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Comhairle Chontae Chorcaí

Cork County Council

MIDLETON

Sewage Treatment Plant

ENVIRONMENTAL IMPACT STATEMENT

NOVEMBER 1996

MCOS

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Consulting Engineers

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PREFACE

This Environment Impact Statement (EIS) was prepared to assess the impact, on the environment, of the Municipal Sewage Treatment Plant proposed in the Preliminary Report in "Midleton Sewage Treatment Plant" prepared and presented by M.C. O'Sullivan & Co. Ltd., Consulting Engineers in October 1993.

That Preliminary Report, in turn, was prepared to provide a Sewage Treatment Plant to meet stringent standards set down by Cork County Council in order to anticipate any possible requirements, which may have been included in the upcoming (at that time) regulations on Urban Wastewater Treatment. When the Minister for the Environment published S.I. 419 in December 1994, Cork Harbour was not declared a "Sensitive" water. Nevertheless, Cork County Council still proposes to produce a fully denitirified effluent to meet "Sensitive" water standard.

The Preliminary Report, also, had to deal with the treatment of both municipal and industrial wastes and, accordingly, put forward proposals for treating both wastes. Because of the scale and variability of the industrial wastes, it was proposed that these be treated in a separate plant on the same site as the municipal waste.

Subsequent to presentation of the Preliminary Report, Universal Foods Plc. decided to treated their own waste and so the Council will only construct the municipal plant. However, this decision does not affect any of the considerations regarding the location of the wastewater treatment plant as the effluent from the new industrial treatment will continue to discharge to the town drainage system and must be kept separate from the municipal wastewater.

This Statement is presented in two distinct sections. The first section deals with the reasons for site selection and wastewater treatment method together with a description of that treatment method. The second section deals with the impacts on the environment of the construction and operation of the wastewater treatment plant.

SECTION 1

INTRODUCTION

SECTION 1

INTRODUCTION

1.0 HISTORICAL BACKGROUND

1.1 A Preliminary Report was prepared on Midleton Sewerage Scheme in March 1972 covering the urban district and adjacent county area with the Urban Council acting as Executive Authority.

1.2 The Report proposed a scheme which contained the following elements:-

(a) Rectification of problems with existing sewers.

(b) Extension of the sewers to cater for areas outside the existing system.

(c) Collection of all the waste water (domestic and industrial) to a low lift pumphouse at Bailick Road.

(d) Discharge of all sewage to a second pumphouse at Ballynacorra, from where the sewage would be pumped for final disposal.

1.3 Five different options were proposed in the Report for the disposal of the sewage as follows:-

(a) Comminution plus tidal tanks and discharge at Ballynacorra.

(b) Comminution plus tidal tanks and discharge at Rathcoursey.

(c) Full treatment at Ballynacorra.

(d) Treatment of one third of the pollution load.

(e) Treatment of domestic effluent only.

The recommended option was (b) which was tidal tanks plus outfall at Rathcoursey.

1.4 In January 1974 sanction was obtained to prepare Contract Documents for a Stage 1 scheme as recommended, but with the modification that as an economy measure the outfall pipe from the tidal tanks should not be taken as far as Rathcoursey, but should discharge at Ballynacorra with provision for extension to Rathcoursey in the future. Tenders for this scheme were invited and received, and the recommendation on these tenders was submitted to the U.D.C. in April 1975. In the meantime, land acquisition and foreshore licenses were negotiated, the former resulting in a public inquiry following a compulsory purchase order on the tidal tanks site. The recommended tender for the scheme was not sanctioned at this stage.

1.5 In 1977 a major study of Cork Harbour was undertaken by Cork County Council, part of which included an extensive dye survey analysis at Rathcoursey Point. As a result of these studies, M.C. O'Sullivan recommended that the tidal tanks be eliminated from Midleton Sewerage Scheme and the outfall point now be extended to Rathcoursey.

1.6 In November 1978 the Minister for the Environment directed that contract documents be revised to include the Rathcoursey outfall and be submitted to the Department for approval. However, as a result of the interjection of local pressure groups the Southern Committee of Cork County Council decided to apply for extra funding to enable a full treatment plant to be provided, and a new foreshore license was applied for in December 1979.

1.7 In June 1981 the Minister for the Environment requested that the whole scheme for Midleton be re-examined, and a new report prepared which would consider the inclusion of secondary treatment before disposal.

1.8 This Report was presented in December 1981 and in it five options for the disposal of the sewage were discussed as follows:-

(a) Secondary treatment of domestic sewage and a discharge at Ballynacorra.

(b) Secondary treatment of domestic and industrial sewage and a discharge at Ballynacorra.

(c) Discharge of comminuted sewage at Rathcoursey.

(d) Secondary treatment of domestic sewage and a discharge at Rathcoursey.

(e) Secondary treatment of domestic and industrial effluent and a discharge at Rathcoursey.

1.9 The Report recommended option (c), discharge of comminuted sewage at Rathcoursey Point, as the best method of treating the sewage from Midleton town. Following this the foreshore license was progressed for the Rathcoursey outfall and discussions took place between the Department of the Environment, the Department of the Marine and the Department of Fisheries. The result of these discussions was the addition of a tidal holding tank capable of retaining one hours ultimate flow at the bottom of the tide.

1.10 The scheme was then sanctioned and put out for tender in October 1985.

1.11 The scheme was constructed and commissioned in December 1988.

1.12 On the 21st May, 1991 E.C. Directive 91/271/EEC concerning urban waste water treatment was adopted. Under this directive secondary treatment is the basic requirement for all waste water discharges from population equivalents of 2,000 or more to internal fresh waters and estuaries, and of 10,000 or more to coastal waters.

This directive requires that the secondary treatment be provided as follows:-

i) by end of year 2000 for all towns having a population equivalent greater than 15,000

ii) by end of year 2005 for all towns having a population equivalent of between 10,000 and 15,0000

iii) by end of year 2005 for all towns having a population equivalent of between 2,000 and 10,000 where final discharge is to a freshwater or an estuary.

Statutory Instrument S.I. 419/1994 gives effect in Irish legislation to the E.C. Directive 91/271/EEC.

1.13 In accordance with the above, Cork County Council in January 1993 commissioned a new Report which would include secondary treatment for Midleton Sewerage Scheme.

1.14 The Council further instructed that the new Report be accompanied by an Environmental Impact Statement in accordance with SI/349/1989 and EC Directive 85/337/EEC.

2.0 WASTE WATER TREATMENT PLANT - PRELIMINARY REPORT 1993

2.1 In October 1993 M.C. O'Sullivan submitted the Preliminary Report on the treatment of sewage for Midleton incorporating a secondary treatment plant. This Report dealt with:-

1. The treatment of both domestic and industrial wastes from the town of Midleton to secondary standards, with the provision for nutrient removal and disinfection, if required.

2. An examination of the effects of the discharge of treated sewage to the receiving waters.

3. Alterations to existing pumping stations and pipe network relating to the inclusion of the secondary treatment plant.

2.2 The treatment plant proposed in the Preliminary Report consists of the treating of incoming sewage to secondary standards by extended aeration using fine bubble diffused air in aeration basins, followed by settlement in circular settling tanks from which the treated effluent is returned to the existing outfall. The report also proposed facilities for the treatment of sludge including digestion tanks, thickening tanks and dewatering equipment.

2.3 The Report recommends that the existing outfall at Rathcoursey Point be retained as a final outfall point for the treated effluent.

3.0 ENVIRONMENTAL IMPACT STATEMENT

3.1 This Report which details the environmental impact study carried out, presents an assessment and base line study of the existing natural environment in and around the site of the proposed treatment plant and outfall pipe with reference to flora and fauna, water quality, noise and air emissions and other amenity and beneficial uses of the area.

3.2 The Statement also includes a detailed technical description of the proposed treatment works including details of design capacity and standards of effluent discharged at the outfall pipe.

3.3 The Statement includes an evaluation of the beneficial and adverse impacts on the existing environment of the construction and subsequent operation of the proposed treatment works. It also sets out the features that are incorporated in the design of the plant to mitigate any adverse impact of the proposed development.

4.0 NON TECHNICAL SUMMARY

4.1 A non technical summary setting out the main content of the E.I.S. is provided separate from this volume.

5.0 ACKNOWLEDGEMENTS

5.1 MCOS acknowledge the contributions made by the following experts/agencies in the various specialist disciplines.

1. Irish Hydrodata,
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2. Natural Environment Consultants,
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3. Niall Hyde & Associates,
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   23 St. Stephens Green,
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4. Eolas,
   The Irish Science and Technology Agency,
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   Dublin 4.

5. Envirocon,
   Environmental Consultancy,
   Clifton House,
   Lower Fitzwilliam Street,
   Dublin 2.

6. Dr. Elizabeth Twohig,
   Department of Archaeology,
   University College Cork.

6.0 DRAWINGS

6.1 The following drawings accompany this Report.

MIDLETON SEWAGE TREATMENT PLANT - E.I.S.

DRG NO.	TITLE
EIS1	1/10,560 Location Plan
EIS2	1/2,500 Layout Plan
EIS3	Layout Plan of Sewage Treatment Plant
EIS4	1/250 Elevations of Site showing Building Profiles

SECTION 2

PROJECT DESCRIPTION

SECTION 2

PROJECT DESCRIPTION

1.1 Midleton town is located approximately 18 kilometres east of Cork City on the north eastern corner of Cork Harbour. It is located on the main route between Cork and Waterford and serves both as a market town to the rural hinterland and as an industrial base. The town is built adjacent to where the Dungourney River meets the Owenacurrra River, and both rivers are tidal as far as the town.

1.2 Downstream of the town, the Owenacurra River flows through mud flats, through a narrow neck at Bailick and on to the village of Ballynacorra approximately 1.4 kilometres downstream of Midleton. Approximately 2 kilometres further downstream from Ballynacorra is the village of Rathcoursey. Upstream of Rathcoursey the greater part of the estuary consists of mud flats which are exposed at low tide.

2.0 EXISTING SEWERAGE SYSTEMS

2.1 Prior to 1988 the sewage from the town of Midleton was discharged to both the Owenacurra and Dungourney Rivers in a multiplicity of outfalls. In the 1988 scheme a new pipe network was laid consisting of approximately 13,300 lin.m. of sewers varying in diameter from 100 mm. to 900 mm.

2.2 The sewage was collected to a main pumphouse at Bailick Road where the domestic and industrial streams were discharged to separate pump wells. From this pumphouse the effluent is lifted a short distance and then discharged by gravity to a second pumping station located at the village of Ballynacorra. At this station the effluent receives primary treatment by way of comminution before being pumped to the head of the pressure outfall line.

2.3 The waste water is then discharged via a holding tank at Rathcoursey to the East Passage. The tidal holding tank is capable of holding the ultimate flow for a period of one hour at low tide (2,120 cu.m.).

2.4 A comprehensive monitoring programme has been put in place in order to analyse the effects of the discharge on the waters of the harbour. A base line monitoring programme was carried out for two years, prior to the commencement of discharge, independently by Cork County Council and An Foras Forbatha.

3.0 PROPOSED SEWAGE TREATMENT

3.1 In the brief associated with the Preliminary Report, it is the intention of Cork County Council that all effluent of a domestic and industrial nature receives satisfactory treatment prior to its discharge to the receiving waters.

3.2 All sewage of a domestic nature in the environs of Midleton Town is to be collected and conveyed to the proposed treatment work.

3.3 Midleton is also fortunate in having four significant industries within the environs of the town.

Two of these industries are located in Knockgriffin on the north west of the town and the wastes from these plants are treated in private waste water treatment plants. The treated effluent from these plants is discharged to the estuary adjacent to Ballyannan House.

Irish Distillers Ltd. is a major industry in Midleton. Irish Distillers Ltd. also has its own private waste water treatment plant but it discharges its treated effluent to the public sewers under licence. The hydraulic load associated with this industry is taken into account in the Preliminary Report.

A fourth major industry, Universal Foods Ltd. also operates in Midleton. At present preliminary treated effluent from this plant is being discharged into the sewers and conveyed to the outfall point at Rathcoursey. The Preliminary Report provided the flexibility to allow the discharge from Universal Foods Ltd. to be treated in the new treatment works by Cork County Council or alternatively to allow the industrialist to privately treat the effluent.

The following table shows the design for treating both domestic and industrial wastes at the proposed treatment plant.

	Domestic	Industrial	Total
Population Equivalent	15,000	23,750	38,750
B.O.D. Load (max.)	900 kg.	1,425 kg.	2,325 kg.
Dry Weather Flow (max.)	4,650 cu.m.	2,500 cu.m.	7,150 cu.m.

3.4 In the intervening period since the preparation of the Preliminary Report, Universal Foods Ltd. have now taken a decision to treat their own effluent. Due to the flexibility of the treatment works design it is now possible to omit the industrial waste water treatment plant and proceed with the domestic waste water treatment plant.

Therefore, this Environmental Impact Statement concerns itself only with the construction of the domestic waste water treatment plant.

4.0 LOCATION

4.1 The various options for the location of the proposed treatment plant are described in detail in Section 4 and more generally below.

4.2 At the initial stages of preparing the Preliminary Report, when consideration was being given to the treatment of all the industrial effluent and the domestic effluent of Midleton in one large plant, a number of locations were looked at. These were at Bawnard, Loughatalia, Ballynacorra, Bailick and Garryduff. As the design of the treatment progressed, the sites at Ballynacorra and Garryduff were favoured, both on technical and economical grounds.

4.3 Permission was sought from the landowners of both sites to allow access to personnel for the purposes of surveying the sites and examining them in the preparation of the Environmental Impact Statement. In the case of the Ballynacorra site the landowner imposed such unacceptable preconditions that the site was not surveyed, nor was it possible for the experts dealing with noise, odours, flora and fauna, archaeology, etc., to gain access for their investigations.

4.4 However, as the design of the treatment process progressed it became clear that it would not be practical to treat the combined effluent from the town and the industries in one plant because of the large fluctuation both in flow and B.O.D. and, therefore, separate pipelines would be required to whichever treatment plant site was finally chosen.

4.5 At that time it was necessary to separate the treated effluent from the I.D.L. treatment plant from the waste from Universal Foods Ltd. Therefore if the site at Ballynacorra was chosen, two new pipelines would have to be laid along the Bailick Road to the pumping station at Ballynacorra, and two separate rising mains from Ballynacorra to the new treatment plant. During the construction of the sewerage scheme in 1988 great difficulties were experienced in the laying of the 750 mm. main along the Bailick Road because of adverse ground conditions resulting in large contractual claims. Because of the difficulty in laying two further pipelines parallel to the existing, it is deemed inadvisable to pursue this option while there is an alternative.

4.6 The site for the proposed treatment plant favoured in the Preliminary Report is, therefore, Site No. 1 at Garryduff and this Environmental Impact Statement is based on locating the plant at that site.

5.0 SITE ACCESS

5.1 It is proposed to construct a new access road to the site, from the north western corner to the road that runs between the by-pass road near Whitegate House and Ballyannan House as shown on Drg. No. EIS2.

5.2 All construction traffic and commercial vehicles will be instructed to use this new road. However, local traffic will at all times have access to Ballyannan Wood through Riversfield Estate and under the by-pass as pertains at present.

5.3 It is not envisaged that access will be made to the site from the by-pass road at any time.

6.0 EXISTING LAND USE

6.1 The land on which it is proposed to site the new treatment plant is used for agricultural proposes at present, in recent years mainly as pasture land. The nearest residence is approximately 100 m. from the northern end of the plant.

7.0 SITE TOPOGRAPHY

7.1 The site slopes gently from 3.5 m.O.D. at the western boundary to 2.5 m.O.D. at the bottom of the by-pass embankment. The road level of the by-pass adjoining the site is approximately 7.3 m.O.D.

8.0 BRIEF PROCESS DESCRIPTION

8.1 Drawing No. EIS3 shows a layout of the site on a scale of 1:1,000. The design of the treatment plant is such as to reduce effluent concentrations to a maximum of 20 mg./l. B.O.D. and 30 mg./l. of suspended solids as well as removing nutrients to satisfy the recently adopted E.C. directives 91/271/E.C.C. concerning urban waste water. The average percentage removal of B.O.D. expected through the plant is in the order of 93% for the domestic effluent. A detailed description of the treatment process is given in Section 3. A brief description of main elements of the treatment plant is given hereunder.

DOMESTIC WASTEWATER TREATMENT

9.1 The sewage from the town of Midleton and the village of Ballynacorra will be pumped to the proposed treatment plant from the existing pumping station at Townparks, and from the proposed submersible pumping station further south on the Bailick Road.

Inlet Works

9.2 The inlet works shall comprise:-

a. Fine Screens (5 mm. bar spacing) with mechanical screenings removal

b. Grit trap with grit removal by means of compressed air.

Both these operations will be fully automatic and enclosed within the machine house.

Secondary Treatment

9.3 From the inlet works the sewage will gravitate to an aeration basin where aeration is achieved by fine bubble diffused air introduced to the sewage from the floor of the tanks.

9.4 The size of the aeration basin is based on a B.O.D. loading of 190 mg./l for 15,000 population equivalent resulting in a proposed tank volume of approximately 4,800 cu.m.

9.5 The flow through the aeration basin is divided into three streams with each tank subdivided into four equal parts. The first section of each reactor will be anoxic to facilitate denitrification in the presence of carbon provided by the raw sewage.

9.6 The biological matter in the incoming sewage will be bio-degraded in the aeration basin by bacteria contained in the mixed liquor suspended solids in the tanks.

9.7 From the aeration basin the treated sewage is passed to secondary sedimentation in final settling tanks.

Secondary Sedimentation

9.8 Secondary sedimentation of the effluent is carried out in three separate tanks designed for a surface loading of 22 cu.m./sq.m./day. The supernatent liquid from these tanks passes through a measurement weir before being discharged to the outfall pipe at the north eastern corner of the site.

9.9 To ensure a consistent level of mixed liquor suspended solids in the aeration basin, settled sludge from the secondary settling tanks is recycled via the anoxic tank at the beginning of each stream.

Sludge Treatment

9.10 A Sludge Managment Strategy is presently being investigated by Cork County Council for the centralised treatment and disposal of sludges from various treatment plants throughout the county.

9.11 The date of implementation of this sludge management strategy is not yet known. In the meantime, it is proposed to treat the sludge emanating from this plant on the site. This proposal will be updated as developments in the sludge management strategy become available. Therefore, throughout the text references to sludge treatment in excess of treatment in a picket fence thickener tank will be qualified by "if required".

9.12 Sludge will be wasted from the aeration basin and pumped to a sludge thickening tank. This is a circular radial flow tank with a continuously rotating gate type picket fence. The sludge is thickened in this tank to a consistency of approximately 4% dry solids.

9.13 If required the sludge will pass from the thickening tank to sludge digestion tanks which would have a retention time of between 10 and 15 days. Air would be bubbled through the sludge in these tanks, thus giving the sludge further treatment by thermophilic aerobic digestion, a process which will kill off pathogens, reduce sludge volumes, and improve dewatering characteristics.

9.14 If required the sludge from the digestion tank would be pumped on to a dewatering machine where it would be dried to between 18 and 25% solids. This dewatering equipment would be housed in the machine house, as would the bin in to which the dried sludge would be dropped before being transported to landfill sites.

