of any archaeological sites discovered shall be carried out as appropriate during their excavation.

Preservation in Situ: Strategies for the preservation *in situ* of archaeological remains as described above should be considered on a case-by-case basis, in consultation with the Statutory Authority.

Construction Works: The positioning of temporary site offices, access roads, haul roads, spoil heaps and borrow pits will take into account the location of identified sites and areas of archaeological potential.

Mitigation measures, both at pre-construction and construction phases, are required to be undertaken in compliance with national policy guidance and statutory provisions for the protection of the archaeological heritage, including: *National Monuments Acts 1930-2004.* These recommendations are subject to approval by The Department of the Environment, Heritage and Local Government.

Table 15.2: Summary of Impacts and Mitigation recommended for Sites, Potential Sites and areas of Archaeological Potential

Site Reference	Townland	NGR	Site Type	Proximity to the route	Impact	Mitigation
SITE A4	Mountkennedy Demesne	32630/ 20724	17th Century House	Crosses Avenue leading to the house	Impact on Avenue	It is firstly recommended that this site and the environs of the site be avoided to a distance of at least 20m by the proposed development. Should there be substantial grounds that ensure that this is not possible, any development work within this distance or within the area of the site should be preceded by archaeological investigation in the form of controlled trial trenching. Any features and material of significance that are uncovered may be subject to further mitigation measures, including full excavation to resolution. The implementation of these mitigation measures should be conducted well in advance of the construction phase. This will allow for the full establishment of the nature and extent of the site at an early stage and will minimise the risk of delays at construction phase.
15.6.3 SITE A6	Kilquade	36975 28425	Possible Enclosure	c.15m	Direct Impact on the Environs of the site.	It is firstly recommended that this site and the environs of the site be avoided to a distance of at least 100m by the proposed development. Should there be substantial grounds that ensure that this is not possible, any development work within this distance or within the area of the site should be preceded by archaeological investigation in the form of controlled trial trenching. Any features and material of significance that are uncovered may be subject to further mitigation measures, including full excavation to resolution. The implementation of these mitigation measures should be conducted well in advance of the construction phase. This will allow for the full establishment of the nature and extent of the site at an early stage and will minimise the risk of delays at construction phase.
SITE A10	Ballyloughlin	33054/ 20647	Possible Enclosure	c.10m	Potential Direct Impact, Impact on Environs.	
SITE A12	Newcastle Lower	32991 20460	Possible enclosure	c. 50m	Impact on Environs.	
RC 1	Killickabawn		Crossing on Stream “A”		Direct impact. The section of this river that the route of the proposed scheme crosses will be impacted.	
RC 2	Ballyronan/ Newtownmountkennedy Demesne		Crossing on Stream “B”		Direct impact. The section of this river that the route of the proposed scheme crosses will be impacted.	

Site Reference	Townland	NGR	Site Type	Proximity to the route	Impact	Mitigation
RC 3	Newtownmountkennedy Demesne/ Ballygarrett		Crossing on Stream “B”		Direct impact. The section of this river that the route of the proposed scheme crosses will be impacted.	It is recommended that a pre-disturbance bankside inspection and survey be undertaken by a suitable qualified underwater archaeologist to ascertain the archaeological potential of this site. Should it be established that archaeological potential does exist at this location further specific recommendations and ameliorative measures will be made. A wading survey (if the water level is below 50cm) or an underwater survey (if the water is above 75cm) and visual survey of this site may be conducted. If the water level is in between these levels (50 cm-75 cm) the type of survey will be at the discretion of an experienced underwater archaeologist. The underwater survey may involve a metal detection survey, which should also be undertaken by an experienced underwater archaeologist.
RC 4	Kilquade/ Woodstock Demesne		Crossing on Stream “B”		Direct impact. The section of this river that the route of the proposed scheme crosses will be impacted.	
RC 5	Ballydonarea/ Cooldross Middle		Crossing on Tributary of Stream “A”		Direct impact. The section of this river that the route of the proposed scheme crosses will be impacted.	
RC 6	Cooldross Lower/ Ballyloughlin		Crossing on Stream “Z”		Direct impact. The section of this river that the route of the proposed scheme crosses will be impacted. A culvert will also be inserted to cross the stream.	
RC 7	Ballyloughlin/ Leabeg Middle		Crossing on Stream “C”		Direct impact. The section of this river that the route of the proposed scheme crosses will be impacted. A culvert will also be inserted to cross the stream.	

Site Reference	Townland	NGR	Site Type	Proximity to the route	Impact	Mitigation
RC 8	Leamore Upper		Crossing on Stream "D"		Direct impact. The section of this river that the route of the proposed scheme crosses will be impacted. A culvert will also be inserted to cross the stream.	
RC 9	Leamore Upper		Crossing on Stream "D"		Direct impact. The section of this river that the route of the proposed scheme crosses will be impacted. A culvert will also be inserted to cross the stream.	
MA1	Off the coast at Newcastle		Wreck	At Newcastle new pipe will be laid that will extend c. 450m into the sea from the shore.	Potential Direct Impact	It is recommended that an archaeological programme of remote-sensing and pre-disturbance underwater inspection be conducted prior to the commencement of these works. The remote-sensing will involve the deployment of a boat-towed high frequency side-scan sonar to map the seabed and locate potential targets of interest. It will include a sub-bottom profiler to detect buried anomalies. Points of interest that are highlighted within the pertinent area will then be diver-truthed. A team of qualified underwater archaeologists will inspect and record each anomaly. Their work will include a licensed metal-detector survey of the pertinent area. Underwater inspection will determine if further investigation is needed.
MA2	Off the coast at Newcastle		Wreck	At Newcastle new pipe will be laid that will extend c. 450m into the sea from the shore	Potential Direct Impact	

Part B - Architecture

15.7 DESCRIPTION OF THE EXISTING ENVIRONMENT- ARCHITECTURE

15.7.1 Country Houses, Demesnes and Associated Features

The 18th century, a relatively peaceful period, saw the large-scale development of demesnes and country houses in Ireland. The main residences of such estates were usually large houses built in a formal, fashionable style, conforming to national and international standards of taste. The houses generally form part of the larger demesne landscape. Sites **AH1, AH2** and **AH3** are examples (**Figure 15.2**). Demesnes were dominant features of the rural landscape throughout the 18th and 19th centuries. The 18th century demesne landscape favoured grid-like patterns and symmetrical gardens linked by tree-lined avenues, often organised in complex systems across the demesne lands. The avenues focused on the main façade of the house and could stretch for miles, offering impressive views of associated landscape features such as tree-rings, formal gardens, architectural follies, ponds and mazes. Deer parks with substantial boundaries incorporating large areas of the demesne are still often depicted on maps Associated structural features also included large ornamental gates, lodges, icehouses and pigeon houses. Follies found within demesne grounds are temples, grottos, columns, round towers, gazebos and ornamental bridges. In the later 18th and early 19th century, landscape design became less formal, creating 'natural' parklands. Walled kitchen gardens and stable buildings were located at a distance from the main house, sometimes connected by sunken passages, so-called 'hahas'. Estate cottages and lodges were widely built in the late 19th century and were often treated in a formal manner, thus linking them architecturally to the main residence. After the Famine in the mid-19th century, many demesnes went into a rapid decline and the lands were subsequently divided up amongst neighbouring farmers. Once the land had been sold, the houses became neglected and were often demolished.

From the late 18th century onwards, prosperous farmers and professional people also started to build substantial houses in the Georgian style for themselves. Even these more modest structures generally featured landscaped parklands around the main residence, even though they did not feature extensive demesnes. (Sites **AH4** and **AH5** are examples).

15.7.2 Vernacular Architecture

The majority of buildings found in the Irish countryside are part of the vernacular tradition. This means that they follow local traditions and use local materials, rather than being architect designed in a formal style. Most rural houses were farmhouses and associated outbuildings. In the 19th century, detached houses for minor gentry and professionals were also built in rural areas. Until the mid-19th century, smaller houses were often constructed from mud. From the 19th century onwards, farmhouses were generally built of stone and roofed with locally quarried slate, thatch or corrugated iron. There are many variations in the design, size and structure of farmhouses and their associated outbuildings. They range from single storey cottages to large two storey structures. The most common form of residences in smallholdings is the single-storied, thatched cottage of three roomed, rectangular plan. These generally featured a central hearth-lobby entrance. Occasionally these simple structures were extended both in length and height in the later 19th century. A number of outbuildings were often grouped around a farmyard, forming a central court, especially in the richer midland regions.

15.7.3 Survey Findings

Below are details of the architectural sites recorded during the paper survey and the field inspection. It consists of five sites, three of which are protected in the Wicklow County Development Plan 2004-2010. The locations of all of the sites in proximity to the proposed development is depicted on **Figure 15.2.**

SITE AH1

TOWNLAND	Bromley
COUNTY	Wicklow
O.S. 6" SHEET	19
IDENTIFICATION	Cartographic, Literary, Extant
SITE TYPE	Demesne House
STATUS	Wicklow County Development Plan 2004-2010 Schedule 10.8, No. 59
PROXIMITY	Pipeline skirts western boundary of property

Bromley House and demesne. The building is listed in the Record of Protected Structures for Co. Wicklow. The construction of new roads in the vicinity has already altered the authenticity of the boundary and avenue.

SITE AH2

TOWNLAND	Ballyronan
COUNTY	Wicklow
O.S. 6" SHEET	19
IDENTIFICATION	Cartographic, Literary, Extant
SITE TYPE	Demesne House
STATUS	Protected- Wicklow County Development Plan 2004-2010. Schedule 10.18. No. 56.
PROXIMITY	Pipeline skirts western boundary of property

Belfield House was constructed in the 18th century and associated demesne. The building is listed in the Record of Protected Structures for Co. Wicklow.

SITE AH3

TOWNLAND	Mountkennedy Demesne
COUNTY	Wicklow
O.S. 6" SHEET	19
IDENTIFICATION	Cartographic, Literary, Extant
SITE TYPE	Demesne House
STATUS	Protected- Wicklow County Development Plan 2004-2010. Schedule 10.18. No. 37.
PROXIMITY	Pipeline skirts eastern boundary

It is Mountkennedy House, and associated demesne. The house was constructed in the 1780's by General Cunningham. The building is listed in the Record of Protected Structures for Co. Wicklow.