Nutrients

9.15 Nitrification and denitrification are achieved in the aeration basin by the inclusion of an anoxic zone before the aeration process.

Outlet From Works

9.16 From the secondary clarifiers the settled liquid will discharge via a measurement flume to the existing 750 mm. trunk sewer on the Bailick Road.

SECTION 3

PROCESS DESCRIPTION

SECTION 3

PROCESS DESCRIPTION

DOMESTIC SEWAGE TREATMENT

1.0 GENERAL

1.1 The brief for this scheme is very specific in terms of the volumes to be treated and the effluent standard to be achieved.

1.2 The brief states that all flows up to 6 D.W.F. shall be carried forward to receive at least primary treatment. All flows up to 3 D.W.F. shall receive full secondary treatment.

1.3 The final effluent standards to be achieved are:

$B.O.D._5$	20 mg./litre
S.S.	30 mg./litre
Total N	15 mg./litre

1.4 These standards are somewhat stricter than those contained in Directive 91/271/EEC on Urban Wastewater Treatment.

1.5 The projected loads for the Domestic Sewage Treatment Plant were established in the Preliminary Report as follows:-

Stage 1	10,000 p.e.
Stage 2	5,000 p.e.
Total	15,000 p.e.

1.6 The ultimate design population is under the economic borderline (>20,000 p.e.) between two distinct types of treatment:

- primary sedimentation with anaerobic digestion of the sewage sludge.
- full extended aeration treatment with aerobic sludge treatment, if required.

1.7 Stage 1 population equivalent (10,000) is well below that economic borderline.

1.8 The plant proposed for Midleton is an extended aeration type plant which would give full nitrification and denitrification in order to achieve the effluent standards. Aeration would be by means of diffused air which has the benefit that it is extremely quiet and reduces aerosols over the aeration sections to virtually nil. The plant is designed to treat up to 3 DWF with 2 hours retention of a further 3 DWF for subsequent treatment.

1.9 The plant is designed to be low in maintenance and as foolproof as possible with many early warning alarm systems built in. The proposed treatment plant would contain the following elements:-

- Inlet Flow Meters
- Screening House
- Grit Trap
- Bio Reactors
- Sedimentation Tanks
- Outlet Flume for Treated Effluent
- Sludge Settling and Thickening Tank
- Aerobic Sludge Digester (if required)
- Sludge Dewatering House (if required)
- Machine House
- Control House
- SCADA System
- Metering and Monitoring

2.0 HYDRAULIC LOAD

2.1 The sewage is collected to Pumphouse No. 1 at Bailick Road from where the sewage will be pumped to the domestic sewage treatment plant. There is a storm overflow at Bailick Road and it was decided to combine the protection of this overflow with hydraulic flow balancing to the sewage treatment plant so that only 3 D.W.F. is pumped to the treatment plant.

2.2 When a rainstorm event occurs, organic matter which has been deposited on the sewer pipes during dry weather is stripped off and flushed to the outfall. The polluting effect of this first flush can be much greater than normal dry weather foul flow. Therefore, the proposed balancing tank at Bailick Road Pumphouse has been designed to hold this "first flush" and return it to the domestic pump sump for discharge to the treatment plant when the peak of the storm has passed.

2.3 This stormwater balancing tank performs the second function of giving primary sedimentation to stormwater overflows prior to discharge to the receiving waters. Any overflow is also fine screened to prevent any possible carry over of offensive matter.

2.4 Therefore, it has been possible to design the domestic sewage treatment plant for a hydraulic load of 3 DWF while avoiding the necessity of duplicating stormwater balancing at the plant.

3.0 SCREENING

3.1 The screening of raw sewage dictates the quality of sludge and effluent produced. It is also one of the areas where odours may arise in a treatment plant. It is proposed to house the inlet screens for the domestic sewage plant to facilitate the collection of any odours which may arise and allow them to be scrubbed before discharge to the atmosphere.

3.2 The main reason for odours in screenings is the trapping of faecal matter with the inorganic screenings. This can be overcome by the washing and baling of screenings, but quite often not all the faecal matter is removed by the washing and the baled screenings give rise to foul odours when they are retained too long within the plant. In addition, such contaminated screenings are unacceptable for disposal on municipal landfill sites. It is necessary to liquidise and wash off the faecal matter prior to screening.

3.3 In the Midleton situation, all the inflows to the proposed sewage treatment plant are pumped and the pumping action will perform the liquidisation of the faecal matter.

3.4 Fine screens (5 mm. bar spacing) are proposed to remove the inorganic matter from the sewage flow. It is proposed that duty and standby screens would be provided so that no deterioration in the treated effluent or sludge could occur in the event of a breakdown of a screen. The inorganic matter trapped on the screens would be passed to a top feed launder where the screens would be washed clean of obnoxious materials and compacted into bales for disposal to landfill.

3.5 A system, virtually identical to this, is already in operation at Little Island on the Riverstown/Glanmire Sewerage Scheme where the sewage is pumped over a long distance prior to screening and baling of the screenings. This system has been successful.

4.0 GRIT REMOVAL

4.1 The removal of grit is very important within the sewage treatment process and especially in this particular treatment plant because once the grit passes into the large tanks associated with sewage treatment, it will settle out, thereby, reducing the volumes available and giving a medium for the growth of anaerobic bacteria. In addition, because of the nature of the sewage treatment plant site in Midleton many of the interconnecting pipelines between the treatment elements would be drowned and settlement of grit in these would have adverse consequences.

4.2 Because of the fact that diffused air is proposed in this plant, an aerated grit trap will be used in place of the more common mechanical grit trap. An aerated grit trap gives greater control over the size of grit removed and therefore over the amount of organics deposited.

4.3 The aerated grit trap serves a secondary function as an aerated grease trap and will allow for the removal of any grease.

4.4 Grit will be removed from the hoppers in the invert of the grit trap by means of air lifts which will discharge to a grit classifier housed within the screening house. This grit classifier will remove any remaining organics and return them to the flow while, at the same time discharging the grit into a skip which also receives the compacted screenings. The skip will be within the screening house so that no odours will escape to the atmosphere without scrubbing.

4.5 From the grit chamber the sewage will be transported in a drowned pipeline to a splitter chamber located adjacent to the bio reactors.

5.0 SECONDARY TREATMENT

5.1 The brief for this scheme requires better than the E.C. standards for B.O.D. and suspended solids. The effluent shall also meet the following standards for nitrogen:

N = 15 mg./litre

6.0 DENITRIFICATION

6.1 Removal of nitrogen by biological means is simpler within an activated sludge system in that ammonia (NH_3) in the sewage is progressively converted to nitrite (NO_2) and nitrate (NO_3) so that a fully nitrified effluent is discharged at the outlet end of a plug-flow system. By the time the sewage has been fully nitrified, all the carbonaceous material will have been oxidised.

6.2 The bio reactor proposed for Midleton is designed as a plug flow/stepped aeration system which will give full nitrification/denitrification to the sewage. The loading rate of the tanks is reduced to allow an anoxic zone at the inlet to the tanks.

6.3 Denitrification requires a carbon source for the chemical reactions necessary to release nitrogen to the atmosphere. This carbon source could be added to the effluent from the aeration zone as methanol or some other carbon based chemical with consequent effects on the running costs of the plant. In this plant, it is proposed that the incoming raw sewage will be used as a carbon source and mixed with a high rate return of fully nitrified mixed liquor from the outlet of the bio reactors (5 D.W.F.).

6.4 This fully nitrified effluent in the form of nitrate would combine with the raw sewage in the anoxic (oxygen deficient) zone and the bacteria within the zone would strip oxygen from the nitrate molecules to release free nitrogen, carbon dioxide and water. These chemical reactions allow for the release of approximately 83% of the total nitrogen from the effluent. This percentage may be varied by increasing or decreasing the rate of return of the activated sludge.

7.0 NITRIFICATION

7.1 From the anoxic zone (which comprises 25% of the total of the reactor) the mixed liquor passes into the first of three distinct stepped aeration zones. The first aeration zone will boost dissolved oxygen levels to 0.8 mg./litre to assist in the conversion of the ammonia in the incoming sewage to nitrite. The flow will continue into the second aerated tank where the dissolved oxygen levels will be boosted to 1.2 mg./litre to assist in the conversion of the nitrite to nitrate. From the second aeration zone, the sewage will pass finally to the third aeration zone where dissolved oxygen will be boosted 2 p.p.m. to ensure full nitrification.

7.2 Each of the four zones will have mixers to ensure full mixing if the diffused air rate is not sufficient to maintain the mixed liquor in suspension. In normal running conditions, these mixers will not be required in three of the four tanks. The exception is the anoxic zone.

7.3 The mixed liquor will discharge over a weir at the outlet end of the bio reactor into a channel which in turn discharges in an inverted syphon to the sedimentation tanks.

8.0 SLUDGE RETURN

8.1 From the outlet channel of the bio reactors, a submersible axial flow pump will return mixed liquor at a rate of 4 D.W.F. into a channel which returns the mixed liquor to the inlet of the bio reactor. This 4 D.W.F. volume will be joined by a further 1 D.W.F. of returned, settled, activated sludge from the sedimentation tanks. These two comprise the recirculation of 5 D.W.F. mentioned above for denitrification.

8.2 By returning 4 D.W.F. of mixed liquor suspended solids directly from the outlet of the bio reactor to the inlet, the running and capital cost of the plant are substantially reduced while still giving full denitrification. The static lift of the liquor is minimised as the liquor is just pushed through a wall and given minimal additional head to allow a flow to inlet. The friction losses associated with discharge from the reactor to the clarifier and back to the reactor are avoided. Similarly, the capital cost of the clarifiers is substantially reduced because the hydraulic load to those clarifiers is reduced by a factor of 2.

9.0 AERATION

9.1 Aeration of the bio reactor would be by means of fine bubble diffused air aeration arranged so that any bank of diffusers may be removed from the surface without removing the tank from service. Control of the dissolved oxygen levels would be by means of sensors mounted just below the surface of the liquor. Because of the fact that the air is supplied to the sewage at the bottom of the tank, it is best to measure the D.O. near the surface when the air has been virtually fully absorbed.

9.2 These D.O. meters will maintain fixed levels of dissolved oxygen in each of the three aerated tanks as mentioned earlier. This will be done by means of a SCADA (computer controlled) system which will analyse the D.O. and adjust pneumatically operated valves feeding the air into each tank. In this way, precise control of the process is maintained and running costs are minimised.

9.3 The diffused air for the plant will be supplied by air blowers housed in the machine house adjacent to the screening room. These blowers would be arranged in such a way that one blower would provide the basic minimum air requirements of the plant and the output from the other blower would be varied by means of a frequency inverter to provide precisely the amount of air required to maintain the process at its optimum. This control function would be controlled by the SCADA system.

9.4 The fact that all mechanical plant is either submerged or housed with acoustic hoods lends to the overall quietness of the plant.

10.0 EXCESS SLUDGE

10.1 In any sewage treatment system, a large part of the B.O.D. is removed as sludge and this has to be disposed of by treatment and dewatering. In an extended aeration plant, the sludge varies in characteristic from one plant to the next. The overall sludge age (i.e. 15 days, 25 days, etc.) has a great bearing on the treatability and dewatering characteristics of the sludge. Therefore, it is very important to be able to control the sludge age.

10.2 The normal operation in this country for the disposal of excess sludge from any plant is to allow the sludge to accumulate in the secondary clarifier for a number of hours (or in a smaller plant, days) and to then waste the sludge over a short period to the picket fence thickener or other treatment device. This may cause problems if the sludge is stored for too long a period in the settling tank in that gases can carry solids to the surface and cause carry over with the final effluent.

10.3 In the proposed plant for Midleton, the sludge will be wasted directly from the bio reactors, by means of a submersible pump in the outlet channel from the bio reactor. The excess sludge would be pumped to a sludge settling/thickening tank at a fixed rate over a 24 hour day.

10.4 The rate of wastage would be controlled by means of frequency inverters on the pumps pumping through a metered rising main. This could be varied by the SCADA system. In this way the sludge age in the bio reactor may be precisely controlled, i.e.:

1. Waste 1/15th of the volume of the bio reactors, then sludge age = 15 days.

2. Waste 1/30th of the volume of the bio reactors, then sludge age = 30 days.

10.5 In this way, the sludge treatment and dewatering characteristics may be optimised.

10.6 This method of sludge wastage has the added advantage that the hydraulic load on the sludge settling/thickening tank is greatly reduced, thereby allowing for a much smaller tank to be installed.

11.0 SECONDARY CLARIFIERS

11.1 A single standard circular settling tank is proposed for each of the three streams of the treatment plant. This shape allows for the utilisation of the simplest form of the scraping mechanisms and is therefore most desirable.

11.2 Sludge settled in the secondary clarifiers would be scraped by means of a bridge mounted scraper which would deposit the settled sludge into a central sludge hopper from where the sludge could be drawn directly by means of a pipe manifold to the sludge return pump. This sludge return pump would be housed in a separate submersible pumping station and would pump the settled sludge on a continuous basis at a rate of 1 D.W.F. to the mixed liquor return channel.

11.3 It is proposed to return sludge on a continuous basis so that the retention time of the sludge within the sedimentation tank is short. This will avoid problems which could be created by continuing denitrification within the sludge retained in the sedimentation tank. Denitrification gives rise to nitrogen and carbon dioxide gases which, as they rise, would carry suspended solids to the surface, thereby restricting settlement and creating scum.

11.4 The sludge return pumps would be inverter controlled and the return main will be metered so that the rate of return may be varied to coincide with the population equivalent of the influent. It should be noted that there is no intention of wasting excess sludge from the sedimentation tank.

12.0 OUTFALL

12.1 From the secondary clarifiers the settled liquid will discharge to individual collecting manholes which would be interconnected and carry the final effluent to a measuring flume for discharge to the existing 750 mm. outfall sewer on the Bailick Road and thence to Pumphouse No. 2 at Ballynacorra and the final outfall at Rathcoursey.

12.2 Because of the site levels, these outfall manholes will be drowned and the liquid will be carried in drowned pipelines to the outlet measuring flume. The level of this flume is dictated by the outfall syphon inlet chamber.

12.3 From the outlet measuring flume the liquid will be carried in a 400 mm. inverted syphon under the Owenacurra River to discharge to the existing 750 mm. gravity sewer on the Bailick Road adjacent to the By-Pass Road.

13.0 DISINFECTION

13.1 The main concern with regard to the existing sewage outfall at Rathcoursey has centred around the question of contamination of the receiving waters by faecal matter. In general, the monitoring of the receiving waters in the North Channel shows very variable results both pre and post discharge. These results indicate no disimprovement in the receiving waters.

13.2 The introduction of secondary sewage treatment for the domestic effluent of Midleton will have the effect of reducing the average faecal coliform counts to approximately 1.6 x 10^5/100 ml. in the effluent. Monitoring of existing extended aerations plants confirm these counts.

13.3 The collection system for Midleton sewage is being changed to ensure that all domestic sewage and indeed, discharges from small abattoirs and the mart (if desired) will be collected and passed through the domestic sewage treatment plant. This means that any potential source of faecal pollution in Midleton will pass through the domestic sewage treatment plant.

13.4 Irish Distillers Ltd. and Universal Foods Ltd. are food type industries , which do not produce faecal bacteria. Therefore the treated effluent from these industries will not contribute towards the faecal coliform counts in the discharge.

13.5 Therefore, if the sole source of faecal pollution in the North Channel area is due to Midleton Sewerage Scheme, then the existing situation where there is neither improvement nor deterioration in the quality of the receiving waters, would be greatly improved by the reduction (>90%) in faecal coliforms being discharged. If Midleton Sewerage Scheme were the sole source of faecal coliforms contributing to the North Channel, then this reduction on its own will have the effect of converting the North Channel waters from "Conditional" under the Shellsan classification to "Approved".

13.6 It is reiterated that disinfection is not necessary. However, it is proposed to install a facility whereby disinfection can be incorporated in the scheme at a later date if desired.

13.7 There are many methods of disinfection, the more common being:

- Chlorination (Chlorine or Hypo-Chlorite)
- Peroxyacetic Acid (PAA Addition, e.g. Oximaster)
- Ozone Addition
- Excess Lime Addition (e.g. Clariflow)
- Ultraviolet Radiation
- Microfiltration (e.g. EXX Flow, Memcor, Stalk, or Crossflow Microfiltration)
- Enhanced Settlement (WETS, Nalfloc, Co-polymer Flocculation Systems)

13.8 All the above methods have been under investigation by the National Rivers Authority in Great Britain and only Ultra Violet disinfection has been passed for longterm use. In addition, a number of potentially hazardous by-products have been identified with regard to some of the other methods such as chlorination, while the remaining methods have been found to be very expensive. Therefore, provision is made in a drowned channel upstream of the final outlet measuring flume for the installation of ultraviolet lamps (if required).

13.9 If disinfection is required then it should be U.V. Disinfection. However, it is not recommended that these U.V. lamps be installed as:

- It has not been shown that the existing discharge has caused bacterial deterioration.
- The future discharge will have greatly reduced faecal coliforms concentrations.
- The running costs associated with U.V. disinfection would be approximately IR£34,000/annum at ultimate development for a facility which is not necessary.

14.0 SLUDGE STREAM

14.1 The disposal of the sludge generated in any sewage treatment plant has become the largest and most labour intensive element of that plant. In addition, the introduction of new restrictions with regard to sea disposal, disposal to agricultural land and (possibly in the near future) with regard to disposal to sanitary landfill has created requirements for a better quality of treated sludge. This plant is designed to meet those needs.

14.2 There are a number of options for the final disposal of the sludge generated within the domestic Sewage Treatment Plant at Midleton and these are:

- Transport and treatment in accordance with the recommendations of the proposed sludge management strategy.
- Transport to the proposed City Main Drainage Treatment Plant.
- Recycling to the horticultural land surrounding Midleton.
- Disposal to sanitary landfill.
- Injection into land.

14.3 The most beneficial of these disposal methods would be recycling of the sewage sludge to agricultural land but to do this, the sludge must receive some form of treatment such as:

- Mesophilic anaerobic digestion.
- Thermophilic aerobic digestion.
- Lime stabilisation.
- Long term storage.
- Heat treatment.
- Composting.

14.4 Most of these methods of sludge treatment are not economical in the context of a small sewage treatment plant such as Midleton and Cork County Council intend to look at the economics of providing a central treatment facility for sewage sludge. Indeed, it appears likely that the advent of the new Cork City Main Sewage Treatment Plant could provide such a centralised sludge treatment facility. However, it is proposed to provide sludge treatment in Midleton and this may be deleted at a later date if events dictate.

14.5 The fact that the sewage treatment proposed is Extended Aeration means that anaerobic digestion is not possible. Therefore, thermophilic aerobic digestion would be recommended for this plant in order to:

- reduce the total amount of solids to be disposed of
- to improve the dewatering characteristics of the sludge.

14.6 In addition, the thermophilic aerobic digestion process will kill off pathogens within the sludge so that the cake would be available immediately for use as a fertiliser on horticultural or other farmlands, thus minimising the sludge storage on site.

14.7 The volume of sludge to be disposed of following thermophilic aerobic digestion would be approximately 2 tonnes per day (reduced from 4.5 tonnes per day of undigested sludge) and this reduction alone would have a very large impact on the cost of sludge disposal.

14.8 The sludge from the digesters would be dewatered either by means of a filter belt press or centrifuge housed adjacent to the screening house so that the odours from both rooms could be extracted and scrubbed before being discharged to the air.

15.0 MACHINE HOUSE

15.1 The machine house proposed will house the following elements of the treatment plant:

- Screening and grit removal.
- Sludge dewatering.
- Air blowers.
- Standby generation.
- Main control panel.
- Store/workshop area.
- Air extraction.

15.2 The first two of these elements (i.e. screening/grit removal and sludge dewatering) have been discussed earlier.

16.0 AIR BLOWERS

16.1 The proposal is to use diffused air as a main treatment vehicle for the sewage. To do this the air blowers, which will service:

- the bio reactors
- the grit trap
- the sludge digesters
- the pneumatic valving

must be housed indoors and it is proposed that these blowers would be installed in a special room within the machine house. The air blowers will be complete with acoustic hoods to reduce the noise level from the air blowers to an acceptable level within the house. In addition, the blower room will be so designed that noise levels outside the room would be reduced to domestic level.

17.0 STANDBY GENERATOR

17.1 A standby diesel generator is considered necessary for this scheme to ensure that any breakdown of the main power supply will not affect the plant. This standby generation would have the added advantage that it would enable the operator to minimise power costs on the plant by means of using the diesel standby generator during times of maximum demand, thereby reducing the total E.S.B. bill.

17.2 The generator would be housed in the same building as the air blowers and would also have an acoustic hood to reduce noise levels. In addition, the generator room would be sound insulated in the same way as the blower room. It is proposed that power from the standby diesel generators would be brought by means of underground duct adjacent to the rising mains to the two pumping stations at Bailick Road to ensure that power is also maintained at these stations in the event of mains power failure.

18.0 AIR EXTRACTION

18.1 It has already been noted that the only locations where odours could arise within the proposed sewage treatment plant are:

- at the screening and grit removal stage
- at the sludge dewatering stage
- at the picket fence thickener
- at the aerobic digesters (if installed)

18.2 It is proposed to collect the air from these four elements by force ventilation and to draw them through a peat odour scrubbing bed. The ventilation machinery would be located in the roof space of the machine house with the peat bed adjacent to the house.

19.0 STORE/WORKSHOP

19.1 Finally, a large storage area would be incorporated in the machine house to accommodate the necessary tools for the maintenance of the sewerage scheme such as:

- tractor
- specialised trailers
- lawnmower
- high pressure drain cleaner
- small tools
- workshop

19.2 In this way it is proposed that all the mechanical elements of the treatment plant is kept in one location.

20.0 CONTROL HOUSE

20.1 Control of the complete Domestic Sewage Treatment Plant will be by means of a SCADA (Supervisory Control And Data Acquisition) system which will effectively run the entire plant. This system will be capable of feeding information back to remote outstations such as Town Engineers office, etc. The system will ensure that the Supervisors have full information on the plant at all stages, including flows and influent and effluent monitoring.

20.2 To this end, it is proposed that multiple stream continuous monitoring stations for C.O.D., D.O., pH, phosphorous and nitrogen be installed on the inlet and outlet to the treatment plant with continuous feedback to the SCADA system. In addition, it is proposed that flow metering be installed on all intermediate pipelines within the sewage treatment plant to ensure the optimum amount of information is available on the performance of the plant.

21.0 ADMINISTRATION BUILDING

21.1 It is expected that the Council will maintain an "open door" attitude with regard to visitors to the treatment plant to ensure that any public disquiet about the plant would be allayed. Therefore, it is proposed that reception and lecture facilities should be provided within the control house to allow for groups of visitors.

21.2 In addition, the new Freedom of Information Legislation will probably require the Council to be able to provide casual visitors with full details of operation of the plant. It is felt that this purpose would be best served in a building remote from the remainder of the plant to ensure the safety of the visitors and to reduce interference in the running of the plant.

21.3 The control building will provide all the domestic facilities (canteen, W.C.'s, showers, etc.) required by the operatives and by the visitors to the sewerage scheme.

21.4 Finally, the control house has been located in such a situation as to ensure that all visitors to the sewage treatment plant (whether casual or business) would have to pass through the control building before gaining access.

22.0 MANNING

22.1 At present, Midleton Sewerage Scheme is maintained by a single operator who looks after the operation of the two main pumphouses, the lunar penstock at the tidal holding tank as well as the smaller submersible pumping stations and the sewage collection pipe network. This man is performing his duties to a high standard and is fully occupied by these duties.

22.2 The proposed Domestic Sewage Treatment Plant is highly sophisticated and will require a separate, technically qualified operative for its supervision. This operative would be required to understand the basic operating parameters of the plant and the effects of variation of these operating parameters. In addition, he would be required to be able to operate the SCADA system.

22.3 In addition, the introduction of the Plant and siteworks associated with the Sewage Treatment will require the services of a general operative to maintain the site.

22.4 Two additional employees will be required by the Council when the Sewage Treatment Plant is constructed. It is vital that these employees, and particularly the technical employee, should be available at an early date during the construction.

23.0 OUTFALL

23.1 The discharge from the domestic sewage treatment plant will be to the existing 750 mm. trunk sewer on the Bailick Road from where it will discharge to Pumphouse No. 2 at Ballynacorra. The treated effluent will be pumped to the existing outfall at Rathcoursey which was identified in the 1981 report as the optimum outfall and verified by the study carried out by Irish Hydrodata Ltd. which is described in Section 6.

SECTION 4

TREATMENT SITE OPTIONS

SECTION 4

TREATMENT SITE OPTIONS

1.0 GENERAL

1.1 The brief for the Preliminary Report stated that:

"The various options for dealing with the industrial loads shall be examined. These options are for the industries to treat their effluents either fully or partially prior to discharging independently or to the public sewers. The industrial load to be carried forward for treatment in the municipal treatment works will obviously depend on the option adopted".

1.2 The foregoing brief obviously foresaw two basic scenarios for sewage treatment in Midleton:

- Combined treatment of industrial and domestic sewage in a single plant.
- Separate treatment of domestic and industrial sewage in separate plants.

1.3 The existing sewage collection system in Midleton has a major bearing on the siting of a Sewage Treatment Plant depending on the scenario adopted. Therefore, it is important to understand the collection system.

2.0 EXISTING COLLECTION SYSTEM

2.1 The sewage in Midleton is collected in two separate spinal sewers (municipal and industrial). The municipal sewer was laid in 1987 and collects all the domestic sewage to a domestic pump sump at Bailick Road Pumphouse No. 1 (Towns Park).

2.2 The industrial sewer was laid at various stages from 1955 onwards and in 1987/'88 was collected to the industrial sump of the new sewage pumphouse at Bailick Road. This sewer collects the effluent from Universal Foods Ltd. in the north and Irish Distillers Ltd. in the middle of the town as well as a small amount of domestic sewage en route.

2.3 From the Bailick Road Pumphouse (No. 1) the sewage is pumped to a common gravity sewer which carries it southwards along the Bailick Road to a second major pumphouse at Ballynacorra. The gravity sewer collects domestic sewage from St. Mary's Road, Bailick Road and Ballynacorra along its route.

2.4 The combined sewage is comminuted at Ballynacorra Pumphouse and pumped to a holding tank and outfall at Rathcoursey Point 4.6 km. away.

3.0 SITES

3.1 The existing collection system allows several options for locating the Sewage Treatment Plant depending on whether combined or separate treatment is required. Basically these options are:

- Separate treatment at Midleton.
- Separate or combined treatment at Ballynacorra.
- Combined treatment at Bawnard.

3.2 Two possible Sewage Treatment Plant sites were identified at each location as follows:-

Site 1 - Beechers land, Garryduff at the by-pass road.

Site 2 - Rear of Chadwicks at Bailick Road.

Site 3 - Navratil/O'Brien lands at Ballynacorra Estuary.

Site 4 - Navratil/O'Brien lands at the main road in Ballynacorra.

Site 5 - Woods lands, Ballynacorra West at Bawnard Roads.

Site 6 - Cronin land, Bawnard West.

3.3 The location of these sites is given on Drawing No. EIS1 accompanying this report.

3.4 Detailed contour surveys were carried out on four of the six sites with the permission of the landowners. Permission to survey Site Nos. 3 and 4 was refused by the landowner who set down unacceptable pre-conditions for access. These pre-conditions related to planning and compensation to which the County Council could not agree. The second landowner indicated that he would follow his neighbours lead.

4.0 SITE NO. 1

4.1 This site is a 7.2 hectare field immediately adjacent to the new Midleton By-Pass Road. The field is relatively flat and general ground levels are approximately 4 m. below the by-pass road level. Access to this site would be via a new private road running from Ballyannan Road to the site.

4.2 The attraction of this site, other than its relative remoteness, is the fact that Midleton By-Pass would form a natural barrier to the development of the town. The nearest house is approximately 100 m. from the site on the other side of the By-Pass.

5.0 SITE NO. 2

5.1 Site No. 2 is situated on reclaimed land to the south of Chadwicks Builders Providers and to the west of Bailick Road. This site is not particularly attractive because of its proximity to both Bailick Road and to a residential area. In addition, the site is extremely restricted for space and further land reclamation would be required if industrial effluent treatment is to be carried out on this site. This site is not considered further because of its size and location.

6.0 SITE NO. 3

6.1 This site is situated on the boundary of two farms in the townlands of Ballynacorra and Loughatalia. The site is on the shore of Ballynacorra Estuary and is the most secluded of all the sites considered and is remote from human habitation. The natural gas pipeline from Midleton to Cork passes through the site. In addition, sewage from the site would have to be pumped to outfall. The seclusion of the site is an attractive aspect.

7.0 SITE NO. 4

7.1 This site is also on the boundary of Ballynacorra and Loughatalia Townlands but is situated at the side of the main road to Whitegate virtually in the village of Ballynacorra. The siting of a Treatment Plant at this location would allow for reconnection to the existing outfall without pumping.

7.2 However, development of the site would entail the acquisition of one existing building and it would also be adjacent to a housing estate. The site is highly visible and steeply sloping so that a large amount of preparatory excavation would be required. Experience from the 1987/'88 sewerage scheme indicates the presence of large amounts of limestone rock which would make the site works very expensive. For these reasons this site was not considered further.

8.0 SITE NO. 5

8.1 Site No. 5 is located to the east of the Whitegate Road adjacent to Bawnard Cross Roads. The site is sloping to the south and is ideal for a sewage treatment plant. However, it is overlooked by a large amount of low density housing in Scarriff. Development of this site would not entail crossing the natural gas main, but would entail additional pumping to outfall.

9.0 SITE NO. 6

9.1 This site is located immediately to the west of Site No. 5 in the townland of Bawnard and is bounded to the north by two Natural Gas AGI's (Above Ground Installation). In this case the site is sloping to the north and again, is ideal for development as a sewage treatment plant. There are, however, 4 no. dwellings adjacent to this site and also the effluent from this site would require pumping to outfall. This site is the more attractive of the two sites at Bawnard.

10.0 TREATMENT

10.1 Wastes

10.2 The pollution loads emanating from industrial and domestic sources may be broken down into two groupings;

- Those emanating from human and animal sources.
- Those emanating from other sources.

10.3 The wastes originating in animal sources and which therefore contain large numbers of faecal coliforms are:-

Domestic Sewage.
Meadow Meats Ltd.
Nordic Cold Stores.
Midleton Mart.
Abattoirs.

10.4 The wastes which do not give rise to faecal coliforms are from:-

Universal Foods Ltd.
Irish Distillers Ltd.

10.5 Both Meadow Meats and Nordic Cold Stores have their own treatment systems discharging to an independent outfall and do not wish to combine with a municipal sewerage treatment plant. Indeed, Meadow Meats Ltd. have recently applied for planning permission to construct a tertiary treatment (Constructed Wetlands) stage to their effluent treatment plant.

10.6 Universal Foods Ltd. have now decided to treat their own effluent which will then discharge to the industrial sewer in the town drainage system. Ultimately the treated effluent from Irish Distillers Ltd. and Universal Foods Ltd. will flow to the Bailick Road Pumphouse and discharge at Rathcoursey.

10.7 Irish Distiller Ltd. have their own treatment plant and discharge to the foul sewer system under licence. This will discharge to Rathcoursey as described above.

10.8 The remaining sources of industrial effluent are quite small and can easily be accommodated in a domestic effluent type treatment plant. In addition, the remaining sources of faecal coliform contamination are relatively small and can also be accommodated in a domestic effluent type treatment plant.

11.0 SITE SELECTION

11.1 The Preliminary Report examined various options for treating domestic and industrial effluent. Because of the variability of one of the industrial effluents, that of Universal Foods Ltd., being considered for treatment, it was decided that separate domestic and industrial treatment plants would be required.

11.2 With the advent of Universal Foods Ltd. providing their own treatment, it is now possible to confine the treatment to a domestic type plant.

11.3 The flexibility which was included in the Preliminary Report for dealing separately with domestic and industrial effluents is desirable and will be retained by Cork County Council.

11.4 The separate treatment of the domestic and any future industrial effluents would mean that Sites Nos. 5 and 6 at Bawnard are not economically viable options because of the cost of carrying separate waste streams to these sites from Midleton. It could cost up to IR£2 million in additional capital costs to carry separate sewage streams to Bawnard. There would also be associated running costs.

11.5 This leaves the choice of sewage treatment site location between Midleton and Ballynacorra.

11.6 The existing sewer between Bailick Road Pumphouse No. 1 and Ballynacorra Pumphouse carries, not only the raw sewage from Universal Foods and Midleton Town, but also the treated effluent from Irish Distillers Ltd. (and in the future Universal Foods) as well as infiltration and storm water. It is necessary therefore to collect the municipal sewage from the Bailick Road, St. Mary's Road and Ballynacorra from this sewer to discharge separately to a new treatment plant.

11.7 The comparative costs of collecting the Municipal Sewage from the Bailick Road and Ballynacorra area and discharging it to Ballynacorra or to Midleton have been computed and it is found to be cheaper to pump the Ballynacorra sewage back to a Treatment Plant site at Midleton.

11.8 For this reason, Site No. 1 at Garryduff has been selected as the optimum site for the treatment of sewage in Midleton. This site also allows for the effluent from Universal Foods to be discharged separately to the site, thereby freeing the existing industrial sewer from Universal Foods for stormwater only.

12.0 TREATMENT METHODS

Standards

12.1 The standards laid down by Cork County Council for the effluent from the sewage treatment plant are as follows:-

Parameter	Council Standard	E.C. Standard (91/271/EEC)
$B.O.D._5$	20	25 (70% - 90%)
S.S.	30	35 (90%)
Total Nitrogen (N)	15	15

The above figures are given in mg./lt. and percentage reduction where relevant.

12.2 In order to achieve these standards, biological sewage treatment is required. This treatment may be either aerobic or anaerobic (septic tank) but the latter method is suitable only for small scale plants. There are two basic methods of aerobic biological treatment:

- Fixed Media (percolating filters, etc.).
- Suspended Media (activated sludge).

12.3 There are, of course, a large number of variations of these basic treatment methods. These methods may be regarded as medium to high technology methods. There are also low technology methods of biological treatment, such as broad irrigation or its derivative, "Constructed Wetlands". The differences in the various methods may be summarised under the following headings:

- Capital Costs
- Running Costs
- Land Requirements
- Process Control

Constructed Wetlands

12.4 The concept of treating Midleton Sewage by means of "Constructed Wetlands" was given much publicity in Midleton in the early part of 1993.

12.5 This low technology treatment is very attractive from the point of view of low capital and running costs.

12.6 However, investigations in Northern Ireland, the United States and Austria show that this method of treatment, when applied to large agglomerations, is suitable only as an extra polishing phase after secondary treatment.

Fixed Media Treatment

12.7 Fixed media treatment covers a large number of methods such as standard percolating filters, high rate bio filters, rotating bio reactors, etc. In general, the percolating filters or RBC are perfectly adequate for the treatment of domestic sewage. However, the capital cost is high and for this reason activated sludge treatments are normally cheaper for larger plants. Fixed Media plants can also give rise to low level odour and fly nuisance.

12.8 For high strength industrial effluents High Rate Bio Filters are an extremely effective method of reducing B.O.D. strength for secondary treatment. However, these bio towers require continuous food matter to maintain the bacteria which perform the reduction.

Activated Sludge Treatment

12.9 As with fixed media biological treatment there are many variations of activated sludge (or suspended media) treatment, ranging from high rate (adsorption) to extended aeration (oxidation) methods. All these methods rely on the same micro-organisms but at different stages of activity. The technology for both the process and the control of the process have been developed to a very high degree thereby allowing virtually guaranteed results from the activated sludge system. These methods also possess the benefit of minimal risk of odour and other nuisance.

13.0 DOMESTIC SEWAGE TREATMENT

13.1 The treatment method proposed for the domestic effluent of Midleton sewage consists of an extended aeration treatment plant incorporating full carbonaceous oxidation, nitrification and denitrification.

13.2 The aeration method proposed is diffused air which, while being more expensive in terms of capital cost, gives cheaper running costs than surface aerators and allows for more precise control of the process. In addition diffused air reduces both noise and aerosols from the bio-reactors to an absolute minimum.

13.3 Finally it is proposed to maintain a completely aerobic treatment plant (avoiding primary sedimentation) in order to minimise any possible sources of odour. Any sources of odour which do exist, i.e. screening, grit removal and sludge dewatering, will be housed and the air abstracted and scrubbed before emission.

SECTION 5

THE EXISTING ENVIRONMENT

SECTION 5

THE EXISTING ENVIRONMENT

1.0 GENERAL

1.1 The proposed location for the Sewage Treatment Plant is discussed in Section 2 and Section 4. The effect of siting the plant at that location on the existing environment can be discussed under the headings:

(a) Disposal Works Site and Surrounding Areas

(b) Outfall

(c) Receiving Waters

2.0 DISPOSAL WORKS SITE

2.1 The proposed site is at Garryduff adjacent to the Midleton by-pass road.

2.2 The site is presently used as farmland and the by-pass road forms a natural barrier which cuts off the site from the urban area.

2.3 Visual, odour, noise, ecological and archeological impacts on the site and the land surrounding it are dealt with later in this report, and it can generally be stated the location of the plant at Garryduff will have little impact on it's immediate environment.

3.0 OUTFALL

3.1 It is proposed to use the existing outfall at Rathcoursey to discharge the treated effluent from the new plant. This can only have a beneficial effect on the area immediately surrounding the outfall pipe.

4.0 RECEIVING WATERS

4.1 Before discussing the receiving waters, it is necessary to consider a number of standards, both European and Irish, which relate to the quality of the water into which the sewage for Midleton is discharged.

4.2 These standards deal with shellfish waters, salmonid waters and bathing waters.

5.0 SHELLFISH STANDARDS

5.1 The Council of the European Communities has adopted a number of directives in relation to shellfish waters.

5.2 Council Directive 79/923/EEC on the quality required of shellfish waters sets out the acceptable standards in the Annex to this directive for guideline and mandatory values for various parameters.