SITE AH4

TOWNLAND	Leabeg Middle
COUNTY	Wicklow
O.S. 6" SHEET	19
IDENTIFICATION	Cartographic, Literary, Extant
SITE TYPE	Georgian House & Associated Outbuildings
STATUS	-
PROXIMITY	Pipeline skirts house and outbuildings

It consists of a Georgian house with associated outbuildings. The farm buildings appear to be older than the house. The house is single storied with semi-basement at the front/west elevation and two storey at the rear. These buildings are a fine example of stone built out-buildings with brick surrounds to window and door opes. An avenue links the structures to another some 250m or so further south, where the line passes about 180m from another Georgian farm house, Leabeg House. This house has associated wooden mill and mill-race.

SITE AH5

TOWNLAND	Leabeg Lower
COUNTY	Wicklow
O.S. 6" SHEET	19
IDENTIFICATION	Cartographic, Literary, Extant
SITE TYPE	Lodge & Associated Avenue
STATUS	-
PROXIMITY	Pipeline cuts through avenue and skirts western boundary

It consists of a late 18th century house approached by a long curving drive from the private road from Newcastle to Leamore Park, through flat park land. The front elevation is mounded and the hall door approached by a flight of stone steps. The slated roof is brought forward to slopes carried on four timber columns with three arches formed of timber latticing the whole forming a veranda type entrance porchway. The side elevation to the west is two storey over a basement. There has been an extension added to the rear.

15.8 IMPACTS

Four architectural sites have potential impacts, three of which are protected. Sites **AH2, AH3 & AH5** have potential impacts on their boundaries and avenues while **Site AH4** has a potential impact on its outbuildings. The level of impact and mitigation regarding each architectural feature that will be impacted has been outlined in **Table 15.3.**

15.9 MITIGATION MEASURES

Field Inspection: Given the length of time since the original assessment and the implementation of new policies, guidelines, frameworks and principles in the protection of and approach to architectural sites, it is recommended that a field inspection of the route of the scheme be undertaken prior to construction of the facility. This shall involve a field inspection of the area of the proposed work. Field inspection is considered essential in determining the nature and extent of the remaining above ground evidence. Further recommendations will be made based on this field inspection and on the production of detailed works mapping.

This report recommends that the proposed works avoid direct impacts with the identified elements of the known architectural landscape. Because this may not be possible in the present case, a full programme of mitigation is offered and recommended.

15.9.1 Construction Mitigation Measures

Any impact on architectural heritage is a result of construction activities and therefore the mitigation measures are also related to the construction activities.

- Where a property boundary or entrance is impacted by the scheme, where practical, the boundary or entrance should be reinstated or replicated. This is recommended for sites **AH2, AH3, AH4** and **AH5**.
- Due to their close proximity, it is recommended that sites **AH2, AH3, AH4** and **AH5** are protected from damage during the construction phase.
- Written and Photographic Recording is recommended for the impacted elements of Sites **AH2, AH3, AH4** and **AH5**. This will consist of a photographic record for each element impacted with a description of the site.

Mitigation measures at construction phase will be undertaken in compliance with national policy guidance including Architectural Heritage Protection, Draft Guidelines for Planning Authorities (Department of Arts, Heritage, Gaeltacht & the Islands 2001) and statuary provisions for the protection of the archaeological and cultural heritage. Recommendations are subject to approval by The Department of the Environment, Heritage and Local Government.

15.10 RESIDUAL IMPACT

There are no residual impacts anticipated from the scheme.

Table 15.3: Summary of Impacts and Mitigation Recommended for Architectural Features

Site Reference	Townland	Site Type	Proximity to the route	Impact	Mitigation Measure
AH2	Ballyronan	Demesne House	Pipeline skirts western boundary of property	Potential Impact on western boundary and avenue by the pipeline from Kilpedder	It is recommended that the boundary and avenue be avoided and protected during the laying of the pipe. Should there be substantial grounds that ensure that this is not possible, it is recommended that a detailed photographic and written survey of this avenue and boundary be conducted. Removal of the wall should be carried out in such a way that the potential re-instatement or replication of the feature, using the demolition's material, after completion of the scheme is a possibility. These measures should be conducted well in advance of the construction phase.
AH3	Mountkennedy Demesne	Demesne House	Pipeline skirts eastern boundary	Potential Impact on eastern boundary and avenue by the pipeline from Kilpedder.	
AH4	Leabeg Middle	Georgian House & Associated Outbuildings	Pipeline skirts house and outbuildings	Potential Impact on outbuildings by the pipeline from Kilcoole.	
AH5	Leabeg Lower	Lodge & Associated Avenue	Pipeline cuts through avenue and skirts western boundary	Direct Impact on the avenue west of the Lodge, Potential Impact on the western boundary by the pipeline from Leamore WWTW.	

16 SUMMARY OF MITIGATION MEASURES AND RESIDUAL IMPACTS

The chapter summarises the mitigation measures described in this Environmental Impact Statement. It is intended as a quick reference to be read in conjunction with the specific chapters which give the background as to why these measures are required.

16.1 COMMUNITY

16.1.1 General

- **Site Boundary and Security**: secure fencing and gates will be provided to exclude members of the public
- **Building Regulations**: Compliance with building regulations and appropriate standards in relation to the design of works for example through the provision of handrailing to 1.2 m, covers/decks where appropriate, cleaning equipment to maintain platforms and walkways, protective covers to moving parts etc.
- **Classification of hazardous/ventilation**: classification of hazardous area in buildings, appropriate zoning and specification of electrical apparatus, fixed and portable gas monitoring equipment (methane, petroleum vapours, oxygen level), with effective ventilation.
- **Hygiene Facilities:** provision of hygiene facilities for operators including lockers and washing facilities.
- **Staff Training**: training of operational personnel and development of a safe system of work for the plant.

16.1.2 Construction Phase

These are temporary and relate primarily to dust, noise and vibration and traffic. These will be dealt with at the contract stage in that the contractor will be obligated to put in place measures to reduce these impacts. Further details are contained in subsequent chapters.

16.2 AIR QUALITY

16.2.1 General

In order to limit the spread of offensive odour in the plant environs, it is proposed that odour treatment facilities be installed to deal with the more offensive odour sources. These are outlined in Chapter 7.

16.2.2 Construction Phase

Construction activities have the potential to cause formulation/accumulation of air borne pollution and dust, particularly during the earth moving phase. It will be necessary to provide an effective dust control plan in the vicinity of housing and grazing areas for cattle and horses and also to prevent a

nuisance to road users. The dust mitigation plan will be prepared once the contractor has been selected.

16.3 NOISE

16.3.1 General

Noise control measures are built into the design of the plant with the enclosure of the main sources of noise and the detailed design of the plant will incorporate noise control measures, as appropriate, to meet the criteria. These will include enclosure of the compressors and screening of plant. Further mitigation is provided by the distance of the facilities from the nearest residences.

16.3.2 Construction Phase

British Standard BS 5228: 1997 on Noise Control on construction and demolition sites provides guidance on the methods available to control noise from construction work and is used on road and other large scale construction projects.

16.4 LANDSCAPE AND VISUAL

The primary mitigation measures per EPA Guidelines are as follows:

- Total avoidance of certain negative landscape and visual effects; particularly in terms of sensitive and or prominent landscapes.
- Reduction of certain impacts where avoidance is not possible requiring consideration of the environmental constraints contained on the site.
- Remedy and minimise the possible adverse negative impacts

A series of mitigation and compensatory measures based upon the analysis of the site context, existing conditions, and the proposed site layout have been considered. The aim of proposed mitigation measures is to ensure that the degree of visual intrusion posed by the proposed development at Leabeg is minimised and that the site achieves a high degree of visual integration into the existing fabric of the receiving environment:

- Trees and hedgerows around the perimeter of the site and along the proposed access road will be surveyed to identify trees and elements of the hedgerows that are worthy of retention and which will be protected during the construction phase.
- A Landscape Master Plan will be prepared by the developer and will address landscape issues within the boundary of the site and along the access road. It should also include the following elements:-
    - A tree protection program in accordance with *British Standard 5837 – Guide for Trees* in relation to Construction as part of an ongoing site management strategy. This will assist in ensuring the retention of the existing hedgerows, hedges and trees identified for preservation; and protection of any newly landscaped areas.

- A planting strategy, consisting of tree species capable of adapting to varied site conditions in conjunction with appropriate understorey species. The principal objective of the planting plan should be to assist in the visual integration of the development into the surrounding environment with a scale of planting that adequately screens the site.

- Facilitate effective visual screening by augmenting the existing planting with similar species of trees and hedgerow material. The improved screening of the north-eastern, northern and southern site boundaries will greatly increase the screening along the site boundaries.

- A symphatic architectural design will be developed in conjuction with a qualified architect. The architecture of the facility should take into consideration the following:-

  - The receiving environment through the choice of suitable construction materials and colours .

  - Minimise the overall heights of the structures or works proposed.

- To incorporate appropriate road design that accommodates potential widening and increase in road usage along the section of road shared by the local residence, a detailed survey along the proposed route shall be completed.

- If a defined boundary treatment is required to ensure restricted access into the site, then the boundary should be set back a minimum of 1.5m from existing hedgerows and set out and constructed by hand – this will ensure the continued integrity of existing screening vegetation. Fencing shall be in dark green, blue-grey in colour, matching the exterior finishes on the stuctures proposed for the development.

- The use of directional lighting, on a timer, or motion sensitive, lighting shall be explored to further reduce negative impact.

- The existing woodland area shall be protected through agreed site practices, and if necessary physical barriers such as fencing may be implemented.

16.5 TERRESTRIAL ECOLOGY

16.5.1 General

The woodland and drainage ditch along the eastern boundary of the new treatment plant site at Leamore will be fenced off before construction work starts. Strict site management with regard to storage and handling of fuels, oils, cement and other potentially toxic and hazardous substances will minimise the risk of pollution. An emergency plan to contain any accidental spillages will be put in place before construction work commences.