5.3 The parameter relating to bacterial contamination is the faecal coliform count per 100 ml. and the guideline set limit for shellfish flesh and intervalvular liquid is 300 faecal coliform/100 ml. It is interesting to note that there is no mandatory set value for faecal coliform in the directive.

5.4 Legislation to implement the E.C. Directive of 1979 was not enacted by the Irish Government.

5.5 In 1992, the Council of the European Communities adopted Directive 91/492/EEC laying down the health conditions for the production and the placement on the market of live bivalve molluscs. This Directive respects the former E.C. Directive 79/923/EEC but supersedes the faecal coliform set limit and proposes new requirements for faecal coliform levels in shellfish flesh taken from production areas. These new requirements for faecal coliform in live bivalve mollusc flesh are set out in Table 1 below.

Table 1: Requirements for Live Bivalve Molluscs in Accordance with E.C. Directive 91/492/EEC in relation to Faecal Coliform in Shellfish Flesh.

	f.c./100 gr. of Flesh	Compliance of Samples	Further Treatment
Immediate Human Consumption	<300	100% < 300	Not Required
Human Consumption After Treatment	300 - 6,000	90% < 6,000	Purification after Relaying
Human Consumption After Treatment	6,000 - 60,000	100% < 60,000	Relaying for Long Period, Intensive Purification

5.6 Before consumption, treated molluscs must have faecal coliform levels in flesh less than 300/100 grams.

5.7 In Chapter 1 of the Annex to E.C. Directive 91/492/EEC, production areas for shellfish are categorised as follows:-

a) Molluscs can be collected for direct human consumption if the faecal coliform level is less than 300/100 grams of flesh.

b) Bivalve molluscs can be collected and placed on the market for human consumption after treatment in a purification centre, after relaying, provided that the faecal coliform level is less than 6,000/100 grams of flesh in 90% of samples taken. After purification, all the requirements set out in (a) above must be met.

c) If faecal coliform counts exceed 6,000/100 grams, then bivalve molluscs can be collected and placed on the market only after relaying over a long period (at least two months) or after intensive purification so as to meet the requirements under (a) above. Live bivalve molluscs from these areas must not exceed a faecal coliform count of 60,000/100 grams of mollusc flesh before purification.

6.0 SHELLSAN CLASSIFICATION SYSTEM

6.1 E.C. Directive 79/923/EEC and E.C. Directive 91/492/EEC both refer to faecal coliform concentrations in the shellfish flesh or intervalvular liquid of the mollusc. The Department of the Marine have adopted the Shellsan Classification System and this relates directly to the faecal coliform concentration in the coastal waters in which the shellfish live. The Department of the Marine Shellsan Category Classification is set out below in Table 2. This system classifies shellfish water into three categories as follows:-

Approved, i.e.	no further purification necessary.
Conditional, i.e.	purification necessary by relaying in uncontaminated sea water.
Restricted, i.e.	pressure cooking essential.

Table 2: Shellsan Category Limits.

Geometric Mean of Faecal Coliform/100 m. of Water		Compliance f.c./100 ml.	Classification
< 14	and	$90\% < 46$	Approved
$> 14 < 140$	and	$90\% < 460$	Conditional
> 140	or more than	$10\% > 460$	Restricted

NOTE: It should be noted that, whereas the Shellsan Classification is a standard adopted by the Department of the Marine, it is not a mandatory standard.

7.0 SALMONID WATERS

7.1 78/659/EEC and SI 293/1988 set out the standards applicable to salmonid waters, some of the relevant standards for which are as follows:-

Parameter	Unit of Measurement	Standard
D.O.	mg./lt. O_2	$50\% \geq 9$
pH		6 to 9
Suspended Solids	mg./lt.	≤ 25
BOD	mg./lt.	≤ 5
Nitrites	mg./lt. NO_2	≤ 0.05
Non-Ionized Amonia	mg./lt. NH_3	≤ 0.02
Total Amonium	mg./lt. NH_4	≤ 1

8.0 BATHING WATERS

8.1 The Council for the European Communities has adopted E.C. Directive 76/160/EEC concerning the quality of bathing water. Statutory Instrument S.I. No. 84 of 1988 gave effect to Council Directive 76/160/EEC and is entitled "European Communities (Quality of Bathing Water/Regulations) 1988.

8.2 The E.C. Directive sets out sixteen parameters by which bathing water must be characterised. The micro-biological parameters set limits for total coliform, faecal coliform, faecal streptococci, salmonella and enteroviruses. The guideline and mandatory values for total coliforms are 500 and 10,000/100 ml. respectively. The guideline and mandatory values for faecal coliform are 100 and 2,000 faecal coliform/100 ml. respectively. The minimum sampling frequency for these coliform bacteria is fortnightly.

8.3 The E.C. Directive mandatory and guideline values apply only to waters which have been designated by National Government. The regulations of 1988 (S.I. No. 84 of 1988) designated bathing areas in the first schedule of this document. In the second schedule, the set limits for parameters are given and the most relevant of these are:-

a)	Total Coliform	5,000/100 ml. (80% compliance)
b)	Faecal Coliform	1,000/100 ml. (80% compliance)
c)	Faecal Streptococci	300/100 ml. (95% compliance)
d)	Salmonella	0/lit.
e)	Enteroviruses	0 PFU/10 lit.
f)	pH	6 to 9
g)	Dissolved Oxygen	$\geq$ 70% $\leq$ 120% of saturation

9.0 BLUE FLAG STANDARDS FOR BEACHES

9.1 The European Blue Flag for Beaches is awarded annually and is only valid for one year. Blue Flag beaches must conform, during the previous bathing season (mid-May to end-August), with at least 80% of results within guideline limits and at least 95% within E.C. mandatory levels. To be eligible for the Blue Flag, a bathing beach has to fulfil all mandatory requirements and, in addition, to fulfil a number of guideline criteria (G).

9.2 In relation to water quality, the following criteria are set out:-

1. Compliance with the E.C. Bathing Water Directive and regional or national legislation governing water quality of beach and any inflows.

2. At least fortnightly sampling results of total coliform and faecal coliform for the previous year bathing season with at least 80% of results falling within E.C. Bathing Water Directive guideline values (G) and 95% of results falling within E.C. Bathing Water Directive imperative values (I).

3. No industrial or sewage discharge affecting the beach/ bathing area.

4. Local and regional emergency plans to cope with pollution accidents.

9.3 The quality of bathing water is governed by E.C. Directives and National Regulations. Beaches, which are required to comply with Blue Flag standards, are assessed on an annual basis, based on water quality sampling for the previous year, as well as compliance with additional standards relating to inter-tidal sediment, education and information, beach area management and safety.

9.4 The requirements relating to bathing water standards in respect of E.C. Directives, national limit values and Blue Flag standards for bacterial counts are set out below in tabular form.

Irish Bathing Water Standards (1992)

Parameter	Unit	E.C. Directive* 76/160/EEC	National Limit Values	"Blue Flag" Standards
Total Coliform	/100 ml.	10,000 (I) 500 (G)	<5,000	500
Faecal Coliform	/100 ml.	2,000 (I) 100 (G)	<1,000	100
Salmonella	/1 lit.	0 (G)	0	0
Enteroviruses	PFU/10 lit.	0 (I)	0	0
Faecal Streptococci	/100 ml.	100 (I)	< 300	100

*(I) E.C. Mandatory Limits.
(G) E.C. Guideline Values.

10.0 GENERAL COMMENT

10.1 The waters of the North Channel, East Passage and Owenacurra Estuary are not recognised bathing waters. Nevertheless, it is important that the receiving waters should be compared to the standards set out above. Similarly, although the Owenacurra and Dungourney Rivers are not designated salmonid rivers, in accordance with the First Schedule of SI 293, 1988, Natural Environment Consultants, in their report on the existing environment, refer to runs of sea trout, grilse and salmon and these should also be protected as much as possible. The main marine life activity in the area is the harvesting of oysters in the North Channel. In the last number of years, there has been much controversy about the quality of the waters in the North Channel with respect to bacterial counts, in particular, faecal coliform counts and the following discussion concentrates on this particular parameter to set the current background levels against which the effluent from the propose treatment plant is to be discharged.

11.0 MONITORING OF RECEIVING WATERS

11.1 When sanction was given to construct Midleton Sewerage Scheme as it now exists, with its discharge of comminuted sewage at Rathcoursey Point, it was decided to monitor the receiving waters before and after the discharge was constructed in order to ascertain its effects, if any, on the marine life.

11.2 Sampling began in September, 1985 by the Department of the Marine and in October, 1986 by An Foras Forbartha, the sampling of the latter body being taken over by the E.R.U. in September, 1988 and now by the Environmental Protection Agency (EPA).

11.3 The samples have been analysed and the results documented and statistically analysed by the E.P.A.

11.4 Sampling was carried out at twelve stations, the locations of which are shown on plan at the end of this section.

11.5 The work done by the E.P.A. was the more comprehensive, the sampling regime for which was as follows:-

a) Sampling was carried out at the twelve locations on one day for each month of the year.

b) At Stations 8, 9 and 10 (over the oyster beds), 6 no. to 14 no. samples per station were taken on each run.

c) Sampling Point 11 was the sampling of oyster flesh generally taken from the beds owned by Atlantic Shellfish Ltd. and this generally comprised randomly selected samples of 36 oysters each month.

d) At all other stations, only 2 no. samples/month were taken.

e) Samples of the sewage from Midleton were also taken from the holding tank at Rathcoursey.

11.6 In their Annual Report, submitted in March, 1996, the E.P.A. compared the condition of the waters at the sampling points most relevant to the harvesting of oysters over the years from September, 1985 to April, 1995 in Table 2 which is reproduced at the end of this section.

11.7 The period from September through to April was chosen for two reasons:-

1. That is the traditional period when native oysters are marketed for human consumption.

2. That is the time of the year which has the shortest periods of sunlight (and hence least bacterial mortality due to ultra violet rays).

11.8 Before going into any comment on the results, it is worth putting them into context in respect of the various standards already mentioned.

11.9 The most stringent is the Blue Flag Standard of 100 fc./100 ml. Examination of the column (in Table 2) showing the median counts for each station shows that the median value:-

i) Exceeded the limit in 1986/1987.

ii Fell below the limit at four stations in 1987/1988.

iii) Exceeded the limit in 1988/1989.

iv) Fell below the limit in one station in 1989/1990.

v) Fell below the limit at four stations in 1992/1993.

vi) Exceeded the limit at all stations in the intervening years.

11.10 However, both the national limit value of 1,000/100 ml. and the E.E.C. mandatory level of 2,000/100 ml. were not exceeded by the median value at any station in any year.

11.11 The E.E.C. Directives on shellfish do not set standards for the waters in which the shellfish are harvested, but the Shellsan Classification System used by the Department of the Marine does and, although this is not a legally binding standard, nevertheless it is interesting to note how these waters have complied with the standard since samples were first taken in 1985/1986. Table 3 of the E.P.A. Report shows a variation in the geometric mean of the samples taken over the oyster beds from 1986 to 1994, from a low of 25 in 1987 to a high of 205 in 1991 for samples taken by the Department of the Marine and Table 4 of the same Report shows a variation from a low of 16 in 1988 to a high of 347 in 1991 for samples taken by the Department of the Marine and the E.P.A. between March and November in the years 1988 to 1995. (Tables 2,3 and 4 are reproduced at the end of this section.)

11.12 It should be noted that the vast majority of the samples were taken at the surface of the waters rather than at depths which would have been more indicative of the environment in which the oysters live.

11.13 For instance, in 1991, at the three stations over the oyster beds, out of a total of 422 samples taken, only 15 were taken at depths varying from 1 m. to 8 m., the remainder were surface samples and, since then, all samples were surface samples.

11.14 Although 15 is too small a number from which to draw statistical conclusions, nevertheless, it is worth examining these results and comparing them to their corresponding surface samples.

11.15 The samples at depth were taken at each of three stations and the results are as follows. (Depths at which samples were taken are shown in parenthesis):-

	July		August	Sept.	Dec.
	fc/100 ml	fc/100 ml	fc/100 ml	fc/100 ml	fc/100 ml
Station 8					
Sample at Depth	0 (6 m.)	0 (6.5 m.)	5 (8 m.)	175 (6 m.)	0 (5.5 m.)
Corresponding Surface Sample	30	195	5,400	260	100
Station 9					
Sample at Depth	0 (4.4 m.)	5 (2.8 m.)	45 (4 m.)	0 (4.5 m.)	0
Corresponding Surface Sample	45	20	20	30	15
Station 10					
Sample at Depth	20 (1 m.)	25 (3.5 m.)	0 (2 m.)	0 (3 m.)	140 (4 m.)
Corresponding Surface Sample	35	35	30	15	10

These results can be further compared in the following table:-

	No. of Samples	Median fc/100ml.	Geometric Mean fc/100ml.	Arithmetic Mean fc/100ml.
Samples Taken at Depth	15	0	5	28
Total Samples at stations 8,9,10, for July, August, September, December	151	50	43	198
Total Samples for Year (Station 8)	140	208	135	383
Total Samples for Year (Station 10)	140	90	69	210

11.16 From the very limited data available, it would appear that the waters at the depths at which the oysters feed have much lower counts of faecal coliforms than the overlying surface waters. (There are two exceptions to this).

11.17 Considering again the results of the analysis of the samples taken from the North Channel, Table A below has been produced from Table 2 of the E.P.A. Report. The median values which fluctuate from year to year can be generally classified as follows:-

1986/1987	Below Average
1987/1988	Low
1988/1989	Above Average
1989/1990	Below Averagé
1990/1991	High
1991/1992	High
1992/1993	Low

Table A: Median Values of Faecal Coliforms/100 ml. Taken from E.P.A. Results.

Location	'86-'87	'87-'88	'88-'89	'89-'90	'90-'91	'91-'92	'92-'93	Arith. Av. of Medians
Station 6	144	115	284	166	440	320	88	222
Station 8	158	48	184	168	270	260	100	170
Station 9	186	83	190	104	250	170	90	153
Station 10	116	80	190	96	238	183	40	135
Station 12	144	63	400	168	293	445	240	250

11.18 Based on data from the same report, Table B was produced as shown below. This gives an indication of the range of the results, the maximum values of which vary greatly from year to year with no particular pattern.

Table B: Maximum Values of Faecal Coliforms/100 ml. Taken from E.P.A. Results.

Year	'86-'87	'87-'88	'88-'89	'89-'90	'90-'91	'91-'92	'92-'93
Station 6	6,120	550	4,490	2,880	970	2,025	2,000
Station 8	1,400	1,008	6,750	2,952	1,100	5,400	780
Station 9	900	575	7,380	2,448	820	770	610
Station 10	650	409	6,120	1,800	2,437	1,020	820
Station 12	646	204	1,825	2,952	7,365	3,000	1,260

11.19 The Hydrographic Survey and Numerical Modelling, carried out by Irish Hydrodata as part of this EIS shows pictorially, in the coloured charts at the back of their Report, the effect of a sewage outfall at Rathcoursey Point on the waters of the North Channel. These show the greatest effect to be at high water for a spring tide and, to a lesser extent, high water on a neap tide at which times the bacterial count could be similar at Rathcoursey and over the oyster beds. At all other stages of the tides, the charts show a marked decrease in the coliform counts from Rathcoursey westwards.

11.20 However, the above tables for the years 1990/1991 and 1991/1992 indicate a high bacterial count at all stages of the tides as only approximately 12.5% of the samples were taken at the various stations within one hour of high water.

11.21 This prompted an examination of the data for these years which might indicate other sources of contamination.

11.22 As part of the sampling regime, two samples were taken per day at Belvelly Bridge on the extreme western end of the North Channel. The following table shows the results of these samples for the years 1991 and 1992 and compares them to the samples taken at Rathcoursey Point on the same days.

Table C: Median Values of Faecal Coliforms/100 ml. for Rathcoursey Point and Belvelly Bridge in 1991 and 1992.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Rathcoursey 1991	463	970	644		60	78	193	301	442	1,300	350	60
Belvelly 1991	6,375	3,750	12,229	17,100	770	1,058	1,375	455	195	742	1,640	4,005
Rathcoursey 1992	203	291	243	45	105	30	180	98	115	50	210	1,250
Belvelly 1992	3,153	610	2,945	438	400	760	608	1,350	2,950	1,545	2,300	7,550

11.23 This table shows that on only two occasions in the 24 months did the faecal coliform count at Rathcoursey exceed that of Belvelly, i.e, September and October, 1991. In most other cases, the counts at Belvelly greatly exceed those for Rathcoursey.

11.24 It is worth noting that on 21st March, 1991, the highest level of faecal coliform was recorded at Belvelly Bridge at 21,807/100 ml. On the same day, the highest level recorded at Rathcoursey Point was 765. On that same day, the levels of faecal contamination in oyster flesh were recorded at 83.3, 119.3 and 131.3 which were the highest recorded over the two years, 1991 and 1992 (median for the year 1991 was 17 per gram).

11.25 In contrast to the above, on 24th April, 1991, a high level of 20,500/ 100 ml. was recorded at Belvelly Bridge. No sample was taken at Rathcoursey and the three samples taken from the oyster flesh showed faecal coliform counts of 0, 0.7 and 1.3 per gram.

11.26 In 1992, the highest level recorded at Belvelly was 14,000/100 ml. in December, on which day the figure for Rathcoursey Point was also high at 2,000/100 ml. The levels recorded in the oyster flesh for the same day were 68.7, 7.3 and 23.3 respectively (median for year = 11 per gram).

11.27 Samples taken at the by-pass bridge at the top of the Owenacurra Estuary also show high levels of faecal contamination, 1,000,000/100 ml. in August, 1991 and 18,000/100 ml. in January, 1992. The counts occur despite the fact that discharge of domestic effluent has been eliminated from the river.

11.28 The outfall from the Meadow Meats Treatment Plant is located in the Owenacurra Estuary opposite Green Point. Samples taken by Irish Hydrodata, in the course of their survey of the water over this outfall, showed faecal coliform counts in the four samples taken of 2,400, 46,000, 2,400 and 4,600/100 ml.

11.29 It is likely that all of these potential pollution sources, as well as rainwater run-off from farmland, contribute to the coliform counts in the samples gathered by the Department of the Marine and the E.P.A. in the past number of years.

11.30 In May, 1992, the discharge regime from the Midleton holding tank was altered to discharge on an outgoing tide only. The figures in Table 2 for 1992/1993 would at first glance seem to indicate a major improvement as a result of this as the median figures for that period are the lowest of the seven periods monitored by the E.P.A.

11.31 Furthermore, based on the samples taken in 1992 before May and after May, there is a definite decrease in the counts after May when the discharge regime was altered.

11.32 However, the results for December, 1992 are a contradiction to the above as can be seen from the following:-

	Geometric Mean for Year	Geometric Mean for December
Rathcoursey Point	106	1,000
Station 8	72	187
Station 9	77	259
Station 10	48	323
Station 12	189	343
Belvelly Bridge	1,081	3,924

11.33 The figures for December, 1992 are more like those for the period September, 1990 to April, 1991 which was a period of high faecal coliform counts, rather than the latter half of 1992 which generally had low coliform counts.