Surface water run off from buildings and paved surfaces will be passed through oil interceptors through an attenuation pond with a reedbed area, prior to discharge to local watercourses. The pond will be included in the site landscaping, and will have a surface area of at least 1,000 m^2. A central pond depth of 2m with gently sloping margins will facilitate the development of planted marginal vegetation including reeds.

Site landscaping will include tree and shrub planting, including native species which occur in the area of the site. Suitable species are alder, willow cultivars, and silver birch on wetter ground, with ash, hazel, oak, holly, wild cherry, hawthorn and blackthorn on drier ground.

Access to the construction site will be along and existing farm access, and across fields. Access routes will be fenced off, with fencing at a minimum 3m distance from the base of hedgerows, to minimise soil compaction over root systems.

16.5.2 Construction Phase

The principal mitigating measure is the selection of the outfall pipeline route. It is proposed to route the outfall pipe through the least sensitive habitats in the Murrough coastal wetland complex avoiding the designated Special Protection Area and the Special Area of Conversation (SAC). A survey of the marsh will be carried out prior to construction to determine the most suitable to site the pipeline in the marsh complex.

Short term impacts are the loss of vegetation along a 30m wide construction strip. Topsoil will be removed and stored for replacement after the pipeline is laid; intensive grassland and cultivated wet grassland areas will be reseeded with ryegrass and field boundaries reinstated.

A 2ha pipeline assembly area will be constructed on unused improved wet grassland. Topsoil will be removed and stored for subsequent replacement. It will probably be necessary to create a firm working surface of broken stone or gravel, which will be laid over a geotextile to facilitate removal of the working surface after pipeline laying is complete. The assembly area will be restored to its existing contours. No long term impacts on this habitat are envisaged. If reseeded, vegetation similar to that on unimpacted unused improved wet grassland is expected to establish within five years. Water quality in watercourses and wetland areas will be protected by strict site management. Fuels and oils will be stored in designated areas. All re-fuelling and maintenance work on machinery will take place in designated areas, which will be agreed and sited to minimise any risks of surface run-off or spillage to drains and watercourses.

From unused improved wet grassland, the pipeline will run in a tunnel at some depth under the coastal grassland and shingle ridge vegetation, to a coffer dam construction site on the foreshore close to Six Mile Point. This location is south of the little tern colony. Since construction work on the foreshore is weather dependent, it may coincide with breeding activity at the tern colony. Close liason will be arranged with the BirdWatch Ireland tern protection scheme wardens, and with Dúchas - National Parks and Wildlife, during the year when construction will take place. Little terns will be deterred from any attempted nesting in the vicinity of the construction site through the use of agreed procedures, and encouraged to nest at the usual colony site at The Breaches. Procedures will be agreed and operational by the end of April, when little terns normally start to arrive, in the construction year.

The Blackditch area, between Five Mile Point and Newcastle Station Road, contains a mosaic of reedbed, willow, the priority habitat *Cladium* fen, and an area of wet woodland which is habitat to a number of rare species of fly. Reedbeds and marshy grassland bordering this wetland complex extend to within 50m of the Newcastle Station Road; no construction work will take place to the south of the road in order to protect these habitats.

Drainage from this complex is towards the north, through the drainage channel which runs between the airstrip at Newcastle and the railway line. The outfall pipeline will pass under this drainage channel and through the shingle ridge below sea level. It is considered unlikely that the pipeline installation will have any implications for the hydrology of the Blackditch wetland habitats. Site investigations including boreholes will be carried out to type the sediments and assess hydrological gradients along and across the pipeline route before construction work starts. Investigation results and any implications for upstream wetlands will be subject to ecological assessment, and consultation with Dúchas - National

Parks and Wildlife, so that detailed monitoring/mitigation and tunnel design and construction methods can be put in place as appropriate.

Specific mitigation for bats and badgers is outlined in Chapter 10.

16.6 MARINE ECOLOGY

16.6.1 General

Long term monitoring will be put in place to verify the plant performance and impacts to include:

(i) The bacteriological status of the water, including areas which are fished for whelks and used for bathing, in order to ensure that standards are maintained. Monitoring of the bacteriological quality of the whelks will be carried to verify the lack of contamination.

(ii) Water quality and biodiversity of the marsh fauna and flora;

(iii) The subtidal fauna and flora.

Table 16.1: Summary of Suggested Mitigation Measures to Minimise the Impact of the Development on the Marine Environment (see text for details)

Impact	Mitigation measures
Sedimentation	Minimise the duration of construction works and the area affected.
Decrease in water quality	Minimise the risk of accidental spills of oil, fuel and other chemicals. Remove all wastes from the area.
Habitat disturbance	Minimise the area of marsh, seashore and seabed affected by the outfall construction.
Damage to fisheries	Minimise the area of seabed affected by the outfall construction. Buoy fixed at the outfall to alert fisheries to its location.

16.6.2 Construction Phase

Due care and vigilance will be followed to prevent accidental contamination of the site and surrounding environment during the construction of the pipeline and infrastructure. In particular measures will be taken to prevent the contamination of the stream entering the watercourse draining into the marsh. Disturbance to the freshwater and marine water flows into the marsh will be minimised, and the hydrographic regime restored if affected.

16.7 SOILS AND GEOLOGY AND HYDROGEOLOGY

16.7.1 General

Monitoring of sewage effluent discharges will be undertaken in strict accordance with planning conditions to include compliance with sample type, frequency, analysis and reporting.

The Sludge Management Plan for County Wicklow recommends that sludge treatment hub centres be located at Wicklow and at Greystones WWTW, however the plant at Greystones is a stand-alone plant and will not accept imported sludge.

Dewatering facilities will be incorporated into the design of the Leamore WWTW with the dewatered sludge then transferred by road to Wicklow hub centre for treatment and disposal.

Its treatment and disposal according to the relevant EU and National Standards will result in minimum impact on soils and geology.

16.7.2 Construction Phase

Surplus spoil material (soils) will be re-used in reinstatement works and in re-shaping of the treatment plant site. Backfill material will be sourced locally.

A sediment erosion control plan will be employed during the construction phase. The plan will include the following measures:

- Interceptor drains, siltation ponds and silt traps will be employed to channel surface runoff from construction areas and trap silt prior to discharge to surface waters.
- Construction activities will be scheduled such as to minimise the area and period of time that soil will be exposed.
- Disturbed ground adjoining new access roadways will be regraded and revegetated on completion of roadways.
- Vehicular movement will be restricted to prevent unnecessary erosion.

A site management plan will be prepared for the control of pollution to soils during construction. Construction staff will be trained and an on site representative will be responsible for its implementation.

In order to prevent the accidental release of hazardous materials (fuels, paints, cleaning agents, etc.) during construction site activity, all hazardous materials should be stored within secondary containment designed to retain at least 110% of the storage contents. Temporary bunds for oil/diesel storage tanks should be used on the site during the construction phase of the project. Safe materials handling of all potentially hazardous materials will be emphasized to all construction personnel employed during this phase of the project.

The outfall pipeline will be constructed to the south of the SPA on land which is used for a private airstrip. The marsh ecology in this area is at its minimum in comparison to other areas and will result in the minimum level of impact on ecology.

The foul sewer collection system will be laid according to best practice standards incorporating adequate sealing of connections, inspection for defects and leak testing prior to commissioning.

The submarine pipeline will be backfilled with a granular stone material to protect it from wave action.

16.8 MATERIAL ASSETS – AGRICULTURAL PROPERTIES

16.8.1 General

The main mitigation measure will be to minimise as much as possible the routing of the sewer network across agricultural land.

16.8.2 Construction Phase

Adhering to the following mitigation measures will reduce the impact on agricultural activities during the construction phase. Good communications between landowners and the contractors will facilitate the farmer in organising their enterprise during construction. Communications will relate to access issues, possible relocation of sensitive animals during activities that could generate noise/vibration, dust or other nuisances and also temporary fencing requirements.

Severance: Access will be maintained to severed fields during construction. This would be particularly relevant for fields containing livestock. Tillage fields may remain severed for more extended periods depending on discussions with affected landowner. Temporary stockproof fencing will be erected as required to delineate the site boundary and to minimise disturbance to adjacent lands. Access to water for fields containing livestock will also be maintained at all times. This may be achieved with a water bowser or a temporary piped supply. Discussions should take place with local landowners to ensure that construction traffic does not interfere with movements of stock nor hinder farm operations such as silage/hay making and a traffic management plan implemented.

Noise and Air: Precautions will be taken by the contractor to control noise, vibration and dust on and off the site. Methods such as “wetting down” will be employed when required to minimise dust levels. Mitigation measures for dust are dealt with in Chapter 7. Mitigation measures for noise and vibration are dealt with in Chapter.

Drainage: All drainage likely to be affected or disturbed during the construction phase will be identified and reinstated as soon as possible. Delays in reinstatement may cause flooding and subsequent damage to crops. In cases where impeded drainage is causing obvious difficulty to a particular landowner, temporary measures will be taken to allow waters to drain to less critical areas and so minimise the impact. Less critical areas include land of poor agricultural quality that is not intensively farmed.

16.9 MATERIAL ASSETS – NON AGRICULTURAL PROPERTIES

16.9.1 General

Where access to residential, commercial or recreational lands from public roads may be affected by the proposed scheme, alternative access arrangements will be provided at an appropriate location.

Compensation payments for loss of land, and other injurious affection will be agreed with property owners affected by landtake for the scheme during land purchase negotiations.

16.9.2 Construction Phase

During the construction period the contractor will maintain good communication with landowners at all times to keep them informed of the works. Temporary fencing will be erected as required to delineate the site boundary and to minimise disturbance to adjacent lands.

16.10 MATERIAL ASSETS – ARCHAEOLOGY

16.10.1 General

Mitigation measures shall be undertaken in compliance with national policy guidelines and statutory provisions for the protection of the archaeological and cultural heritage, including National Monuments Acts 1930-2004, Framework & Principles for the Protection of the Archaeological Heritage (Department of Arts, Heritage, Gaeltacht & the Islands 1999) and Policy & Guidelines on Archaeological Excavation (Department of Arts, Heritage, Gaeltacht & the Islands 1999).

This report recommends that the proposed works avoid direct impacts with the identified elements of the known archaeological monuments. However, this may not be possible in the present case, a full programme of archaeological mitigation including investigative excavation and archaeological monitoring is offered and recommended. This should be followed by preservation *in situ* or by full-scale excavation where archaeological material is encountered.

16.11 CONSTRUCTION PHASE

16.11.1 Mitigation Measures – Prior to Construction

It is recommended that the following measures be undertaken in advance of the construction phase. This is aimed at allowing a satisfactory time frame in which the mitigation measures can be conducted and the results assessed without causing delays to the construction programme.

Field Inspection: Given the length of time since the original assessment and the implementation of new policies, guidelines, frameworks and principles in the protection of and approach to archaeological and to areas of archaeological potential, it is recommended that a field inspection of the route of the scheme be undertaken prior to construction of the facility. This shall involve a field inspection of the area of the proposed work. Field inspection is considered essential in determining the nature and extent of the remaining above ground evidence and in assessing the potential impact of the development on the archaeological landscape. It often leads to the discovery of hitherto unrecorded archaeological sites. Further recommendations will be made based on this field inspection and on the production of detailed works mapping.

Archaeological Investigation: Archaeological investigative excavation, in the form of controlled trial trenching is recommended for Sites **A4, A6, A10** and **A12**, the sites that are directly impacted or have their environs impacted by the proposed development. This involves sub surface work in an area within their environs and will aid in determining the nature, extent and significance of the archaeology present. Following investigation, further appropriate mitigation strategies should be provided if

required. Such mitigation strategies may involve archaeological excavation of the archaeological remains (preservation by record) or preservation *in situ*. The results of the test trench investigation will enable the appropriate mitigation strategy to be undertaken with the approval of the DoEHLG.

Pre-Disturbance Bankside Inspection: It is recommended that a pre-disturbance bankside inspection and survey be undertaken on **RC1**, **RC2, RC3, RC4, RC5, RC6, RC7, RC8** and **RC9**. This inspection should be undertaken by a suitable qualified underwater archaeologist and will ascertain the archaeological potential of these sites. Should it be established that archaeological potential does exist at this location further specific recommendations and ameliorative measures will be made.

Archaeological Underwater Inspection and Survey: Underwater inspection is recommended for waterbodies found to be of archaeological potential that will be directly impacted by the scheme. This may consist of a wading survey or dive survey depending on the depth of water, visual inspection and a metal-detector survey of the underwater environment. Underwater survey will determine whether further investigation is required.

Visual Inspection Dive Survey and Magnetometry Survey: Visual inspection dive survey and magnetometry survey by hand-held metal-detection should be employed to assess the archaeological potential of the seabed surrounding the proposed marine outfall areas.

Preservation in Situ: Strategies for the preservation *in situ* of archaeological remains should be considered on a case-by-case basis, in consultation with the Statutory Authority. Preservation in situ can be undertaken through:

- Avoidance of the confirmed feature in the development process, if possible
- Preservation of the confirmed feature through detailed design, for example blanketed under embankment.

Preservation by record (Archaeological Excavation): Preservation by record in the form of archaeological excavation and recording, to resolution, is recommended for sites where initial investigation has yielded evidence of archaeologically significant material or structures, and where preservation *in situ* is not feasible.

16.11.2 Mitigation Measures – During Construction

Mitigation measures at construction phase will be undertaken in compliance with national policy guidance and statuary provisions for the protection of the archaeological and cultural heritage.

Archaeological Monitoring: It is recommended that archaeological monitoring be undertaken during topsoil stripping of ground works associated with the scheme. This would include any associated earthworks and drainage works, where and as required by the Statutory Authority. There would be a provision for preservation *(in situ)* or preservation by record of any archaeologically significant material that was uncovered at this time.

Retention of an Archaeologist: It is recommended that an archaeologist be retained for the duration of the relevant earthworks. The time-scale for the construction phase will be made available to the archaeologist, at an early stage, with information on where and when topsoil stripping will take place.

Discovery of Archaeological Material: In the event of archaeological features or material being uncovered during the construction phase, the machine work will cease in the immediate area to allow the archaeologist to inspect any such material. Initial assessment will determine the nature, extent and significance of the archaeology present. As a result of the assessment, decisions on the most

appropriate mitigation strategy will be taken with the approval of the DoEHLG. The discovery of any archaeological object will be reported to the Director of the National Museum of Ireland or the Garda Síochána within 96 hours of discovery (Section 23 of the National Monuments Acts 1930 (as amended)).

Fencing: Fencing of any archaeological sites discovered shall be carried out as appropriate during their excavation.

Preservation in Situ: Strategies for the preservation *in situ* of archaeological remains as described above should be considered on a case-by-case basis, in consultation with the Statutory Authority.

Construction Works: The positioning of temporary site offices, access roads, haul roads, spoil heaps and borrow pits will take into account the location of identified sites and areas of archaeological potential.

Mitigation measures, both at pre-construction and construction phases, are required to be undertaken in compliance with national policy guidance and statutory provisions for the protection of the archaeological heritage, including: *National Monuments Acts 1930-2004.* These recommendations are subject to approval by The Department of the Environment, Heritage and Local Government.

16.12 MATERIAL ASSETS

16.12.1 General

Field Inspection: Given the length of time since the original assessment and the implementation of new policies, guidelines, frameworks and principles in the protection of and approach to architectural sites, it is recommended that a field inspection of the route of the scheme be undertaken prior to construction of the facility. This shall involve a field inspection of the area of the proposed work. Field inspection is considered essential in determining the nature and extent of the remaining above ground evidence. Further recommendations will be made based on this field inspection and on the production of detailed works mapping.

This report recommends that the proposed works avoid direct impacts with the identified elements of the known architectural landscape. Because this may not be possible in the present case, a full programme of mitigation is offered and recommended.

16.12.2 Construction Phase

Any impact on architectural heritage is a result of construction activities and therefore the mitigation measures are also related to the construction activities.

- Where a property boundary or entrance is impacted by the scheme, where practical, the boundary or entrance should be reinstated or replicated. This is recommended for sites **AH2, AH3, AH4** and **AH5**.
- Due to their close proximity, it is recommended that sites **AH2, AH3, AH4** and **AH5**, are protected from damage during the construction phase.
- Written and Photographic Recording is recommended for the impacted elements of Sites **AH2, AH3, AH4** and **AH5**. This will consist of a photographic record for each element impacted with a description of the site.

Mitigation measures at construction phase will be undertaken in compliance with national policy guidance including Architectural Heritage Protection, Draft Guidelines for Planning Authorities (Department of Arts, Heritage, Gaeltacht & the Islands 2001) and statutory provisions for the protection of the archaeological and cultural heritage. Recommendations are subject to approval by The Department of the Environment, Heritage and Local Government.

16.13 RESIDUAL IMPACTS

The scheme will be designed to avoid adverse environmental impacts. Where impacts have been identified mitigation measures will be required to reduce or eliminate these impacts. Therefore once the mitigation measures are put in place the residual impacts of the scheme will be negligible. The following areas have been identified even with mitigation measures has having residual impacts:-

16.13.1 Landscape and Visual

In landscape and visual terms the proposed development does not pose a threat to the landscape charcter associated with this part of Wicklow County. The wooded area to the northeast of the site will continue to provide a backdrop to the buildings or structures proposed. This will significantly reduce the visual impact, due to the fact that there will be no impact on the skyline.

As soon as vegetation screening reaches maturity (10 to 15 years) the short term negative visual impact that the proposed Newtownmountkennedy and Kilcoole Sewerage facility will diminish as the augmented hedgerows and proposed landscape mitigation measures are implemented and established.

16.13.2 Terrestrial Ecology

Residual impacts after mitigation of the outfall pipeline route through the coastal wetland will be short term displacement of improved grassland which is developing a more wet grassland character, and small numbers of breeding birds from the pipeline assembly area. The species involved include meadow pipit, skylark and reed bunting. The pipeline will not traverse the main area of Kilcoole Marshes used by wintering waterfowl, or the cultivated wet grassland areas currently used by whooper swans, but there may be some minor disturbance impacts to waterfowl if construction work is in progress between November and mid-April inclusive. These residual impacts are assessed as being of slight short term local significance.

16.13.3 Marine Ecology

There may be a slight decrease in marine water quality due to the outfall discharge resulting in negligible contamination of the marine environment.

16.13.4 Material Assets

Residual impacts will only be apparent once compensation measures have been agreed between individual landowners and the local authority. However the scheme will only affect one landowner who owns the land of the proposed treatment site and one or two more who own land affected by the proposed access road.

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Ordnance Survey 2nd Edition 6” Map

Ordnance Survey 3rd Edition 6” Map

RMP Constraints Maps

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*JRSA*I Journal of the Royal Society of Antiquaries of Ireland.

PRIA Proceedings of the Royal Irish Academy.

GLOSSARY OF TERMS

Below is a partial glossary of terms used in this report. The definitions herein are not to be taken as comprehensive, but solely as an aid to the non-technical reader.