There are two interesting observations which could be made on this:-

a) In December, 1992, the faecal coliform counts appear to increase from east to west in the North Channel as one moves further away from Rathcoursey Point.

b) The samples taken from the sewage before discharge at Rathcoursey show less than average coliform counts in samples taken both by E.P.A. and Cork County Council, in spite of the relatively high counts in the receiving waters.

11.34 A further point worthy of note is that the improvement in the waters around the oyster beds (as suggested by the 1992 figures) is not reflected in a corresponding improvement in the oyster flesh, as can be seen from the following table of highest values recorded at Rathcoursey, Belvelly, the flesh of the oysters and the holding tank at Rathcoursey.

<u>Table D:</u> Highest Values Recorded Each Month for 1991 and 1992.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Rathcoursey '91	490	970	765		80	80	210	500	508	2,025	376	60
Belvelly '91	9,000	3,750	21,807	20,500	1,450	1,700	2,200	360	275	3,235	1,880	4,005
Oyster Flesh* '91	12	60.7	131.3	1.3	33.3	24	28.7	20.7	0	3.87	3.47	22
Holding Tank '91	570 $\times10^6$	30 $\times10^6$	16 $\times10^6$	20 $\times10^6$	14 $\times10^6$	42 $\times10^6$	110 $\times10^6$	150 $\times10^6$	52 $\times10^6$	282 $\times10^6$	130 $\times10^6$	2 $\times10^6$
Rathcoursey '92	240	328	320	80	170	60	330	125	160	60	325	2,000
Belvelly '92	5,400	720	3,090	650	500	1,500	915	1,800	3,600	1,750	2,950	14,000
Oyster Flesh* '92	12	43.3	49.3	81.3	7.3	1.3	11.3	12	52.7	10	21.3	68.7
Holding Tank '92	94 $\times10^6$	5 $\times10^6$	29 $\times10^6$	6 $\times10^6$	8.5 $\times10^6$	5.6 $\times10^6$	46 $\times10^6$	15 $\times10^6$	19 $\times10^6$	1 $\times10^6$	3 $\times10^6$	5 $\times10^6$
Holding Tank '92 (Cork Co. Council)		2.5 $\times10^6$	0.5 $\times10^6$	1.3 $\times10^6$	1.5 $\times10^6$	3.95 $\times10^6$	16 $\times10^6$	3.4 $\times10^6$	4 $\times10^6$	1.7 $\times10^6$	0.16 $\times10^6$	0.41 $\times10^6$

*Faecal coliforms per gram of oyster flesh.

11.35 There does not seem to be any definite pattern to the results at the various stations. It can be said, however, that the highest contamination of oyster flesh in 1991 coincides with the highest recorded faecal coliform level at Belvelly and the lowest recorded contamination in oyster flesh in 1991 coincided with the lowest faecal coliform count at Belvelly. On both of these occasions, the counts at Rathcoursey were slightly higher than the median. By comparison, in 1992, the highest recorded count in oyster flesh was 81.3 in April, when the figures for both Belvelly and Rathcoursey were relatively low and the lowest count for oyster flesh coincided with the lowest count for Rathcoursey and a count at Belvelly slightly below the median. The second highest faecal coliform count in oyster flesh in 1992 at 68.7 in December coincided with an extremely high count at Belvelly and a very high count at Rathcoursey.

11.36 In general, there does not seem to be sufficient data to draw definite conclusions as to the causes for the coliform counts both in the waters surrounding the oyster beds and in the oyster flesh itself, nor is it sufficiently shown that the discharge of sewage on an ebb tide only has a largely beneficial effect. Indeed, Irish Hydrodata in their Report state that the tidal release does not alter the bacterial concentrations at the sampling locations to any significant extent, which mirrors the conclusion to the Harbour Pollution Report of 1977.

12.0 PRESENT PROPOSAL

12.1 With due regard to all the above, it is difficult to assess the impact of the present proposal for the treatment of Midleton sewage on the receiving waters. It is predicted by the designers that a 99% die-off in faecal coliforms will occur through the treatment plant. This can only have a positive effect on the waters of the North Channel, but to what extent remains to be seen.

12.2 The capacity of the receiving waters to accept the treated effluent from the proposed Midleton Sewage Treatment Plant is dealt with in more detail in the next section.

Scale 1:6336(

Fig 1. Outline map of Cork Harbo(
showing general features
numbered sampling locatio(
(see text).

TABLE 2

Results of sampling carried out by the Department of the Marine and An Foras Forbartha/Environmental Rese
Unit/Environmental Protection Agency during the period September to April at locations in the North Channel area of (
Harbour (see Fig. 1). Values exceeding conditional category requirements of Shellsan scheme are underlined.

DEPARTMENT OF THE MARINE | AN FORAS FORBARTHA/ENVIRONMENTAL RESEARCH UNIT

September 1985 - April 1986

Department of the Marine

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	29	5-2900	190	34.5
10	28	6-800	135	7.1
12	29	10-630	110	6.9

An Foras Forbartha/Environmental Research Unit

No data

September 1986 - April 1987

Department of the Marine

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	15	30-1200	160	26.7
10	13	0-900	82	7.7
12	16	13-220	98	0

An Foras Forbartha/Environmental Research Unit

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	9	62-6120	144	22.2
8	71	6-1400	158	1.4
9	85	2-900	186	4.7
10	70	18-650	116	4.3
12	9	10-646	144	22.2

September 1987 - April 1988

Department of the Marine

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	17	14-900	71	5.9
8	14	1-1000	88	14.3
10	16	0-1000	73	12.5
12	17	11-900	115	11.8

An Foras Forbartha/Environmental Research Unit

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	4*	106-550	115	25.0
8	26*	0-1008	48	3.8
9	26*	6-575	83	7.7
10	24*	6-409	80	0
12	4*	0-204	63	0

*Data only for March and April 1988.

September 1988 - April 1989

Department of the Marine

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	23	25-1600	260	30.4
8	10*	20-500	93	1.0
10	25	35-200	210	4.0
12	26	10-1300	192	11.5

*Data only for February-April 1989 period.

An Foras Forbartha/Environmental Research Unit

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	16	20-4490	284	43.8
8	100	0-6750	184	18.0
9	102	0-7380	190	18.6
10	103	0-6120	190	20.4
12	16	10-1825	400	43.8

continued over

TABLE 2 (Continued)

Results of sampling carried out by the Department of the Marine and An Foras Forbartha/Environmental Resea Unit/Environmental Protection Agency during the period September to April at locations in the North Channel area of C Harbour (see Fig. 1). Values exceeding conditional category requirements of Shellsan scheme are underlined.

DEPARTMENT OF THE MARINE

ENVIRONMENTAL RESEARCH UNIT/ENVIRONMENTAL PROTECTION AGE

September 1989 - April 1990

Department of the Marine

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	24	24-1030	160	16.7
8	21	40-1285	96	19.0
10	22	24-1400	110	22.7
12	24	16-696	126	12.5

Environmental Research Unit/Environmental Protection Agency

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	6*	144-2880	166	16.7
8	36*	16-2952	168	25.0
9	91	0-2448	104	8.8
10	91	4-1800	96	7.7
12	7*	16-2952	168	28.6

*Data only for October-December 1989.

September 1990 - April 1991

Department of the Marine

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	21	60-960	220	14.3
8	20	8-1125	213	25.0
10	19	30-650	180	10.5
12	20	35-810	175	15.0

Environmental Research Unit/Environmental Protection Agency

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	13	8-970	440	46.2
8	90	0-1100	270	15.6
9	91	0-820	250	17.6
10	90	0-2437	238	26.7
12	14	20-1365	293	28.6

September 1991 - April 1992

Department of the Marine

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	22	0-2000	220	22.7
8	22	40-1420	298	27.3
10	19	0-650	155	15.8
12	23	0-1400	180	17.4

Environmental Research Unit/Environmental Protection Agency

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	15	10-2025	320	20.0
8	95	0-5400	260	22.1
9	96	0-770	170	12.5
10	96	0-1020	183	13.5
12	15	55-3000	445	46.7

September 1992 - April 1993

Department of the Marine

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	15	0-300	60	0
8	15	0-640	62	13.3
10	12	9-360	56	0
12	16	7-460	62	0

Environmental Research Unit/Environmental Protection Agency

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	16	0-2000	88	25.0
8	96	0-780	100	6.3
9	96	0-610	90	3.1
10	96	0-820	40	7.3
12	16	10-1260	240	18.8

continued over

TABLE 2 (Continued)

Results of sampling carried out by the Department of the Marine and the Environmental Protection Agency during the pe
September to April at locations in the North Channel area of Cork Harbour (see Fig. 1). Values exceeding condit
category requirements of Shellsan scheme are underlined.

DEPARTMENT OF THE MARINE — ENVIRONMENTAL PROTECTION AGENCY

September 1993 - April 1994

Department of the Marine

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	7	20-520	48	14.3
8	6	18-410	109	0
10	3	56-650	348	33.3
12	6	21-1720	140	33.3

Environmental Protection Agency

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	16	30-10000	245	37.5
8	96	0-10000	250	31.3
9	96	10-3000	220	31.3
10	96	0-10000	200	32.3
12	16	10-4000	540	50.0

September 1994 - April 1995

Department of the Marine

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
Data not available				

Environmental Protection Agency

Station	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	% greater than 460
6	16	10-2000	320	12.5
8	96	0-10000	230	24.0
9	96	0-1200	185	25.0
10	96	0-1500	173	26.0
12	16	70-860	550	56.3

TABLE 3

Results of sampling carried out by the Department of the Marine at four locations in the years 1986-1994. Values exceed conditional category requirements of Shellsan scheme are underlined.

Location	Year	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	Geometric Mean	Arithmetic Mean	% greater than 460
Station 6 (Off Rathcoursey Point)	1986	40	0-1200	94	93	245	17.5
	1987	21	14-500	94	97	149	4.8
	1988	25	6-2100	210	165	381	24.0
	1989	42	4-1600	104	85	171	7.1
	1990	40	30-1030	178	178	266	20.0
	1991	26	0-2000	220	165	347	23.1
	1992	28	8-850	65	74	136	3.6
	1993	17***	0-300	48	37	69	0
	1994	10*****	22-520	84	87	137	10.0
Station 8 (East end of oyster beds)	1986	-	-	-	-	-	-
	1987	9*	1-104	32	25	44	0
	1988	11**	0-1000	147	52	246	18.2
	1989	33	0-500	60	41	91	3.0
	1990	39	0-1285	180	150	268	20.5
	1991	25	4-1420	230	205	392	36.0
	1992	28	0-620	77	66	139	3.6
	1993	17***	0-640	34	35	112	11.8
	1994	8*****	0-410	100	85	133	0
Station 10 (West end of oyster beds)	1986	37	0-316	58	54	82	0
	1987	22	0-900	65	50	123	4.5
	1988	25	0-1000	190	102	219	8.0
	1989	41	0-2000	60	48	130	2.0
	1990	38	0-1400	140	98	220	15.8
	1991	25	0-650	120	87	229	20.0
	1992	24	0-610	59	43	106	4.2
	1993	14****	3-360	50	32	81	0
	1994	7*****	20-650	130	117	215	14.2
Station 12 (Marloag Point)	1986	40	0-300	74	60	95	0
	1987	21	11-220	50	63	93	0
	1988	26	2-900	182	115	206	7.7
	1989	42	2-1300	91	66	154	7.1
	1990	40	4-708	125	114	194	10.0
	1991	26	0-1400	195	157	332	23.1
	1992	29	0-705	75	60	126	3.4
	1993	18***	7-460	55	49	87	0
	1994	10*****	21-1720	114	121	311	20.0

* Data available for May-November period only. ** Data available for January-May period only.
*** No data available for November and December. **** No data available for January, September, November and December.
*****No data available for February, May, October and December.

TABLE 4

Results of sampling carried out by the Department of the Marine and the Environmental Research Unit/Environmental Protection Agency at five locations in the March-November period 1988-1995. Values exceeding conditional category requirements of Shellsan scheme are underlined.

Location	Agency	Year	Number of Samples	Faecal coliforms per 100 ml water: Range	Median	Geometric Mean	Arithmetic Mean	% greater than 4
Station 6 (Off Rathcoursey Point)	DCM	1988	20	6-2100	150	144	383	25.0
		1989	32	4-790	65	61	112	3.1
		1990	31	32-960	40	161	229	12.9
		1991	16	9-2000	127	176	393	25.0
		1992	20	8-850	55	56	120	5.0
		1993	13	8-300	48	46	77	0
		1994	9****	28-520	88	102	150	11.1
	ERU/EPA	1988	18	2-4490	172	188	673	33.3
		1989	16	0-600	112	55	155	12.5
		1990	10*	8-572	236	196	286	20.0
		1991	16	40-2025	349	258	421	37.5
		1992	18	0-330	75	70	119	0
		1993	18	0-10000	70	96	1072	16.7
		1994	18	30-400	105	104	151	0
		1995	18	10-1500	80	79	217	16.7
Station 8 (East end of oyster beds)	DCM	1988	7**	0-280	33	16	81	0
		1989	29	0-500	45	35	84	3.4
		1990	30	0-788	132	118	207	13.3
		1991	15	4-1420	120	162	424	33.3
		1992	20	0-620	54	44	110	5.0
		1993	13	4-640	31	38	118	15.4
		1994	7****	18-410	60	77	127	0
	ERU/EPA	1988	102	0-6750	126	100	412	16.7
		1989	100	0-130	32	38	101	2.0
		1990	60*	0-990	217	157	235	6.7
		1991	110	0-5400	183	131	413	21.8
		1992	108	0-800	60	49	128	7.4
		1993	108	0-50000	48	53	805	13.0
		1994	108	0-10000	80	64	252	9.3
		1995	107	0-610	30	32	114	8.4
Station 10 (West end of oyster beds)	DCM	1988	21	0-370	143	77	158	0
		1989	32	0-240	40	31	59	0
		1990	28	4-524	96	81	145	3.6
		1991	16	2-650	110	77	227	18.8
		1992	16	0-610	27	25	95	6.3
		1993	12	3-360	42	25	71	0
		1994	6****	20-650	112	97	193	16.7
	ERU/EPA	1988	100	1-6120	118	114	486	18.0
		1989	100	0-850	20	16	68	3.0
		1990	156	0-2437	34	33	154	7.1
		1991	111	0-1020	45	50	177	15.3
		1992	108	0-725	35	27	71	0.9
		1993	108	0-2000	48	44	176	16.7
		1994	108	0-1500	35	25	124	10.2
		1995	108	0-1500	30	23	106	5.6
Station 12 (Marloag Point)	DCM	1988	21	2-500	112	90	160	4.8
		1989	32	2-472	54	44	92	3.1
		1990	31	4-708	101	87	143	3.2
		1991	16	0-1400	205	123	355	25.0
		1992	21	0-705	47	42	102	4.8
		1993	14	7-260	51	40	63	0
		1994	9****	21-650	68	90	154	11.1
	ERU/EPA	1988	16	0-1825	106	77	271	18.8
		1989	16	0-680	58	72	127	6.3
		1990	8*	20-480	176	138	193	12.5
		1991	16	10-3000	408	347	770	43.8
		1992	18	10-750	165	141	244	22.2
		1993	18	10-720	220	149	277	22.2
		1994	18	0-1100	305	172	347	27.8
		1995	18	0-1800	115	85	281	16.7
Station 13 (Rostellan Bay)	DCM	1988	12***	10-850	214	118	236	16.7
		1989	32	0-452	25	21	74	0
		1990	30	0-600	104	75	153	6.7
		1991	17	0-12700	132	134	1070	29.0
		1992	19	15-1600	51	68	181	10.5
		1993	14	6-900	57	70	152	7.1
		1994	9****	0-270	40	37	84	0
	ERU/EPA	1988	16	2-2160	61	57	340	25.0
		1989	16	0-520	22	17	94	12.5
		1990	8*	0-300	98	50	120	0
		1991	16	0-2135	25	42	293	18.8
		1992	18	0-1530	38	23	171	11.1
		1993	18	0-650	40	39	111	5.6
		1994	18	0-3000	60	64	313	11.1
		1995	18	0-840	35	19	151	16.7

*Data available for August-December period only.**Data available for March-May period only.
Data available for June-November period only.*Data available for April-September period only.

SECTION 6

ASSIMILATION AND DISPERSION CHARACTERISTICS OF NORTH CHANNEL

Document Reference: 702/93

MIDLETON SEWERAGE SCHEME

MARINE OUTFALL

HYDROGRAPHIC SURVEY / NUMERICAL MODELLING REPORT

Prepared for:-

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Co. Cork.

and

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November 1993

CONTENTS

LIST OF FIGURES

* Included in main report, all others are to be found in the Technical Appendices.

1. INTRODUCTION

1.1 BACKGROUND TO THE STUDY

1.1.1 During recent years work has been progressing on uprating and refurbishing the drainage system in Midleton. This work has been conducted under the auspices of the Midleton Sewerage Scheme prepared for Midleton Urban District Council and Cork County Council by their Consulting Engineers, M.C. O' Sullivan & Co. Ltd. The sewage disposal installation is presently a pumped system discharging comminuted effluent to Cork Harbour via an outfall located some 5km from the town at Rathcoursey Point on the East Passage.

1.1.2 In the future it is envisaged that a treatment works will be built in or adjacent to Midleton. The proposed works will provide for secondary treatment of sewage in accordance with the E.C. Directive 91/271/EEC. The Consulting Engineers are currently preparing an environmental impact assessment of the scheme.

1.2 STUDY BRIEF

1.2.1 This marine survey was commissioned to assist with the planning of the treatment works and siting of the associated outfall. The inner areas of Cork Harbour including the North Channel presently support extensive shellfish producing facilities and a primary concern was to safeguard the future environmental quality of the receiving water.

1.2.2 The main objectives of the study as defined by M.C. O' Sullivan & Co. Ltd. were to:-

- confirm the basic dispersive characteristics of the receiving waters as recorded in previous studies by the use of dye tests;

- to assess the likely fate of treated municipal effluent discharged from potential outfall sites using predictive numerical models.

1.2.3 The preliminary assessments of available data by the Engineer had led to the selection of three possible marine outfall locations. One was the existing outfall to the deeper waters off Rathcoursey Point, while the other two are proposed new outfalls positioned in the Ballinacurra River Estuary.

1.2.4 Figure 1.1 taken from a portion of an Ordnance Survey 1:63,360 map shows the outfall sites and the surrounding areas. Figure 1.2 shows the general bathymetry of the survey area.

1.3 SUMMARY OF FIELD WORKS

1.3.1 Following a full review of available data and bearing in mind the stated objectives of the study the following field works and instrument installations were undertaken at various stages during the survey period.

- deployment of recording tide and current gauges for the duration of the survey works;
- current profile measurements in the East Passage;
- continuous (12.5 hour) dye dispersion and advection experiments. One release from each of the proposed outfall points;
- discrete dye release from Rathcoursey;
- drogue tracking experiments.