Attenuation Pond	Pond used for the collection and slow release of run-off.
Benthic	Describes organisms that live on or in the seabed. Benthic epifauna live upon the seafloor or upon bottom objects and benthic infauna live within the surface sediments.
Biodiversity	The number, variety and variability of living organisms in a particular habitat
Biotope	After (Hiscock 1996) The physical 'habitat' with its biological 'community'; a term which refers to the combination of physical environment (habitat) and its distinct assemblage of conspicuous species'.
Boulder	stones > 25 cm diameter
Calcareous	Substance containing calcium carbonate
Cobble	stones 64 to 256 mm diameter
Community	group of different species which occur together
Culvert	Structure or drain for the diversion of a stream or river
Dissolved Oxygen	A measure of the concentration of oxygen in a liquid, such as water or waste water, usually expressed in mg/l or per cent saturation
Enclosure	Any monument consisting of an enclosing feature such as a bank or a ditch, usually earthen, such as barrows or ringforts. In this report, enclosures are circular or oval unless otherwise stated.
Fauna	A collective term for the animals of a region
Flora	A collective term for the plants of a region
Gravel	sediment grains 4 to 16 mm diameter
Groundwater	Water stored in the soil and rock both above and below the water table
Habitat	The dwelling place of a species or community, providing a particular set of environmental conditions (e.g. forest floor)
Infauna	animals living within sediments
Infralittoral	Rock dominated by algae, water column temperature and salinity variable,
Littoral	Between upper and lower tidemarks, exposed to air at the lowest tides

Mitigation Measures	Measures to ease or soothe the effect of something. Mitigation measures suggest ways to avoid or lessen the negative effects of a project on the environment
Mud	sediment grains < 0.063 mm diameter
Pebble	sediment grains 16 - 64 mm diameter
Pollution	The direct or indirect alteration of the physical, chemical, thermal biological, or radioactive properties of any part of the environment in such a way as to create a hazard or potential hazard to the health, safety or welfare of living species
Precipitation	The manner by which water and other matter in the atmosphere reaches the earth's surface. Wet precipitation includes rainfall, snow, hail, mist and fog. Dry precipitation describes the deposition of gases, aerosols and particles not dissolved in atmospheric borne water
Ringfort	Early christian defended secular settlement consisting of a bank and external ditch defining a circular area that contained the dwelling structures of the occupants; also fairy fort, rath lios, or cashel (the latter constructed of stone as opposed to earth).
Runoff	The gravity flow of surface water in open channels
Sand	sediment grains 0.06 - 4 mm diameter
Sediment	with infauna, and usually some epibiota
Sewage	Liquid wastes from communities conveyed in sewers. Sewage may be a mixture of domestic sewage effluents from residential areas and industrial liquid waste
Slit Trench	A narrow, shallow trench excavated during site investigation operations, for the purpose of acquiring information on the first 5-6 m of the subsoil
Sublittoral	Below the littoral, never exposed to air
Substrata	surfaces (plural) to which an organism grows on or amongst
Substratum	surface (singular) to which an organism grows on or amongst
Sustainable Development	Defined by the Bruntland Commission (1987) as "development that meets the needs of the present without compromising the ability of the future generations to meet their own needs"
The Board	Refers to An Board Pleanála
Zones	Horizontal areas of vertical height above, and depth below, sea level which have characteristic fauna and flora

APPENDIX A

Water Quality Data

Table A.1: Water Quality Data within Streams A, B, C, and D (1999)

Stream	Location	Data (mg/l)				Comments
		BOD_5	S.S.	Ammonia as N	Phosphate as P	
A	1. u/s Kilpedder Plant	2.1	7-15	0.017-0.018	0.086 - 0.091	Satisfactory
	2. Kilpedder Effluent	49 - 80	34 - 106	40.6 - 34.2	10.48 - 11.07	Very Poor Treatment Performance
	3. d/s Kilpedder Plant	5.8 - 10.3	6 - 14	.51 - 1.65	0.42 - 0.84	Gross Pollution
	4. u/s Kilcoole Plant	1.6 - 2.4	13 - 15	.035 - .038	0.17 - 0.18.	Recovered but enriched
	5. Kilcoole Effuent	86 - 112	30 - 48	48.5 - 49.5	11.23 -13.04	Very Poor Treatment
	6. d/s Kilcoole Effluent	14.4 - 16.4	36 - 39	3.3 - 3.6	0.96 - 1.05	Gross Pollution
B	Note: No Effluent Discharge Average Data (4 sites)	1.0 2.8	2 - 18	0.008 - 0.032	0.021 - 0.17	Satisfactory
C	1/2 u/s S.T.W.	2.1 - 3.0	2 -4	.002 - .025	.013 - .032	Satisfactory
	3. NTMK S.T.W	235 - 260	184 -216	31 -62	11.6 - 15.8	Untreated Sewage
	4. d/s S.T.W.	14.4 - 24	19 - 31	2.7 - 3.04	0.9 - 1.2	Gross Pollution
	5. Downstream	3.0 - 3.2	4 - 19	0.086 - 0.091	0.5 - 0.57	Enriched, Moderate Pollution
D	Killadreenan 2/3 Average	3.4 - 4.8 1.2 - 3.0	17 - 31 4 - 8	0.31 - 0.34 0.014 - 0.023	- 1.39 0.16 - 0.19	Moderate Pollution, Enriched Reasonable

Table A.2: Water Quality Data within Streams A, B, C, and D (27 June 2005)

Date	Sample Identity	Location	Conductivity (at 25 deg. C)	Dissolved Oxygen	pH	BOD	Total Suspended Solids	Total Phosphorous	Nitrate as NO3	Nitrite as NO2	ortho Phosphate as PO4	Total Oxidised Nitrogen as N	Ammoniacal Nitrogen as N	Kjeldahl Nitrogen	Total Nitrogen as N	Faecal Coliforms	Total Coliforms
			mS/cm	mg/l	pH Units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	cfu/100ml	cfu/100ml
27/06/2005	A1	u/s Kilpeddar Plant	-		7.58	<2	<10	<0.05	30.5	<0.05	<0.03	7.0	<0.2	<1	7	9	96
27/06/2005	A2	d/s Kilpedder Plant	-		7.86	<2	<10	<0.05	30.0	<0.05	<0.03	6.9	<0.2	<1	7	136	241
27/06/2005	A3	u/s Kilcoole Pump Station	-		7.98	<2	<10	<0.05	25.6	0.14	<0.03	5.9	<0.2	<1	7	42	362
27/06/2005	A4	d/s Kilcoole Pump Station	-		7.48	2	<10	<0.05	0.9	0.09	0.06	<0.3	<0.2	1	1	25	22
27/06/2005	B1	u/s Garden Village	-		7.60	4	<10	<0.05	20.1	0.07	<0.03	4.7	<0.2	<1	5	92	165
27/06/2005	B2	d/s Garden Village, u/s Kilquade	-		7.59	<2	<10	0.36	22.7	1.00	0.53	5.5	1.8	<1	8	740	810
27/06/2005	B3	d/s Kilquade Plant	-		7.76	<2	<10	0.48	26.4	0.93	0.79	6.4	1.6	2	10	440	720
27/06/2005	C1	u/s N'kennedy Pump Station	-		7.56	<2	<10	<0.05	19.4	0.10	0.40	4.5	0.2	<1	6	212	430
27/06/2005	C2	d/s N'kennedy Pump Station	-		7.69	<2	<10	<0.05	19.3	0.08	0.03	4.5	0.2	<1	6	232	360
27/06/2005	C3	1.5km u/s Kicole Marsh	-		8.11	2	<10	<0.05	16.8	0.38	0.05	4.0	<0.2	1	5	39	61
28/06/2005	D1	Northern branch d/s N11	0.640		8.05	<2	<10	0.14	26.2	0.06	0.16	6.1	<0.2	<1	6	76	162
28/06/2005	D2	u/s Newcastle Plant	0.498		8.03	<2	<10	0.15	21.7	0.06	0.18	5.0	<0.2	<1	5	240	355
28/06/2005	D3	d/s Newcastle Plant	0.494		8.10	3	<10	0.26	22.7	0.26	0.19	5.3	<0.2	<1	6	335	360
27/06/2005	E3	Freshwater side of breaches	2.204		7.91	6	<10	0.06	13.2	0.20	0.05	3.1	0.3	2	5	242	550
27/06/2005	E2	Coastal at Outfall line	0.686		7.81	3	<10	0.09	9.0	0.09	0.04	2.1	<0.2	1	3	26	38

Table A.2: Water Quality Data within Streams A, B, C, and D (6 July 2005)

Date	Sample Identity	Location	Conductivity (at 25 deg. C)	Dissolved Oxygen	pH	BOD	Total Suspended Solids	Total Phosphorous	Nitrate as NO3	Nitrite as NO2	ortho Phosphate as PO4	Total Oxidised Nitrogen as N	Ammoniacal Nitrogen as N	Kjeldahl Nitrogen	Total Nitrogen as N	Faecal Coliforms	Total Coliforms
			mS/cm	mg/l	pH Units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	cfu/100ml	cfu/100ml
06/07/2005	A1	u/s Kilpeddar Plant	0.548	6.2	7.67	<2	<10	<0.05	29.7	<0.05	<0.03	6.8	<0.2	<1	7	16	152
06/07/2005	A2	d/s Kilpedder Plant	0.544	7.3	7.85	<2	<10	<0.05	29.1	<0.05	<0.03	6.7	<0.2	<1	7	64	182
06/07/2005	A3	u/s Kilcoole Pump Station	0.551	7.0	8.18	13	<10	<0.05	25.5	0.06	<0.03	5.9	<0.2	1	7	296	382
06/07/2005	A4	d/s Kilcoole Pump Station	0.554	6.8	8.13	<2	12	<0.05	24.5	0.07	<0.03	5.7	<0.2	1	7	308	620
06/07/2005	B1	u/s Garden Village	0.524	6.7	7.88	<2	<10	<0.05	20.8	0.07	<0.03	4.8	<0.2	1	6	236	870
06/07/2005	B2	d/s Garden Village, u/s Kilquade	0.622	6.4	8.05	<2	<10	0.16	24.4	0.29	0.89	5.7	0.2	1	7	590	840
06/07/2005	B3	d/s Kilquade Plant	0.626	6.4	8.06	<2	24	<0.05	23.9	0.31	0.88	5.6	0.2	2	7	620	890
06/07/2005	C1	u/s N'kennedy Pump Station	0.333	7.1	7.81	<2	<10	<0.05	18.3	<0.05	0.04	4.2	<0.2	2	6	311	483
06/07/2005	C2	d/s N'kennedy Pump Station	0.335	8.0	7.80	<2	<10	<0.05	18.8	<0.05	0.03	4.3	<0.2	2	6	324	372
06/07/2005	C3	1.5km u/s Kicole Marsh	0.433	6.6	8.01	<2	<10	<0.05	16.2	0.19	0.04	3.8	<0.2	1	5	98	172
06/07/2005	D1	Northern branch d/s N11	0.640	6.5	8.07	<2	<10	<0.05	25.6	0.06	0.04	5.9	<0.2	<1	7	230	670
06/07/2005	D2	u/s Newcastle Plant	0.506	6.9	8.03	<2	<10	<0.05	21.9	0.05	0.04	5.0	<0.2	<1	6	460	860
06/07/2005	D3	d/s Newcastle Plant	0.517	6.8	8.01	2	<10	<0.05	21.5	0.20	0.41	5.0	<0.2	NDP	NDP	650	920
06/07/2005	E1	Coastal at Breaches	52.950	7.4	8.67	<2	24	<0.05	1.9	<0.05	0.03	0.4	<0.2	<1	1	16	47
06/07/2005	E2	Coastal at Outfall line	53.250	7.3	8.70	<2	37	<0.05	<0.3	<0.05	0.03	<0.3	0.4	<1	1	6	31