1.3.2 All field works were undertaken during the period 15th September to 11th October 1993.

1.4 NOTATION

1.4.1 Throughout this report the following conventions and units are used:

- current speeds are presented in metres per second (m/s). Current directions are given in degrees relative to true north (°T) and indicate the direction to which the current is flowing.
- wind speed and direction are given in metres per second (m/s) and degrees true (°T). Note that wind direction refers to the direction from which the wind blows. (Note 1 knot = 0.51m/s).
- water depths are given in metres relative to Malin Head datum.
- times are given in hours British Summer Time.

MIDLETON SEWERAGE SCHEME OUTFALL STUDY 1993

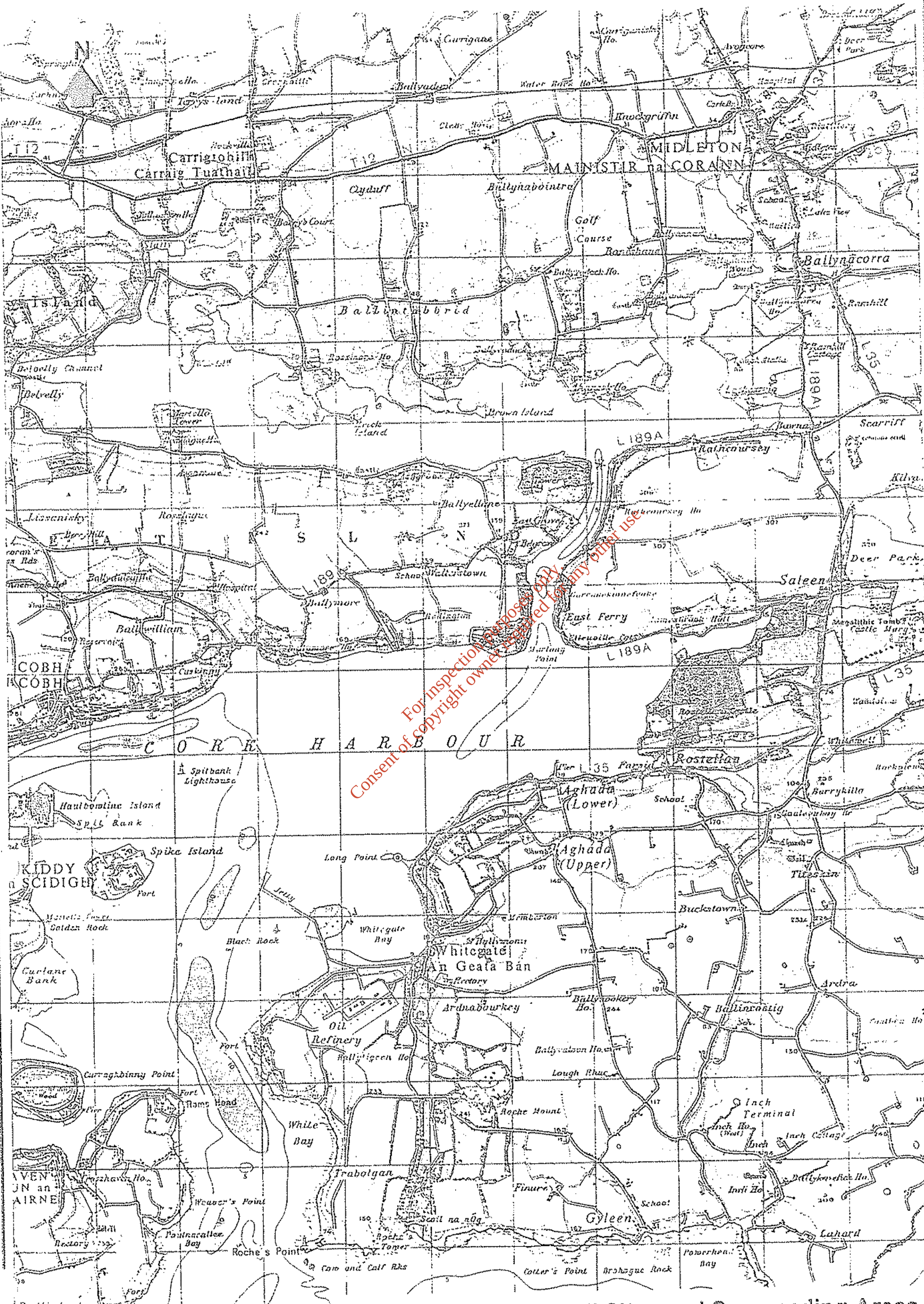

Figure 1.1 Outfall Sites and Surrounding Areas.*

MIDLETON SEWERAGE SCHEME OUTFALL STUDY 1993

Taken from
Admiralty Chart
N0. 1765

Depths in
fathoms.

Figure 1.2 Bathymetry

2. FIELD STUDIES

2.1 CURRENT AND TIDE MEASUREMENTS

2.1.1 Two recording current meters were deployed in the North Channel at the locations shown in figure 2.1, for a 17 day period. The meters were attached to U-moorings and set to record the currents at 1.3m above the seabed every ten minutes.

2.1.2 Data from the current meters are shown in figures 2.2a, 2.2b. At the site off Brown Island the flows were regular and peak flood tide speeds of 0.4m/s were reached during the large spring tides of 17th/19th Sept. Ebb tide values almost reached 0.3m/s. During average spring tides the corresponding values would be approximately 0.35m/s on the flood and 0.26m/s on the ebb. During the average neap tides of 24th/25th Sept. flood tide speeds fell to 0.2m/s and ebb values to below 0.1m/s.

2.1.3 The current meter to the north of Bagwell's Hill was deployed to record the water movements within the gyre which forms in this area. This was achieved and, as figure 2.2b shows, the flow is directed towards the east for about 9.5 hours of each tidal cycle. Only for a very short time (<2 hours) at the start of the flood does the flow adopt a westerly direction.

2.1.4 Peak current speeds within the gyre reached 0.55m/s for a short period during each tide over the spring tides of 17th/19th Sept. These were directed to the east. For much of the time the speed was in the region of 0.3m/s. For the short period of flood a peak speed of 0.2m/s was recorded. These speeds were recorded on large spring tides and could be expected to reduce by about 15% for average springs. During the neap tides of 24th/25th Sept. no particularly strong flows were evident and recorded speeds were generally in the range 0.15m/s to 0.20m/s for much of the tidal cycle.

2.1.5 Current profile measurements were made in mid-channel at the site of the existing outfall off Rathcoursey. The measurements took place over a 12.5h tidal cycle on 25th August during mean tide conditions and results, figure 2.3, compare favourably with data recorded at the one third points on the channel section recorded previously by M.C. O' Sullivan & Co. Ltd. Peak surface speeds of 0.9m/s were observed during the flood with a slightly lower value of 0.8m/s during the ebb. Nearbed speeds of 0.7m/s were recorded during both the ebb and flood. The flood tide was observed to last for approx. 6.0 hours while the ebb was slightly longer at 6.5 hours.

2.2 DROGUE TRACKING

2.2.1 A limited drogue tracking exercise was conducted to provide information for verification of the numerical model. This took the form of a drogue released on each side of the East Passage channel at Rathcoursey at approx. LW+1 hour on 16th Sept. One drogue travelled to the east up the Ballinacurra Estuary and the other to the west along the North Channel.

The paths are shown in figure 3.6 of Section 3. Drogue sails were set at 1.5m below the surface.

2.3 DYE RELEASES

2.3.1 Three continuous dye releases were made, one from each of the proposed outfall locations, to provide information on the likely trajectories of the effluent plumes on the ebb and flood tides. An FMI dosing pump was used to deliver a continuous accurate flow of Rhodamin B dye solution over the discharge period (approximately 50kg in 12.5 hours). A fast shallow draft survey launch fitted with a Turners Designs Model 10 fluorometer was used to track the plume. The boats position was logged in real-time on a PC from a Sercel NR53 survey DGPS unit.

2.3.2 The dye plume was tracked throughout the period of the discharge and on the following two days at the high water times. Temperature and salinity measurements were made at spot locations throughout the tracking.

2.3.3 To make the dye plots inter-comparable the measured concentrations have been normalised. On the plots showing the developing plume during the release period the measured concentrations (units dye/m^3) have been divided by the dye injection rate (units dye/second). On the plots showing the dye distribution at 24 hours and 48 hours after discharge the measured concentrations (units dye/m^3) have been divided by the total amount of dye released (units dye).

2.4 DYE RELEASE NO. 1 - RATHCOURSEY - 14th SEPTEMBER 1993

2.4.1 This dye release took place during average spring tide conditions. An inflatable boat with the dye dosing equipment was moored over the existing outfall and the dye released on the surface. The dye release commenced at 0848hrs (BST) and continued until 1920hrs. Low water (Cobh) was at 1055hrs and high water at 1654hrs.

2.4.2 Tracking of the dye continued throughout the day with the survey vessel continually traversing through the plume. From the start of release the dye travelled down the East Passage into the lower harbour with traces of dye detected off Lower Aghada by low water (figure 2.5).

2.4.3 At low water slack, c. 1100hrs, a large patch of dye lay between the discharge point and the western side of the channel. By 1130hrs the flood had commenced and the dye plume was travelling in a north westerly direction. Approximately 2 hours after low water the dye was distributed as shown in figure 2.5. The relatively large patch of dye travelling along the North Channel is the result of the dye patch forming around the discharge point at low water slack. Traces of dye were also detected in the Ballinacurra Estuary but concentrations were much lower.

2.4.4 Tracking later in the day at LW+4hrs showed the concentrated patch of dye to have moved over 2km westwards past Brick Island and to have elongated and widened to almost the full width of the channel (figure 2.6).

At this time also the main plume was travelling almost due north from the discharge point towards Ahanesk before splitting into two streams, one travelling to the east and the other to the west. The plume to the west, which contained the greater concentration of dye, moved along the northern shore to Brown Island before beginning to extend southwards across the channel.

2.4.5 At high water (1700hrs) dye was detected throughout the North Channel and all the way up the Ballinacurra Estuary to Midleton (figure 2.7). Highest concentrations were detected in the North Channel and the concentrated patch which developed around the release point at low water slack had travelled westwards to Weir Island. Water depth limitations prevented tracking any further in this direction.

2.4.6 Shortly after high water, at 1716hrs, the dye plume was observed to be travelling in an eastward direction from the release point towards Rathcoursey Point before turning southwards and travelling downstream along the eastern shore. As the ebb became more established the plume travelled down the middle of the channel and mixed rapidly. Two hours after high water dye was detected in a plume extending almost 2km into the lower harbour as shown in figure 2.8. Later again at HW+4h the plume had moved further out the harbour and low dye concentrations were detected off Lower Aghada pier as indicated in figure 2.9.

2.4.7 On the following day, 15th Sept., dye concentrations were measured throughout the survey area at low water (1200hrs) and high water (1800hrs). The dye was found to have been fully mixed with similar concentrations in all areas. Figure 2.10 shows the dye distribution at high water (1800hrs). The dye was just detectable towards the upper end of the East Passage and at the extent of tidal travel, towards Belvelly and Ballinacurra, concentrations increased to $3x10^{-8}$. Some traces of dye were also detected close to the shore off Rostellan as shown in figure 2.10.

2.4.8 Further tracking on the following day showed that concentrations had fallen to close to background over much of the area. The highest values were recorded at the western end of the North Channel near Weir Island as shown by figure 2.11.

2.5 DYE RELEASE NO. 2 - BALLINACURRA - 21st SEPTEMBER 1993

2.5.1 This continuous dye release took place from a point just below the N25 road bridge (M9) crossing the Owenacurra River upstream of Ballinacurra. The release commenced at 0845hrs while the tide was still flooding and continued until 2130hrs. A partial blockage in the dosing pump early in the day reduced the rate at which the dye was being released and only 20kg in total was discharged. High water on the morning of release was at 0940hrs and low water at 1613hrs. Tidal ranges corresponded to mean tide conditions and weather conditions were good with light winds.

2.5.2 Slack water at the discharge point was observed to occur at 0920hrs and the plume began to move downstream along the western bank. The first tracking exercise commenced at 1130hrs (HW+2h) from the leading edge of the plume, which lay off Green Point, upstream to the discharge point (figure 2.12).

2.5.3 At HW+3h the leading edge of the plume had reached Ahanesk and low concentrations of dye were detected in the waters towards Rathcoursey Pier (figure 2.12). Tracking later in the day between HW+4h and HW+5h showed that the dye in the East Passage was well mixed (figure 2.13).

2.5.4 Tracking was conducted in the outer harbour at low water. Dye concentrations were generally low and the dye was distributed over a wide area. The highest concentration was recorded near the shoreline to the west of Aghada pier. At LW+1h the tide had turned and a patch of dye was detected moving toward East Ferry (figure 2.13). Tracking in the East Passage showed the dye to be well mixed over the channel cross section.

2.5.5 Tracking between LW+2.5h and LW+3.5h showed that the dye had travelled along the North Channel towards Belvelly as shown in figure 2.14. Tracking up the Ballinacurra Estuary showed a steady increase in concentration up to the release point.

2.5.6 Tracking at high water (1130hrs) on the following day, 22nd Sept., showed that appreciable concentrations of dye remained in the Ballinacurra Estuary. Low concentrations were detected in the North Channel as far west as Weir Island (figure 2.15).

2.5.7 Tracking at high water (1230hrs) on 23rd Sept. showed that the dye was distributed more evenly throughout the area (figure 2.16). Concentrations were still highest near Ballinacurra and concentrations near Weir Island had also increased somewhat. Off the East Ferry low concentrations of dye were also detected.

2.6 DYE RELEASE NO. 3 - GREEN POINT - 8th OCTOBER 1993

2.6.1 This dye release took place during average neap tide conditions and moderate easterly winds. The inflatable boat with the dye dosing equipment was positioned in mid channel to the west of Green Point. Dye injection commenced at 0800hrs and continued until 2040hrs. Forty seven kilograms of dye were released over the 12.6 hour period. High water on the day was at 1040hrs and low water at 1721hrs.

2.6.2 From the time of release the dye plume moved upstream towards Ballinacurra on the flooding tide. A track at High Water showed low dye concentrations as far upstream as the quays (figure 2.17).

2.6.3 At the change of tide the plume began to move downstream. The large 'patch' of dye that formed around the inflatable boat during the slack water period moved to the west, probably due to the easterly wind, and became lodged in Ballyannan bay.

2.6.4 At HW+2h (1130hrs - 1230hrs) the plume was travelling in a south westerly direction and lay along the shoreline at the southern end of Ballyannan bay (figure 2.17). From here the plume travelled towards the East Passage and quickly mixed evenly across the channel. Some traces of dye were recorded in the gyre to the north of Bagwell's Hill. This was probably the result of the easterly wind, which by 1200hrs had increased to a fresh 7-8m/s, moving the surface waters towards and into the gyre. Tracking further down the East Passage showed that by HW+2.75h the dye plume had reached Marloag Point.

2.6.5 Tracking in the lower harbour at low water showed the dye to be distributed over a wide area as seen in figure 2.18. By the time the survey boat reached the North Channel the tide had just begun to flood and the plume lay in an east-west direction off Ahanesk and a large patch of dye had begun to move westwards. No further tracking was conducted on this tide.

2.6.6 On the following day, 9th Oct., dye concentrations throughout the survey area were recorded at both high and low waters. The dye distribution at high water (c. 1130hrs) is shown in figure 2.19. The highest levels were recorded upstream of the release point while levels in the North Channel were highest off Brick Island. Dye concentrations fell to near background levels in the outer bay past Marloag Point.

2.6.7 Tracking at high water (c. 1230hrs) on 10th, figure 2.20, showed that most of the dye had dispersed and that there was only a small increase in levels from Rathcoursey up to Midleton and along the North Channel towards Belvelly.

2.7 DYE RELEASE NO. 4 - RATHCOURSEY - 11th. OCTOBER 1993

2.7.1 A discrete release of dye was made from the site of the existing Rathcoursey outfall a flooding tide in order to obtain information for the numerical model set-up.

2.7.2 One litre of dye was released on the surface at HW-3h and tracked as it travelled northwards and then to the west along the North Channel. The positions of the resulting patch are shown in figure 2.21. The tidal range on the day was 2.3m corresponding to large neap conditions and weather conditions were good with calm seas and slack winds.

2.7.3 During each tracking period the survey vessel travelled through the patch in a Zig-Zag pattern recording the dye concentration levels. Most of the dye moved along the North Channel though some entered the shallow bay to the north east of Brown Island. Tracking ceased when the patch had widened to the full width of the channel.

2.8 ANALYSIS OF DYE STUDY RESULTS

2.8.1 Results from the three dye releases have shown the likely path of a plume effluent discharging from each outfall site. The plume from Rathcoursey travels down the East Passage on the ebb tide and out into the lower harbour. On the flood it travels northward towards Ahanesk before dividing with the greater portion going to the west along the North Channel towards Belvelly.

2.8.2 The plume from an outfall at Ballinacurra travels down the East Passage and into the lower harbour. On the flood the dye moves back up toward the East Passage with some going towards the East Ferry as shown in figure 2.13. Dye contaminated waters also travels along the North Channel and at the outfall site itself the plume pushes back upstream against the freshwater inflow from the Owenacurra River.

2.8.3 The plume from the Green Point outfall site follows a similar path to that from the Ballinacurra site and with an easterly wind, as prevailed during the release, contaminated surface waters can move across and into the gyre on the western side of the East Passage during the ebb tide.

2.8.4 From the results of the three dye releases and the decrease in the average dye concentration between the high waters on Day 2 and Day 3 the tidal exchange factor has been calculated to be approximately 0.28. This is in general agreement with exchange factors ranging from 0.10 to 0.35, with an average of 0.17, determined by M.C. O' Sullivan in the Cork Harbour Pollution Report for the area upstream of Rathcoursey Point.

3. PREDICTIVE MODEL OF EFFLUENT DISPERSION

3.1 INTRODUCTION

3.1.1 The principal purpose of the modelling analysis was to facilitate the selection of a suitable outfall location for the efficient disposal of the treated waste waters from the proposed Midleton sewage works.

3.1.2 Numerical models provide the means by which the effects of discharges can be examined under varying conditions. In this respect they are an extension of the field studies which were conducted for a limited set of conditions.

3.1.3 The approach followed standard methods involving the set-up and calibration of appropriate models. These included two dimensional flow and contaminant models to simulate the water dynamics and effluent dispersion patterns. The model covered the tidal area extending from Belvelly Bridge to Ballinacurra (figure 3.1) and was the principal method by which the various discharge options were evaluated and compared.

3.1.4 The requirements of the various National and EC regulations formed the basis of all decisions. These regulations provide specific levels which must be adhered to for various contaminants and include:

91/271/EEC	-	Urban Waste Water Treatment Directive;
79/923/EEC	-	Shellfish Waters Directive;
76/160/EEC	-	Bathing Waters Directive;
NLV(1979)	-	D.O.E. Bathing Waters, National Limit Values;
SHELLSAN	-	Dept. of Marine, Shellfish Waters Standards;
BLUE FLAG	-	E.C. Sponsored Beach Monitoring Program.

3.1.5 Of the contaminants identified by these documents the faecal coliform bacteria levels are the most stringent standards and a discharge meeting these requirements will normally meet all other criteria. In assessing the suitability of each outfall site a desirable target faecal coliform (fc) level of 100 per 100ml was suggested by the consulting engineers, M.C. O' Sullivan & Co. Ltd., for all bathing areas. This corresponds to the Guideline Level of EC Directive 76/160. For shellfish producing areas a target level of 14 fc/100ml corresponding to the Dept. of Marine Shellsan 'Approved Category' was set. EC Directive 76/160 has been adopted by the Government and is a statutory instrument (SI 84 and SJ 99). Shellsan is a guideline standard set by the Dept. of the Marine and has no legal status.

3.1.6 The long term design proposals for the sewage plant allow for the treatment of municipal effluent from the town and local industries. After treatment the effluent will contain faecal coliforms at a concentration of approximately 1×10^5 per 100ml. The design dry weather flow will be 54 litres/second. This figure was used in determining outfall discharge characteristics and then for the subsequent decisions on suitable outfall locations.

3.2 DISPERSION MODEL - SET UP AND DATA

MODEL METHODOLOGY

3.2.1 A two dimensional (2D) depth averaged flow model was used to simulate the tidal circulation in the study area. The model is based on a finite difference solution of the equations of motion of fluid flow and incorporates non-linear effects and drying bank features. Essentially the area to be modelled is divided up into a large number of discrete cells which represent the shape and bathymetry of the site. Boundary conditions are then applied in the form of tidal oscillations and the equations of motion solved for each cell at successive time steps. The predicted speed, direction and elevation data can be then compared with field results.

3.2.2 The movement and mixing of the treated wastewaters discharged from the potential outfall locations were simulated using a particle track technique. With this technique each particle represents a certain quantity of effluent which, after release, is moved around in the model area by means of advection due to tidal currents and dispersion due to turbulence and current shear. The model operates on the same grid as employed in the flow model.

BATHYMETRIC DATA

3.2.3 Bathymetry was defined on a rectangular grid with cells of horizontal dimension 25m x 25m. The model dimensions were 370 cells (9.25km) east-west and 240 cells (6km) north-south. It extended from Belvelly Bridge to Ballinacurra and down the East Passage to Marloag Point (figure 3.1). Depth values were taken from Admiralty Charts 1773, 1765 and various other bathymetric surveys and comprised charted spot depths and digitised contour lines all of which related to Irish National Grid (ING) co-ordinates. This irregularly spaced data was transformed into a regular square grid by an appropriate surface fitting algorithm. Coastline data was obtained from the Ordnance Survey 6" sheets for the area.

TIDAL HEIGHT DATA

3.2.4 Measured data from the three sites, Section 2.1 of this report, were analysed and a single sinusoidal oscillation corresponding to a mean spring or neap tide determined. These were used to generate boundary conditions at the southern end of the East Passage.

CURRENT DATA

3.2.5 Data on currents in the model area was obtained from the measurements provided by recording current meters, direct reading current meters used at fixed stations and drogue tracks. Data from all available sources and previous studies was employed where appropriate.

DIFFUSION RATES

3.2.6 Diffusion rates depend on the effects of current shear over the water depth and are very variable. The along stream rate is also the greater (as a consequence of the shear) and was quantified using an empirical relationship. The across stream diffusion was scaled to be 15% of the along stream rate ($3m^2/s$) such that a typical value would be equivalent to a diffusion coefficient of $0.5m^2/s$ which was found to agree best with the measured rates of dye dispersion during the field survey works.

WIND AND WEATHER CONDITIONS

3.2.7 Only calm weather was simulated in the model as this would limit mixing and thus produce likely worst case conditions. River flows were also assumed to be negligible and representative of a dry weather period where dilution and dispersion of the effluent stream due to freshwater would be low.

SAMPLE LOCATIONS

3.2.8 Results from the model runs are presented as concentration contour plots and as time series of concentration at selected sites. These sites are shown in figure 3.2. Each site comprised 24 grid cells arranged in a rectangular configuration (6 x 4) centred on the axis of the plume.

3.3 DISPERSION MODEL - ANALYSIS & SIMULATION METHODS

HYDRODYNAMIC MODEL

3.3.1 Tidal water circulation patterns in the model area were simulated using the 2D flow model described earlier. A tidal oscillation with an amplitude corresponding to either a mean spring or a mean neap tide and a period of 12.42 hours was applied at the southern boundary. Typical coastal water model coefficients (i.e. eddy viscosity, bed friction etc.) were employed and the model then run for the required length of time; normally three tidal cycles. Output was generated for every hour of the tidal cycle and the first 6 hours of each simulation was disregarded due to possible initial transient start-up effects.

3.3.2 Examples of the model flow field for times of maximum ebb and maximum flood on a spring tide are shown as vector diagrams in figures 3.3a,b. Examples of the time series output at selected cells are discussed in the following section.

VERIFICATION OF THE FLOW FIELDS

3.3.3 The flow fields were verified in two ways. First, the time series of currents at the sites of the fixed station and recording current meters were compared with measurements. Second, the trajectories of the drogue tracks were simulated by tracking a particle through the model flow fields under equivalent conditions.

3.3.4 The current time series at the fixed station and recording current meter sites were abstracted from the model flow fields. Time series from the grid cell corresponding with each location were produced. The results from three fixed station sites are shown in figures 3.4a-c. One data set was recorded during this study while the other two were recorded by M.C. O' Sullivan & Co. Ltd. in 1985. The model data have been scaled to match the tidal ranges during the measurements and overall it can be seen that the agreement is good.

3.3.5 Predicted time series at the current meter sites compared reasonably well to measured values, figures 3.5a,b though not as closely as those in the East Passage. This is to be expected given that there is more scope for spatial variation in the open waters. Off Brown Island comparisons were very close during spring tides while the model did not fully reproduce the ebb pattern in this specific cell. In the gyre, to the north of Bagwell's Hill, the model produced a realistic pattern for a complex flow feature. The main ebb flow is predicted accurately while the flood lasts for longer than actually recorded. These differences are considered to be minor and within allowable tolerances for models in complex flow areas. Therefore on the whole the model is considered to be reproducing the current patterns to an acceptable degree.

3.3.6 Two drogue tracks were made for comparison of model and field data. The actual drogue tracks and the simulated tracks are plotted in figure 3.6. It can be seen that there is good agreement, further confirming the validity of the model.

SIMULATION OF EFFLUENT DISPERSION

3.3.7 The processes of advection and dispersion of effluent were simulated using a particle tracking program, PTM. A discharge was represented by the release of a number of discrete particles each time step (250 seconds). The subsequent motion of the particles was the sum of two effects :

i) advection in the tidal current and;
ii) dispersion due to turbulence and current shear.

The advection was calculated by stepping through the variations in the current field, in time and space, using linear interpolation between data points and a predictor-corrector method of integration of the particles displacement. The dispersion was included by subjecting each particle to a random displacement each time step.

3.3.8 The effect of vertical shear of a horizontal current is to enhance the dispersion along the axis of the horizontal current and is called shear dispersion. The tidal currents are sheared over the full depth of flow and, after the effluent has mixed through the depth, the shear dispersion can be described by a mixing coefficient approximated by the product of the depth mean current and the depth. To account for general turbulent mixing the diffusion coefficient normal to the effect of shear was defined such that the variance of the effluent cloud should be 0.15 times the variance along the axis of tidal shear dispersion.

3.3.9 The dispersive displacement of each particle each time step ,dt, was scaled by the square root of the increment in the variance of the effluent cloud which is given by the product:

$$(\text{increment in variance}) = 2\,K\,dt$$

where K is the effective diffusion coefficient as described above. The actual step length taken by each particle was also determined by a random number selected from a normal distribution with zero mean and unit variance and scaled by the product 2 K dt. Steps in the x and y coordinate directions were made such that the step lay along the tide shear, either up-current or down-current with equal probability, with a component normal to the resultant as described in the previous paragraph.

3.3.10 Particles which moved out of the model, through the southern end of the East Passage, were collected and held on an edge strip of cells. By means of a simple numerical scheme these particles could re-enter the model, at a later time after the current had reversed direction. The rate and number of particles which re-entered during a given tide were chosen to reflect the likely mixing in the lower harbour and were determined from the tidal exchange factors discussed in Section 2.8.4. The lower value of 0.17 was used to ensure a conservative result. Particles were still subject to decay while within the edge strip.

3.3.11 The process of bacterial decay was included in the model by evaluation of the probability of decay for each particle during each time step. This was expressed as a function of T_{90} where T_{90} is the time for 90 percent decay. An actual decay event occurred when a random number was less than this probability. Each similation was run for a time of at least 2' x T_{90} to ensure steady state predictions were achieved.

3.3.12 The results of the particle tracking programs were files containing the coordinates of each particle remaining in the model calculations at each output time (0.5 hour) through the model simulation and a file of depth averaged concentrations for each cell within the model area at each time. The model results were also input to separate programs in order to translate particle densities into relative concentrations of effluent within the specific locations of interest described in Section 3.2.8.

CALCULATION OF EFFLUENT CONCENTRATIONS

3.3.13 The particle position files from each run were entered into a program which performed two functions for each specific sample location:

a) it assembled a time series of the peak concentration in any of the cells within the selected sample location based on half-hourly values through the simulation;
b) it assembled a time series of average concentrations based on the total number of particles within the sample area boundaries.

3.3.14 Concentrations were initially calculated relative to a unit discharge and then scaled to give concentrations in faecal coliforms per 100ml (fc/100ml) based on the discharge characteristics given in Section 3.1.6. The program then sorted the particles by concentration into specified bands, which were then used to prepare plots with colour coded infill of cells according to concentration band.

VERIFICATION OF DISPERSION PATTERNS

3.3.15 The results of the discrete dye release from Rathcoursey Point were used to estimate the dispersion rates of the effluent plume. The model was then used to simulate the continuous dye release from Rathcoursey (14/9/93). Results in figure 3.7 show the model predictions at HW on the day of release. A decay rate of 1% per day and tidal exchange factor of 20% at the southern boundary were assumed. The model results are in good agreement with the recorded dye distribution shown in figure 2.7 and thus allow confidence in the validity of the model.

3.4 DISPERSION MODEL - RESULTS

SPECIFICATION OF MODEL RUNS

3.4.1 After completion of the model set-up, validation and various test simulations ten production runs were conducted as described in Table 3.1. Runs 1 to 4 simulated discharges from the Rathcoursey outfall while the discharges from the Green Point and Ballinacurra outfalls are included in Runs 5 to 9. A decay time of 12 hours was employed for Runs 1-9. Run 10 shows the effects of a reduced decay time (T_{90} = 6h) on the discharge from the Rathcoursey outfall.

RUN	Tide	Site Reference	T_{90}	Outfall Location
1	neap	A	12	Rathcoursey - Continuous
2	spring	A	12	Rathcoursey - Continuous
3	neap	A	12	Rathcoursey - Ebb Tide
4	spring	A	12	Rathcoursey - Ebb Tide
5	neap	B	12	Green Point - Continuous
6	spring	B	12	Green Point - Continuous
7	neap	B	12	Green Point - Ebb Tide
8	neap	C	12	Ballinacurra - Continuous
9	spring	C	12	Ballinacurra - Continuous
10	neap	A	6	Rathcoursey - Continuous

Table 3.1 - Specification for model runs 1-10.

EFFLUENT DISTRIBUTIONS

3.4.2 Examples of effluent distributions arising from the various discharges are shown in the plots contained in the appendices at the end of this report. These plots compare neap and spring tide results for calm conditions at the times HW-3h, HW, HW+3h and LW.

CONCENTRATION TIME SERIES AT SELECTED LOCATIONS

3.4.3 Time series of peak bacterial concentrations at the sample locations, shown in figure 3.2, were produced from the values calculated on the half hour for each of hours 12 to 24 for any grid cell within the 24 cell sample array as described in Section 3.2.8. These results are shown in figures 3.8 to 3.18. The maximum peak concentration for each location taken from all 26 times was abstracted and is listed in Table 3.2 for model Runs 1 to 10.

3.4.4 The average bacterial concentration at the sample locations based on the number of particles within the sampling areas volume has also been computed and is included on figures 3.8 to 3.18. The maximum average concentration for each location for all output times are listed in Table 3.3.

SAMPLE	RUN NUMBER/OUTFALL SITE									
SITE	1/A	2/A	3/A	4/A	5/B	6/B	7/B	8/B	9/C	10/A
S1	35	26	24	21	10	11	16	1	10	10
S2	14	39	12	32	10	21	10	0	18	5
S3	98	87	68	67	35	35	38	2	23	87
S4	27	16	35	26	4	16	5	1	2	15
S5	13	43	9	13	974	1936	1087	285	777	7
S6	7	14	5	17	324	492	216	3122	4310	6

Table 3.2 - Maximum Peak Concentrations (fc/100ml), Runs 1-10.
A: Rathcoursey, B: Green Point, C: Ballinacurra.

SAMPLE	RUN NUMBER/OUTFALL SITE									
SITE	1/A	2/A	3/A	4/A	5/B	6/B	7/B	8/B	9/C	10/A
S1	18	15	12	13	4	5	5	0	4	8
S2	6	21	5	18	2	9	3	0	6	1
S3	54	47	33	27	10	11	14	1	8	44
S4	14	8	20	12	2	7	1	0	1	9
S5	2	6	2	3	602	1079	538	146	298	1
S6	1	3	1	1	151	222	93	441	585	1

Table 3.3 - Maximum Average Concentrations (fc/100ml), Runs 1-10.
A: Rathcoursey, B: Green Point, C: Ballinacurra.

3.5 INTERPRETATION OF MODEL RESULTS

3.5.1 Output from the model was presented as faecal coliform concentrations at representative locations for each half-hour of the tidal cycle. These were in the form of time series of the peak concentration within any single cell of a 24 cell configuration and as the average concentration within the total configuration. All of these numerical output values together with graphical plots, included in the appendices at the rear of the report are relevant when assessing the results.

3.5.2 The peak value provides an indication of the likely maximum concentrations. It can however, in some instances, give spurious results which are not indicative of the true concentration. These arise from the way the concentrations are calculated (i.e. the number of particles in a 25m x 25m cell area) and from the temporal resolution of the model. In the first case clusters of particles can occasionally remain within a cell, particularly if speeds are low, as happens around slack waters, and an artificially high concentration can be recorded. This result can be further distorted if the cell is close to the shore where a decrease in the tidal level can be a significant proportion of the water depth and produce an unreliable increase in concentration with time. The temporal resolution of the model is governed by the practicality of dealing with large amounts of data. Thus with a typical output resolution of half hour, as adopted in this case, a patch of concentrated effluent may pass by an individual cell point between model outputs. This limitation can be avoided by examining suitably sized areas and computing the average concentration. Given the fine spatial resolution of the model (25m x 25m) and the variability encountered in the real world it is considered that the average value is a better indicator of bacterial concentration than the peak value.

3.5.3 In interpreting the results the terms of reference are taken to be those set out in the various National and E.C. directives mentioned in Section 3.1.4. and the target levels of 100 fc/100ml (Bathing Areas) and 14 fc/100ml (Shellfish Waters) set by the Consulting Engineers. There are no officially designated bathing areas within the locality affected by the proposed discharges. However, for the purposes of determining an appropriate outfall site it is considered desirable that the requirements are satisfied in as far as possible.

RATHCOURSEY OUTFALL - INTERPRETATION OF RESULTS

3.5.4 Five model runs were made simulating the Rathcoursey outfall discharge under differing conditions. Four of these (Run 1 to Run 4) employed a bacterial decay time (T_{90}) of 12 hours while a shorter time of 6 hours was used for one run. Predicted concentrations at selected locations are presented in figures 3.8 to 3.12 as time series and as contour plots in Appendices 1 to 4. Results for the shorter decay time (Run 10) are given in figure 3.17 and in Appendix 10.

3.5.5 On the neap tide, Run No. 1, the effluent plume moves northwards towards Ahanesk on the flooding tide, Plot 1.1, before splitting with the majority going westwards along the North Channel. Concentrations in the plume are less than 100 fc/100ml. At high water the model shows effluent as far west as Brick Island and up the Ballinacurra Estuary as far as Green Point. Concentrations at the extremities are low and generally less than 14 fc/100ml. In the area of the shellfish beds predicted concentrations are in the range 14-100 fc/100ml. On the ebbing tide the contaminated waters move towards the East Passage, Plot 1.3, and by low water, Plot 1.4, only trace bacterial concentrations remain in the North Channel. Individual isolated coloured areas shown on the plots indicate particles trapped in shallow waters and are not representative of real concentrations.

3.5.6 During spring tides, Run No. 2, the effluent plume follows similar patterns to those predicted during neaps, as can be seen from Plots 2.1 to 2.4. At high water, Plot 2.2, the effluent plume has travelled right through the North Channel as far as Weir Island and up the Ballinacurra Estuary to Midleton. Concentrations are still low at the extremities and only occasionally exceed 14 fc/100ml. In the shellfish bed areas predicted concentrations are generally less than 14 fc/100ml but in several localised spots are in the range 14 to 100 fc/100ml. The model also shows that during spring tides the water in Ballyvodock bay become contaminated with bacterial concentrations in the range 14 to 100 fc/100ml.

3.5.7 The time series plots of figures 3.8 to 3.9 provide a more accurate representation of the predicted concentrations at the sampling locations and show that peak levels in the vicinity of the shellfish beds will reach 35 fc/100ml for about 1 hour during neap tides. Average values in the same location will reach approximately 18 fc/100ml.

3.5.8 Runs 3 and 4 investigated the effects of restricting the discharge of Rathcoursey to the ebb tide only. Concentration contours for the four principal stages of the tide are shown in Plots 3.1 to 3.4 and Plots 4.1 to 4.4. From commencement of discharge at high water the effluent moves down the East Passage where it mixes rapidly across the channel. At low water (Plots 3.4 and 4.4) predicted concentrations are generally in the range 14 to 100 fc/100ml. On the flooding tide the plume moves back up the East Passage and into the North Channel and Ballinacurra River estuary. As with the continuous discharge predicted concentrations are highest in the North Channel. The greatest difference between the two discharges occurs in the area off Ballyvodock where a significantly lower bacterial level is predicted for spring tides.

3.5.9 Comparison of the time series of figure 3.10 and 3.11 with those for the continuous releases, figures 3.8 and 3.9, shows that the tidal release does not alter the bacterial concentrations at the sampling locations to any significant extent. The principal difference is that the peak occurs at a slightly different time and is typically about 20% lower. The reduction in peak and average values at the various sites can be seen in Tables 3.2 and 3.3.

GREEN POINT OUTFALL - INTERPRETATION OF RESULTS

3.5.10 Three model simulations were made of this outfall. Runs 5 and 6 simulated continuous discharges for neap and spring tides while Run 7 examined an ebb tide discharge during neap tides.

3.5.11 At high water on a neap tide, Plot 5.1, effluent is concentrated in the Ballinacurra Estuary upstream of the discharge point. Highest bacterial concentrations occur at Ballinacurra village with a peak in the range 300 to 1000 fc/100ml. On the ebbing tide the plume moves southwards and out the East Passage, Plot 5.3. Bacterial concentrations are seen to lie in the range 300 to 1000 fc/100ml for about 450m downstream of the outfall and to have fallen to 14fc/100ml in the East Passage. On the flooding tide contaminated water from East Passage travel to the west along the North Channel though bacterial concentrations are low (Plot 5.4).