APPENDIX B

Baseline Noise Measurements

Location 1

Date	day	SOUND PRESSURE LEVEL dB			
	Time	$L_{Aeq,T}$	$L_{A01,T}$	$L_{A10,T}$	$L_{A90,T}$
09/03/99	Tuesday	17:00	48.3	59.5	48.0	38.5
		18:00	46.8	56.0	49.0	39.5
		19:00	48.8	60.0	51.0	41.0
		20:00	58.2	58.0	45.0	35.5
		21:00	39.8	51.0	39.0	33.5
		22:00	45.7	58.5	43.5	33.5
		23:00	40.5	48.5	37.5	31.5
		00:00	34.6	41.0	33.5	30.5
10/03/99	Wednesday	01:00	35.6	48.0	33.0	30.0
		02:00	32.6	43.0	32.5	29.0
		03:00	34.3	46.5	34.5	28.0
		04:00	29.4	31.5	30.5	27.5
		05:00	33.4	46.5	29.5	27.0
		06:00	34.4	48.0	30.0	26.5
		07:00	47.2	57.5	51.0	31.5
		08:00	49.3	58.5	52.0	34.0
		09:00	46.3	56.0	50.0	31.5
		10:00	52.3	61.5	51.0	32.5
		11:00	49.6	61.0	52.0	33.0
		12:00	48.3	59.5	49.5	29.5
		13:00	49.7	59.5	52.5	34.5
		14:00	48.1	59.5	50.0	32.5
		15:00	46.8	56.5	49.5	32.5
		16:00	43.9	53.5	47.0	33.5
		17:00	43.3	54.5	46.0	32.5
		18:00	51.5	58.5	50.5	33.5
		19:00	41.9	53.0	42.5	30.5
		20:00	42.1	55.0	37.5	30.0
		21:00	48.9	59.5	39.0	29.0
		22:00	47.8	57.0	39.0	30.0
		23:00	31.6	34.0	33.0	29.5
		00:00	49.3	53.5	36.5	29.0

Location 1

Date	day	SOUND PRESSURE LEVEL dB				
		Time	$L_{Aeq,T}$	$L_{A01,T}$	$L_{A10,T}$	$L_{A90,T}$
11/03/99	Thursday	01:00	37.5	50.5	34.0	25.0
		02:00	26.1	31.5	27.5	24.0
		03:00	30.1	42.5	29.0	23.5
		04:00	30.8	38.0	33.0	25.0
		05:00	36.1	49.5	35.0	28.5
		06:00	34.8	44.0	36.0	30.5
		07:00	45.1	55.0	48.0	32.0
		08:00	44.4	54.5	47.5	35.0
		09:00	45.3	55.5	47.0	35.5
		10:00	46.3	57.0	49.0	36.0
		11:00	46.6	55.5	48.5	37.5
		12:00	45.4	56.0	47.5	36.0
		13:00	42.1	51.0	45.0	34.5
		14:00	59.7	57.0	50.0	34.0
		15:00	56.3	60.5	47.5	35.0
		16:00	42.6	51.5	46.0	32.5
		17:00	45.1	55.5	47.5	31.5
		18:00	48.6	61.0	48.0	33.5
		19:00	40.9	50.5	44.0	33.0
		20:00	37.8	47.5	39.5	31.0
		21:00	36.8	47.5	37.5	27.5
		22:00	37.6	46.0	32.5	25.0
		23:00	32.9	42.0	31.5	25.0
		00:00	34.9	42.0	36.0	23.5
12/03/99	Friday	01:00	53.9	60.0	32.5	23.5
		02:00	28.5	37.0	29.0	24.5
		03:00	31.6	39.0	28.0	24.0
		04:00	44.1	49.0	27.0	22.5
		05:00	39.2	42.0	27.0	22.5
		06:00	28.5	39.0	29.0	23.5
		07:00	49.6	59.5	52.0	32.5
		08:00	46.9	57.0	50.5	33.0
		09:00	46.9	57.0	49.5	33.0
		10:00	50.8	57.0	50.0	36.0
		11:00	45.7	55.0	48.5	36.5
		12:00	54.0	58.0	48.0	37.5
		13:00	51.9	63.0	50.0	39.0
		14:00	52.1	64.0	52.0	39.0
		15:00	46.1	54.0	47.5	37.5
		16:00	44.9	53.5	46.5	33.0

Location 2

Date	day	SOUND PRESSURE LEVEL dB			
	Time	$L_{Aeq,T}$	$L_{A01,T}$	$L_{A10,T}$	$L_{A90,T}$
12/03/99	Friday	18:00	46.4	58.0	47.0	37.0
		19:00	42.7	52.0	45.0	37.0
		20:00	40.5	50.5	43.0	31.5
		21:00	39.4	49.0	41.0	30.5
		22:00	40.7	50.5	43.5	32.0
		23:00	49.0	54.5	38.5	31.0
		00:00	34.0	38.0	32.5	27.0
13/03/99	Saturday	01:00	34.4	38.5	33.0	27.0
		02:00	49.4	37.0	30.5	24.5
		03:00	49.9	37.0	29.0	23.5
		04:00	31.9	34.5	29.5	24.0
		05:00	28.8	36.5	30.5	23.5
		06:00	36.4	47.5	38.5	25.5
		07:00	48.3	59.0	52.0	33.5
		08:00	47.9	50.0	50.5	36.5
		09:00	46.0	55.0	47.5	36.0
		10:00	49.8	64.0	50.0	38.5
		11:00	53.9	62.0	59.5	38.0
		12:00	46.6	56.5	48.0	39.5
		13:00	49.9	63.5	49.5	38.0
		14:00	48.0	59.0	50.5	37.5
		15:00	46.0	57.5	47.5	37.0
		16:00	42.0	52.0	44.0	34.5
		17:00	48.3	61.5	47.5	34.5
		18:00	51.0	63.5	51.0	35.0
		19:00	40.6	51.0	43.0	33.0
		20:00	37.4	48.5	38.0	32.0
		21:00	35.8	45.0	36.0	31.0
		22:00	32.7	36.5	34.0	30.5
		23:00	35.8	47.0	34.5	28.5
		00:00	37.8	45.5	39.5	28.5

Location 2

Date	day	SOUND PRESSURE LEVEL dB				
		Time	$L_{Aeq,T}$	$L_{A01,T}$	$L_{A10,T}$	$L_{A90,T}$
14/03/99	Sunday	01:00	35.9	41.5	38.0	32.0
		02:00	38.4	44.5	40.5	34.0
		03:00	38.4	46.5	41.5	32.5
		04:00	37.9	38.5	35.0	29.5
		05:00	36.3	49.5	32.0	27.0
		06:00	35.7	47.0	38.0	25.5
		07:00	46.6	56.5	50.0	33.5
		08:00	48.2	58.5	52.0	35.0
		09:00	49.7	61.0	51.0	34.5
		10:00	51.8	64.0	54.0	33.0
		11:00	51.6	65.0	51.0	33.5
		12:00	46.9	58.5	47.5	36.0
		13:00	50.4	63.5	48.0	37.0
		14:00	46.9	58.5	48.5	35.5
		15:00	46.1	59.0	47.0	34.0
		16:00	49.4	60.5	50.5	37.0
		17:00	46.3	57.5	47.5	37.5
		18:00	52.4	67.0	51.5	36.0
		19:00	41.3	52.5	42.5	33.5
		20:00	45.3	58.5	42.0	33.0
		21:00	38.1	48.5	40.0	31.5
		22:00	31.8	35.5	33.0	29.0
		23:00	32.0	41.0	32.5	29.0
		00:00	33.1	37.0	34.5	29.0
15/03/99	Monday	01:00	33.6	38.0	35.0	29.5
		02:00	32.3	37.5	34.5	28.5
		03:00	41.1	47.5	44.0	36.0
		04:00	43.4	48.5	45.5	39.5
		05:00	38.3	46.0	42.0	29.5
		06:00	38.3	49.5	41.0	28.0
		07:00	45.4	55.0	48.5	37.5
		08:00	50.0	61.0	52.5	39.0
		09:00	47.6	59.0	49.5	38.5
		10:00	46.8	57.5	49.5	37.0
		11:00	48.1	59.0	49.5	39.0
		12:00	51.4	60.0	54.0	45.5

Location 2

Date	day	SOUND PRESSURE LEVEL dB			
	Time	$L_{Aeq,T}$	$L_{A01,T}$	$L_{A10,T}$	$L_{A90,T}$
15/03/99	Monday	13:00	54.5	60.5	57.5	47.5
		14:00	53.0	59.0	56.0	46.5
		15:00	52.7	59.0	55.5	47.5
		16:00	53.9	60.5	57.0	45.5
		17:00	47.6	53.5	50.0	41.5
		18:00	49.9	62.5	49.0	40.5
		19:00	44.0	51.5	46.5	38.5
		20:00	40.9	49.5	42.0	36.0
		21:00	39.9	47.0	41.5	35.0
		22:00	38.9	49.0	40.5	32.0
		23:00	40.3	46.0	43.5	32.5
		00:00	53.3	58.5	52.0	41.5
16/03/99	Tuesday	01:00	54.2	64.0	47.5	36.5
		02:00	42.9	51.5	45.5	29.0
		03:00	36.2	46.5	37.5	28.5
		04:00	37.4	40.5	34.0	24.5
		05:00	35.9	48.0	35.0	25.0
		06:00	39.4	48.5	43.5	28.0
		07:00	46.2	55.5	49.5	35.0
		08:00	51.3	64.0	52.5	36.5
		09:00	52.4	65.0	52.0	35.5
		10:00	54.9	57.0	47.5	35.0
		11:00	44.3	54.5	46.5	35.5
		12:00	46.9	59.5	46.5	34.5
		13:00	47.6	59.5	49.5	37.0

Fig. 8.9

Location 3

Date	day	SOUND PRESSURE LEVEL dB			
	Time	$L_{Aeq,T}$	$L_{A01,T}$	$L_{A10,T}$	$L_{A90,T}$
09/04/99	Friday	02:00	39.7	47.1	39.2	34.2
		03:00	38.2	46.2	37.7	33.8

APPENDIX C

Terrestrial Ecology – Species Lists

Scientific Names of Plant Species Recorded in the Scheme Area

Grasses	**Gramineae**
Cock'sfoot	Dactylis glomerata
Common reed	Phragmites australis
Common salt-marsh grass	Puccinellia maritima
Couch grass	Elymus repens
Creeping bent-grass	Agrostis stolonifera
Crested dog's tail	Cynosurus cristatus
False brome	Brachypodium sylvaticum
Fescue	Festuca spp.
Floating sweet-grass	Glyceria fluitans
Lyme grass	Leymus arenarius
Marram grass	Ammophila arenaria
Marsh foxtail	Alopecurus geniculatus
Meadow grasses	Poa spp.
Purple moor grass	Molinia caerulea
Red fescue	Festuca rubra
Reed canary grass	Phalaris arundinacea
Ryegrass	Lolium perenne
Sea couch	Elymus pyncanthus
Sweet vernal grass	Anthoxanthum odoratum
Sweet-grass	Glyceria spp.
Yorkshire fog	Holcus lanatus
Rushes	**Juncaceae**
Hard rush	Juncus inflexus
Jointed rush	Juncus articulatus
Sharp-flowered rush	Juncus acutiflorus
Soft rush	Juncus effusus
Sedges	**Cyperaceae**
Black bog-rush	Schoenus nigricans
Carnation sedge	Carex panicea
Common club-rush	Schoenoplectus lacustris
Glaucous sedge	Carex flacca
Greater pond-sedge	Carex riparia
Long-stalked yellow sedge	Carex lepidocarpa
Remote sedge	Carex remota
Sea club-rush	Bolboschoenus maritimus (Scirpus maritimus)
Wood sedge	Caxex sylvatica
Bur-reeds	**Sparganiaceae**
Branched bur-reed	Sparganium erectum
Bulrushes	**Typhaceae**
Bulrush	Typha latifolia
Dicotyledons	
Alder	Alnus glutinosa
Alexanders	Smyrnium olusatrum
Angelica	Angelic sylvestris
Ash	Fraxinus exelsior
Beech	Fagus sylvatica

Birch	Betula spp.
Bird’s foot trefoil	Lotus corniculatus
Black poplar	Populus nigra
Blackthorn	Prunus spinosa
Bluebell	Hyacinthoides non-scripta
Bramble	Rubus fruticosus agg.
Brooklime	Veronica beccabunga
Buck’shorn plantain	Plantago coronopus
Butterfly bush	Buddleia davidii
Chickweed	Stellaria media
Cleavers	Galium aparine
Clover	Trifolium spp.
Common duckweed	Lemna minor
Common scurvey-grass	Cochleria officinalis
Corn marigold	Chrysanthemum segetum
Cow parsley	Anthriscus sylvestris
Creeping buttercup	Ranunculus repens
Creeping cinquefoil	Potentilla reptans
Curled dock	Rumex crispus
Daisy	Bellis perennis
Dock	Rumex spp.
Dog violet	Viola riviniana
Elder	Sambucus nigra
Elm	Ulmus spp.
Marsh violet	Viola palustris
Fool’s watercress	Apium nodiflorum
Fumitory	Fumaria spp.
Glasswort	Salicornia spp.
Golden saxifrage	Chrysosplenium oppositifolium
Great willowherb	Epilobium hirsutum
Greater sea-spurrey	Spergularia media
Hawthorn	Crataegus monogyna
Hazel	Corylus avellana
Hemlock water-dropwort	Oenanthe crocata
Herb robert	Geranium robertianum
Hogweed	Heracleum sphondylium
Holly	Ilex aquifolium
Honeysuckle	Lonicera periclymenum
Horse chestnut	Aesculus hippocastanum
Hottentot fig	Carpobrotus edulis
Ivy	Hedera helix
Kidvey vetch	Anthyllis vulneraria
Lesser celandine	Ranunculus ficaria
Lesser sea-spurrey	Spergularia marina
Lords and ladies	Arum maculatum
Marsh marigold	Caltha palustris
Meadowsweet	Filipendula ulmaria
Nettle	Urtica dioica
Oak	Quercus petraea
Primrose	Primula vulgaris
Ragwort	Senecio spp.
Ramsoms	Allium ursinum
Ribwort plantain	Plantago lanceolata
Sanicle	Sanicula europea
Scentless mayweed	Matricaria perforata
Sea arrowgrass	Triglochin maritima
Sea aster	Aster tripolium
Sea beet	Beta vulgaris maritima
Sea buckthorn	Hippophae rhamnoides
Sea campion	Silene vulgaris maritima

Sea holly	Eryngium maritimum
Sea milkwort	Glaux maritima
Sea plantain	Plantago maritima
Sea purslane	Halimione portulacoides
Sea rocket	Cakile maritima
Sea sandwort	Honkenya peploides
Sea spurge	Euphorbia paralias
Sow thistle	Sonchus spp.
Spiked water-milfoil	Myriophyllum spicatum
Sweet chestnut	Castanea sativa
Sycamore	Acer pseudoplatanus
Thistle	Cirsium spp.
Thrift	Armeria maritima
Tormentil	Potentilla erecta
Vetch	Vicia spp.
Water mint	Mentha aquatica
Watercress	Nasturtium spp.
White clover	Trifolium repens
Wild carrot	Daucus carrota
Wild cherry	Prunus avium
Wild garlic (ramsoms)	Allium ursinum
Wild rose	Rosa spp.
Willow	Salix spp.
Wood anemone	Anemone nemorosa
Wood avens	Geum urbanum
Yarrow	Achillea millefolium
Yellow horned-poppy	Glaucium flavum

APPENDIX D

Marine Ecology – Field Notes and Species Lists

Field Notes and Site Descriptions from the Marsh Survey

No.	Time (hours)	Description (location, substratum, fauna and flora)
1	16:20	The site was located north of an airfield at the southern end of a drainage channel running parallel to the coast. The sample was taken from the brackish peaty coloured water at the southern end of channel adjacent to an inflow pipe through an embankment. The substratum was gravely. Water boatmen were present on the surface, with molluscs, fish, gammarids, and cased caddisflies in the channel.. A frog was present alongside the seaweed *Fucus* sp. The channel south of the embankment had an accumulation of *Lemna* sp. (duckweed) which has built up on the north extremity. The channel leading north is cobble with mud, with roots of reeds in bunches at the edge of the channel. Patches of *Enteromorpha* sp., other green algae and *Fucus* sp occurred along the edge of the channel
2	16:40	The site was located approximately 500 m north of site 1 in the main drainage channel. The substratum was fine mud and sand. Four juvenile flounder *Limanda limanda*, water boatmen, gammarids, lots of shrimps and amphipods and two *Carcinus maenas* were recorded.
3	16:57	The site was located approximately 500 m north of site 2 in the main drainage channel. The substratum was mud and cobbles (more muddy than further south). Two gobies, four flatfish (flounder) were recorded. There were mysids, amphipods, water boatmen and a glass eel (*Anguilla anguilla*). There were also patches of *Enteromorpha* sp., filamentous green algae and broken up patches of *Fucus* sp.
4	17:10	The site was opposite a drainage channel running perpendicular to the main channel. A flap valve was located in the bank opposite and water was seeping through it. The substratum was fine sandy mud with patches of consolidated mud. North of this as the channel widens and breaks up there is more *Fucus ceranoides*. No other species were noted.
5	17:20	The site was located approximately 500 m north of site 4 in the main drainage channel. The substratum was fine sandy mud with patches of consolidated mud. A sample was taken in the channel with amphipods, shrimps, six *Carcinus maenas* and 1 flatfish.
6	17:28	The site was located approximately 500 m north of site 5 at the end of the mudflat, near the edge of the Breaches, just south of the railway bridge. Two *Hediste diversicolor* were found in the intertidal mud, with sticklebacks and various other fauna present in the subtidal part. There was a very fibrous upper layer indicating the presence of decaying plant material. The biotope was possibly LMU.HedOl.
7	17:45	The site was located just behind the railway bridge across the Breaches. The substratum was sandier with some gravel. The sand was finer leading into the channel behind the bridge but becoming coarser closer to the bridge. On the higher, coarser intertidal part, there was *Enteromorpha* sp. and other green algae on pebbles and cobbles. In the intertidal, an anoxic layer is near to the surface. There is a diatom film on the surface. The sediment was muddy sand in the channel. One *Hediste diversicolor* was found in the intertidal area, while mysids were found in the more muddy subtidal part. Under and around the bridge on the walls, there was green alga above *Fucus ceranoides* with sparse *Rhodopthamniella* sp. below this in patches. Biotope SLR.Fcer

Species Recorded from the Marsh Sites.

P = present.
Numbers refer to the number of individuals recorded

Species	**Site number**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Lymnaea peregra	4	-	-	-	-	-	-
Trichoptera indet.	-	1	-	-	-	-	-
Rana temporaria	1	-	-	-	-	-	-
Sigara concinna	3	2	2	-	-	-	-
Annelida							
Oligochaete indet.	-	-	-	-	1	-	1
Hediste diversicolor	-	-	-	-	-	2	-
Crustacea							
Neomysis integer	2	1	2	-	9	1	38
Amphipoda indet.	6	9	2	-	1	-	-
Palaemonetes varians	-	9	-	-	-	5	-
Carcinus maenas	-	2	-	-	6	-	1
Pisces							
Anguilla anguilla	-	-	1	-	-	-	-
Gasterosteus aculeatus	1	-	-	-	-	1	-
Limanda limanda	-	-	1	-	-	-	-
Pomatoschistus sp.	-	-	2	-	-	-	-
Pleuronectes flesus	-	4	-	-	-	-	-
Algae							
Enteromorpha sp.	-	-	P	-	-	-	-
Fucus sp.	P	-	-	-	-	-	-
Fucus ceranoides	-	-	-	P	-	-	P
Number of species	**7**	**7**	**7**	**1**	**4**	**4**	**4**

List of Species or Higher Taxa Recorded from Each Site.

The list is arranged in taxonomic order. Species names follow Howson and Picton (1997). P = present, R = rare, O = occasional, F = frequent, C = common, A = abundant. Biotopes are 1 = IGS.Mob, 2 = ECR.PomByC, 3 = MCR.Flu.SerHyd, 4 = MIR.Lhyp and 5 = MCR.Myt.HAs.

	Dredging station																		
SPECIES	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Porifera																			
Cliona celata	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scypha ciliata	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Oscarella lobularis	-	-	-	P	-	C	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthozoa																			
Urticina felina	-	-	P	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-
Hydrozoa																			
Tubularia larynx	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calycella syringa	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Halecium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-
Halecium beanii	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-
Halecium halecinum	P	-	-	P	-	-	-	-	P	-	-	-	P	P	-	-	-	-	-
Kirchenpaueria similis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P
Nemertesia antennina	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Table 5.5 contd																			
Nemertesia ramosa	-	-	-	-	-	-	-	-	P	-	-	-	-	P	-	-	-	-	-
Abietinaria abietina	-	-	P	-	P	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Diphasia sp.	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-
Diphasia attenuata	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydrallmania falcata	O	P	P	-	P	-	-	R	P	-	-	P	P	P	-	-	P	-	P
Sertularella sp.	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Sertularella polyzonias	-	-	-	-	-	-	-	-	-	-	-	P	-	P	-	-	-	-	P
Sertularia argentea	-	P	-	-	P	P	-	R	P	-	-	-	-	-	-	-	P	-	-
Sertularia cupressina	P	P	-	-	-	-	-	R	-	-	-	-	-	P	-	-	-	-	-
Clytia hemisphaerica	P	-	-	-	P	-	-	-	P	-	-	-	-	-	-	-	-	-	-
Laomedea flexuosa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P
Annelida																			
Polychaeta indet.	-	-	-	-	P	-	P	-	-	-	-	-	P	P	-	-	-	-	-
Terebellidae indet.	-	P	-	-	P	P	-	-	-	-	-	-	P	P	-	-	-	-	-
Sabellaria alveolata	-	-	-	-	-	-	-	-	P	-	-	-	P	P	-	-	-	-	P
Sabellaria spinulosa	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	P
Phyllodocidae indet.	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lanice conchilega	-	-	P	-	P	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Sabellidae indet.	-	-	P	-	-	P	-	-	-	-	-	-	-	P	-	-	-	-	-
Serpulidae indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-
Pomatoceros triqueter	-	-	P	-	P	-	-	-	-	-	-	P	-	P	-	-	P	-	P
Aphroditoidea indet.	-	-	P	-	P	P	-	-	P	-	-	-	P	P	-	-	-	-	P
Oligochaeta indet.	-	-	P	-	-	P	-	-	-	-	-	-	P	-	-	-	-	-	-
Polynoidae indet.	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syllidae indet.	-	-	-	-	P	-	-	-	P	-	-	-	P	P	-	-	P	-	-
Nereidae indet.	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-
Nephtys sp.	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pycnogonidae																			
Endeis charybdaea	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustacea																			
Balanus balanus	-	-	P	-	P	P	-	-	P	-	-	-	P	P	-	-	-	P	A
Balanus crenatus	-	-	-	-	-	-	-	-	-	O	-	A	P	P	-	P	A	-	C
Verruca stroemia	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphipoda indet.	-	P	P	-	-	P	-	-	P	-	-	-	P	-	-	P	P	-	-

	Dredging station																		
SPECIES	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Pandalus montagui	-	P	P	P	P	-	-	-	-	-	-	P	-	P	-	-	P	-	P
Crangon crangon	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pagurus bernhardus	P	P	-	-	F	O	-	-	-	P	-	-	P	P	-	P	P	P	P
Pagurus cuanensis	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-
Pagurus prideaux	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pisidia longicornis	-	P	P	-	P	P	-	-	-	-	-	-	P	-	-	-	P	-	P
Ebalia tuberosa	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Hyas coarctatus	-	P	P	P	P	-	-	-	P	-	-	-	-	P	-	-	-	-	P
Inachus leptochirus	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Macropodia rostrata	-	-	P	-	-	P	-	-	-	-	-	-	-	P	-	-	P	-	-
Eurynome aspera	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cancer pagurus	-	-	-	-	P	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Liocarcinus depurator	P	-	P	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-
Liocarcinus holsatus	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	P	-	-	-
Liocarcinus marmoreus	-	-	P	-	P	-	-	-	-	-	-	-	-	P	-	-	-	-	-
Liocarcinus pusillus	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pilumnus hirtellus	-	P	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Mollusca																			
Tectura virginea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-
Onchidoris bilamellata	P	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Archidoris pseudoargus	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
Mytilidae indet.	P	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mytilus edulis	-	-	-	-	-	-	-	-	-	O	-	P	A	P	-	-	P	-	A
Musculus costulatus	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Musculus discors	-	-	-	-	-	P	-	-	-	-	-	-	P	P	-	-	-	-	-
Modiolus modiolus	-	-	-	-	-	-	-	-	P	-	-	-	-	P	-	-	P	-	-
Palliolum tigerinum	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlamys varia	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	P	-	-
Anomia ephippium	-	-	P	-	P	-	-	-	-	-	-	-	P	-	-	-	-	-	-
Mactra stultorum	P	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-
Calliostoma zizyphinum	-	P	P	-	P	P	-	-	-	-	-	P	-	P	-	-	P	-	-
Table 5.5 Contd																			
Spisula elliptica	-	-	-	-	-	-	-	-	-	-	-	-	P	P	-	-	-	-	-
Gari fervensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P
Chamelea gallina	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Clausinella fasciata	-	-	P	-	C	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Hiatella arctica	-	-	-	-	-	-	-	-	-	-	-	-	P	P	-	-	P	-	P
Leptochiton asellus	-	-	P	P	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Tonicella rubra	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nucella lapillus	-	P	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Ocenebra erinacea	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Buccinum undatum	-	-	-	-	-	-	-	-	-	-	P	-	-	P	-	-	P	-	P
Neptunea antiqua	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acanthochitona fascicularis	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bryozoa																			
Bryozoa indet.	-	-	-	-	-	-	-	-	-	-	-	-	P	P	-	-	P	-	-
Crisidia cornuta	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alcyonidium diaphanum	-	-	-	-	-	-	-	-	-	P	-	-	P	-	-	-	-	-	-
Alcyonidium gelatinosum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-
Crisia sp.	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amathia lendigera	-	P	-	-	P	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Crisia eburnea	-	-	P	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	Dredging station																		
SPECIES	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
Flustra foliacea	O	-	C	C	F	F	-	-	O	-	-	-	P	P	-	-	P	P	O
Echinodermata																			
Antedon bifida	-	-	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crossaster papposus	-	-	P	-	-	-	-	-	-	-	-	-	-	P	-	-	P	-	-
Henricia oculata	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-
Asterias rubens	-	-	P	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ophiothrix fragilis	-	P	-	P	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-
Ophiura ophiura	-	P	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psammechinus miliaris	-	-	P	-	P	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Echinus esculentus	-	P	P	-	P	P	-	-	-	-	-	-	-	P	-	-	-	-	-
Tunicata																			
Ciona intestinalis	-	P	P	-	P	P	-	-	-	-	-	-	-	-	-	-	-	-	-
Corella parallelogramma	-	P	-	-	P	-	-	-	P	-	-	-	P	P	-	-	-	-	-
Ascidiella scabra	-	-	P	-	-	-	-	-	P	-	-	-	P	-	-	-	-	-	-
Ascidia mentula	-	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dendrodoa grossularia	-	-	O	-	F	-	-	-	-	-	-	-	-	P	-	-	-	-	-
Distomus variolosus	-	C	-	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyura tessellata	-	P	-	-	-	-	-	-	-	-	-	-	P	P	-	-	P	-	P
Pisces																			
Diplecogaster bimaculata	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-
Raniceps raninus	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-
Liparis liparis	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-
Ammodytidae indet.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-
Ammodytes tobianus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-
Limanda limanda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-
Algae																			
Heterosiphonia plumosa	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maerl indet.	-	-	-	-	P	P	P	-	-	-	-	-	-	-	-	-	-	-	-
Corallinaceae indet.	-	F	-	P	P	-	-	-	-	-	-	P	-	P	-	-	P	-	-
Plocamium cartilagineum	-	P	-	-	P	P	P	-	-	-	-	-	-	-	-	-	-	-	-
Delesseria sanguinea	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Laminaria indet.	-	-	-	-	-	-	-	-	-	-	P	-	-	P	-	-	-	-	-
Laminaria hyperborea	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Number of species	11	27	40	12	41	33	3	3	21	5	3	8	27	40	1	5	24	4	20
Time dredged (min.)	2	5	3	4	3	3	3	3	3	3	11	5	7	3	4	3	4	5	4
Biotope	3	4	3	3	3	3	1	1	3	1	1	2	5	4	1	1	2	1-3	5