3.5.12 During spring tides, Run No. 6, peak concentrations at high water, Plot 6.1, occur at Ballinacurra village and lie in the range 140 - 300 fc/100ml. On the ebb tide the plume moves downstream quickly (Plot 6.2) and by low water extends right down the East Passage (Plot 6.3). On the flooding tide, effluent contaminated waters from the East Passage are pushed westwards along the North Channel as far as Weir Island (Plot 6.4). Concentrations in the vicinity of the shellfish beds are low and less than 14 fc/100ml.

3.5.13 Restricting the discharge at Green Point to the ebb tide, as shown in Plots 7.1 to 7.4, has the effect of reducing the bacterial concentrations off Ballinacurra village and increasing them in the immediate vicinity of the discharge and in the North Channel.

3.5.14 The concentration time series shown in figures 3.12 to 3.14 indicate the changes in bacterial levels at the selected sampling locations during the different tides and also the effect of a timed discharge. These results are also summarised in Tables 3.2 and 3.3. The principal effect of an outfall at Green Point is that predicted bacterial levels in Ballinacurra (S6) increase substantially from those arising from the Rathcoursey outfall. Restricting the discharge to the ebb tide only reduces the levels by a factor of about 2.

BALLINACURRA OUTFALL - INTERPRETATION OF RESULTS

3.5.15 Two model simulations were made of a discharge to the estuary just upstream of Ballinacurra village, one each for neap and spring tides, Runs 8 and 9. At high water on a neap tide the effluent plume is concentrated in the vicinity of the discharge point with concentrations in the range 300 - 1000 fc/100ml over a wide area of the river estuary (Plot 8.1). As the tide ebbs the plume moves slowly downstream (Plot 8.2) and by low water (Plot 8.3) has almost reached Rathcoursey Point. Bacterial levels at the Rathcoursey end are low and increase steadily back upstream to Ballinacurra village. On the flood tide, Plot 8.4, the plume moves back up the Ballinacurra Estuary and almost no effluent travels along the North Channel.

3.5.16 During spring tides the effluent plume is carried much further downstream and into the East Passage, Plot 9.3. On the flooding tide some contaminated waters enter the North Channel but the predicted concentrations are low (Plot 9.4). Peak concentrations are still recorded in the vicinity of the outfall.

3.5.17 Concentration time series at the six sampling locations for this outfall, figures 3.15 and 3.16 show that peak values in excess of 1000 fc/100ml can be expected at sampling location S6. Locations S5 will also experience high levels with a peak of approximately 440 fc/100ml. Bacterial contamination of the shellfish areas will be negligible.

EFFECT OF DECAY TIME

3.5.18 The effects of bacterial decay on model predictions were investigated for the Rathcoursey outfall discharge in Run 10. Results in the form of concentration contours are presented in Plots 10 and as time series at the sampling locations in Figure 3.17.

3.5.19 Comparison of Plots 10.1 to 10.4 with Plots 1.1 to 1.4 show that the effluent distribution patterns are similar though the spatial extent is reduced. At high water effluent is still present in measurable concentrations in the North Channel as far west as Brick Island.

3.5.20 The concentration time series plots, figure 3.17, shows that areas close to the discharge S1, S3, S4 still experience high levels of bacteria while the reductions are most noticeable at the further away sites. Comparison of the results for Runs 1 and 10 in Tables 3.2 and 3.3 show that peak values in the two shellfish bed sampling areas S1 and S2 would decrease by a factor of about 3 under conditions where the T_{90} was reduced to 6 hours. Reductions in the average values would be by a factor of about 2.

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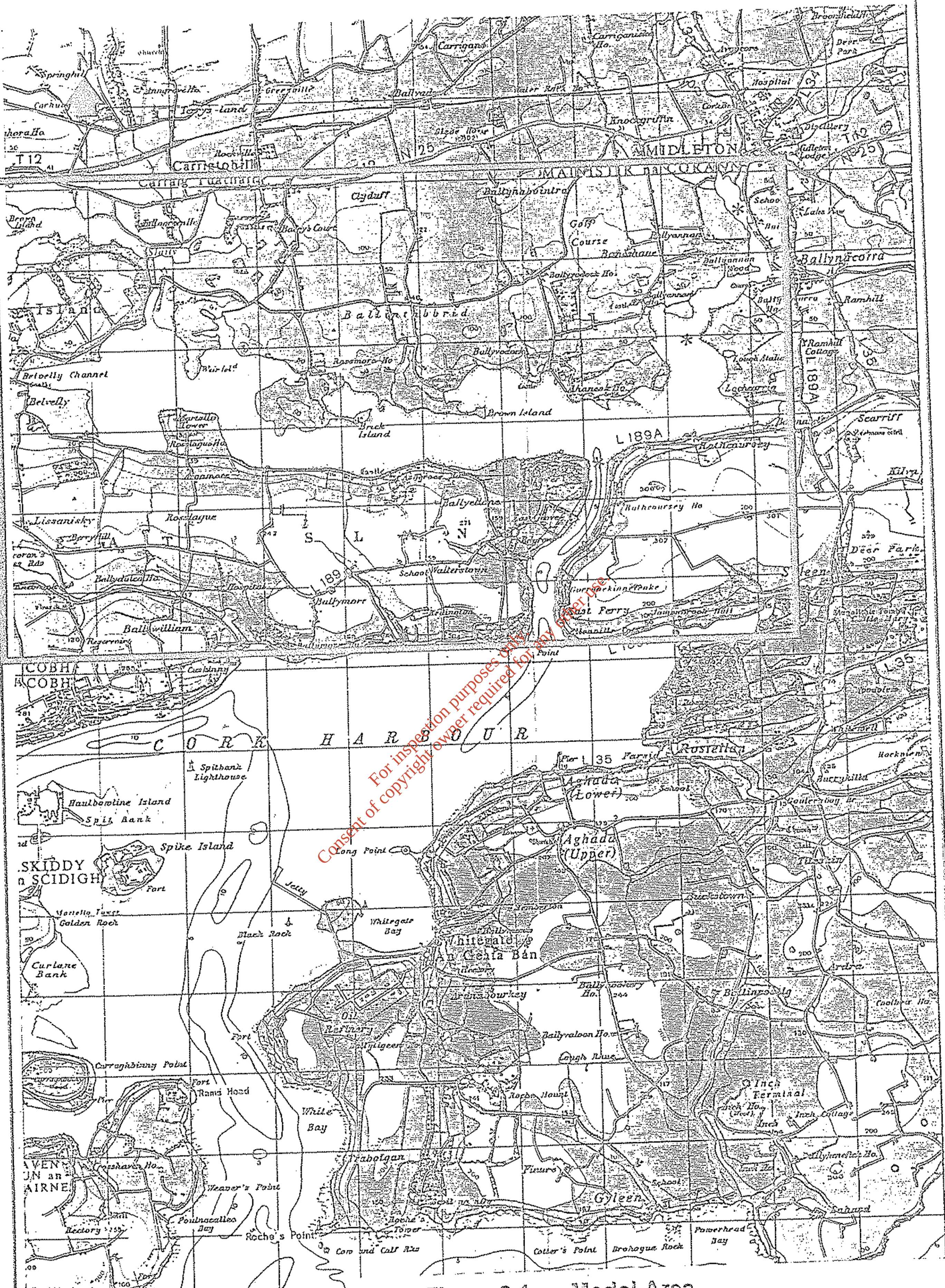

Scale: 1/63,360

Figure 3.1 Model Area

4. SUMMARY AND CONCLUSIONS

4.1 This report presents the findings of dye studies and numerical models of water circulations and dispersion patterns in the North Channel and Ballinacurra Estuary areas of Cork Harbour. The works were conducted in order to assess the effects of the proposed discharge of treated municipal wastewaters from the town of Midleton to the Harbour and form part of an EIS being prepared by the Consulting Engineers, M.C. O' Sullivan & Co. Ltd. for the new treatment works.

4.2 Continuous dye releases were made from the three potential outfall sites, each lasting for a period of 12.5 hours, and the dye plume subsequently tracked for up to 48 hours. This work has confirmed the findings of earlier studies with regard to water exchange and flushing times. It has also shown that the siting of the outfall is the principal factor in determining which areas are likely to be contaminated by the effluent plumes.

4.3 Simulations of discharges from the three potential outfall sites using a 2 dimensional flow and particle track contaminant model provided clear indications of how the various effluent plumes will move and disperse in the North Channel and Ballinacurra Estuary during spring and neap tides. The differences between the three outfalls sites are significant and it is possible to reach firm conclusions based on the predicted levels of contamination at representative areas.

4.4 The criteria against which the outfalls were compared are the Guideline Faecal Coliform level of 100 fc/100ml set out in the EC Bathing Water Directive and the level of 14 fc/100ml necessary to meet the Dept. of the Marine Shellsan 'Approved Category' for shellfish producing waters.

4.5 An outfall at Rathcoursey employing a continuous discharge offers the best option for meeting the Bathing Water Directive in the vicinity of Ballinacurra and comes close to the Shellsan 'Approved Category' level in the North Channel. Restricting the discharge period to the ebb tide provides a small improvement but still will not reduce peak concentrations to below the 'Approved Category' level. Outfalls at Green Point and upstream of Ballinacurra village would ensure compliance with the Shellsan 'Approved Category' requirements in the North Channel but would produce very high bacteria levels in the area of the Ballinacurra quays and thus would not comply with the Bathing Water Directive requirements.

4.6 On the basis of criteria outlined above a continuous discharge at Rathcoursey would be the most favourable and provide the optimum means of achieving the target levels. It is therefore the recommended option.

4.7 For the purpose of evaluation each outfall was assumed to be discharging treated effluent and no other sources were considered. At the present time the existing Rathcoursey outfall discharges untreated effluent and other outfalls and bacterial sources also discharge to the area. The results contained in this document therefore do not necessarily represent present conditions. If it can be shown that the other sources have and will continue to have a negligible impact on bacterial contamination of the area then the possibility of incorporating additional treatment to reduce the bacterial count in the effluent should be investigated as a small improvement would ensure that the Shellsan requirements could also be satisfied.

SECTION 7

WASTE PRODUCTION AND DISPOSAL

SECTION 7

WASTE PRODUCTION AND DISPOSAL

1.0 The main source of waste from the Midleton Sewage Treatment Plant will be:-

(a) Grit and detritus from the grit trap installed at the inlet to the works.

(b) Screenings from the screen and compactors also at the inlet.

(c) Sludge from the dewatering building, if provided on site.

(d) Domestic refuse from the administration building.

(e) Chemical containers, wrappers, etc.

(f) Grass cuttings.

1.1 It is proposed to dispose of the grit, screenings and domestic refuse to the Local Authority Tip located nearby. The chemical containers are normally reusable and will be returned to the manufacturers. Grass cuttings will not pose a problem as these can be composted and used for fertilising the various shrub beds around the site. Sludge will be suitable for either land spreading or land filling purposes.

2.0 GRIT AND DETRITUS REMOVAL

2.1 The quantity of grit and detritus is very variable, being least in domestic sewage from separate systems and most from combined systems taking the flow from heavily gritted roads. The quantity also varies from time to time as storm flows tend to bring the large quantities of grit and detritus to the collection system. The quantity of grit removed from combined sewerage systems usually amounts from 3.8 to 9.8 cu.m./1,000 persons per annum, the lower figure applying to densely built up areas.

2.2. In the case of Midleton, the expected volume of grit per annum from the residential population of 15,000 people is in the region of 57 to 147 cu.m. annually giving an average volume of approximately 2.0 cu.m. of grit per week.

2.3 The grit will be removed from the sewage flow by means of an aerated Grit Trap located at the inlet to the works. This item of plant removes grit from the sewage flow and deposits it to a separate collection chamber. The grit will be washed and the washing water, containing organics, returned to the sewage flow. On a daily basis, the grit will be removed from the grit chamber and deposited in a collection bin for removal off site on a weekly basis. All these elements of the treatment will take place indoors.

3.0 SCREENINGS REMOVAL

3.1. The quantities of screenings entering a sewage collection system is dependent on the domestic population served. The volume of screenings removed from the sewage flow is dependent on the effectiveness of the screens installed to remove the floating solids.

3.2 The quantities of screenings expected is 0.02 cu.m./1,000 head of population per day. Based on a domestic residential population for the Stage 1 works of 10,000 people, the volume of screenings expected per day is 0.2 cu.m. For the fully extended plant, the volume of screenings expected per day will be 0.3 cu.m.

3.3 The screenings will be washed and compacted and the moisture content is expected to be in the region of 85% with a weight of 800 kg. per cu.m. Based on a production of screenings of 0.2 cu.m./day for the Stage 1 works, and 0.3 cu.m./day for the ultimate developed works, the total weekly volume should be 1.4 and 2.1 cu.m. per week for the Stage 1 and fully developed works respectively.

3.4 The screenings will be collected and deposited to a collection bin and on a weekly basis this bin will be taken from the treatment works site to the refuse tip for disposal.

3.5 The screenings will be washed and compacted prior to deposition into the bin and as such should be odour free. This element of the treatment will also be housed.

4.0 SLUDGE PRODUCTION

(a) Domestic Plant

4.1 The sludge from the aeration basin at the domestic sewage disposal works will be digested in a thermophilic aerobic digester, thickened and dewatered in the sludge treatment process at the site. This sludge treatment involves the killing of pathogens, thickening of the raw sludge followed by dewatering in the dewatering house to a solids content of 20% - 25%.

4.2. The excess sludge, which will be produced at the Midleton Sewage Treatment Plant, will be from an extended aeration secondary treatment system. The extended aeration activated sludge system produces inert and stabilised sludge which is devoid of carbonaceous material, which when digested is suitable for landspreading.

4.3 The volumes of sludge expected from the Stage 1 works will be from a population equivalent of 10,000 people. The Stage 2 works will be designed for a population equivalent of 15,000. Based on a per capita sludge production of 45 grams/head/day, which takes into account waste sludge from the extended aeration process and additional precipitation due to phosphorous removal, the expected sludge production for the Stage 1 and fully developed plant are set out in tabular form below.

Sludge Production from the Works

	Population Equivalent	Annual Sludge Product (tonne) dry solids
Stage 1	10,000	164.25
Ultimate	15,000	246.38

4.4 It can be seen that the expected sludge production from the Stage 1 plant with a population of 10,000 people is 164 tonne per annum. The expected sludge production from the fully developed site from a population of 15,000 is 246 tonne of dry solids per annum.

4.5 If sludge treatment occurs on the site, then following sludge thickening and dewatering the expected solids content of the sewage sludge would be 20% - 25%. This would result in a Stage 1 annual sludge volume of 820 cu.m. (2.025 cu.m./day) and an ultimate annual sludge production of 1,230 cu.m. (3.37 cu.m./day) respectively.

4.6 At present it has not been decided on the sludge treatment or disposal system to be employed at Midleton. However, the likely sludge disposal options are:

(a) Disposal of the stabilised sludge to landfill.

(b) Landspreading of stabilised sludge.

4.7 Work is presently being carried out on other possible uses of sewage sludge including composting and sterilisation using kiln dust and lime. However, for the purposes of this Statement, the most likely end destinations of the sewage sludge would be as outlined above, if centralised treatment is not available, and these will be discussed in greater detail hereunder.

Disposal of Stabilised Sludge to Landfill

4.8 Annual Sludge Volumes

	Annual Dry Solid tonnes	Annual Sludge Volume (cu.m.)	Liquid Volume (cu.m.)
Stage 1	184.2	820	656
Ultimate	246.3	1,230	984

4.9 The principal effect of the disposal of stabilised sludge to a landfill site would therefore be to increase the water content of the landfilled site by 656 cu.m./annum initially and 984 cu.m./annum ultimately. A proportion of this may be absorbed by the other solid waste present while the remainder may contribute slowly to the flow of leachate from the landfill. It would not add significantly to the B.O.D. load or any odour problems at the landfill site. The sludge cake would also raise the pH of the landfill towards neutral.

5.0 LANDSPREADING OF STABILISED SLUDGE

5.1 Sludge from sewage treatment plants contains a variety of plant nutrients, in particular nitrogen, phosphate, potassium and certain trace elements. If properly managed, land application of sludge can be a cost saving to farmers in that it reduces the need to purchase commercial fertilisers. Additionally, humic matter found in sludges has the effect of conditioning the soil, providing a slow release mechanism for nitrogen and improving the moisture retention properties of the soil. Landspreading of sludge is supported by the European Communities Directive 75/442/EEC on Waste, Article 3 of which states that: "member states shall take appropriate steps to encourage the prevention, recycling and processing of waste, the extraction of raw materials and of possible energy therefrom, and any other process for the reuse of waste".

5.2 Spreading of sewage sludge on agricultural land is governed by E.C. Directive 86/278/EEC on the Protection of the Environment and in Particular of the Soil. This Directive has now been implemented in Ireland by SI No. 183 of 1991, European Communities (Use of Sewage Sludge in Agriculture) Regulations 1991.

5.3 The E.C. Directive and the Irish Regulations addresses the potential environmental problems which could be caused by the application of sewage sludge to agricultural land.

5.4 When sewage sludge is used on agricultural land it must be applied in accordance with the European Communities Regulations SI No. 183 of 1991. This states that the application of the sludge onto agricultural land must:

(a) take account of the nitrogen needs of the plants

(b) ensure that the quality of soil, surface water and ground water are not impaired.

(c) have regard to the increased mobility and availability of heavy metals where the sludge is used on soil of which the pH is less than 6.

5.5 These regulations set maximum limit values for concentrations of heavy metals in sludge used in agriculture. In addition the soil and sludge applied must be tested for compliance with the regulations in respect of maximum value concentrations of heavy metals in accordance with the set limit values in the Regulations.

5.6 The table below gives typical values for nutrients and heavy metals in an extended aeration sludge. These results have been measured recently at a sewage disposal works under the control of Kerry County Council. The table also shows the E.C. Directive limit values for heavy metals as well as the Irish Regulation limit values. It can be seen that the extended aeration sludge is well within the set limit values for both the E.C. Directive and the Irish Regulations. This disposal works also had phosphorous removal as part of its process and this would account for the high phosphorous levels in the sewage sludge.

Extended Aeration Sludge - Typical Values of Organics & Metal Contents

Parameter	Maximum	Minimum	Mean	E.C. Directive Limit Values mg./kg.	Irish Regulations Limit Values mg./kg.
Organic Matter (%)	70.90	62.90	67.4	-------	-------
pH	7.70	6.87	7.17	-------	-------
Nitrogen (g./kg.)	58.10	48.20	53.10	-------	-------
Phosphorous (g./kg.)	26.70	17.80	22.90	-------	-------
Nickel (mg./kg.)	58.00	23.00	30.00	300-400	300
Lead (mg./kg.)	95.00	67.00	77.00	750-1200	750
Copper (mg./kg.)	696.00	325.00	410.20	1000-1750	1000
Chromium (mg./kg.)	91.00	42.00	56.60	Not Stated	Not Stated
Zinc (mg./kg.)	1382.00	640.00	834.00	2500-4000	2500
Cadmium (mg./kg.)	1.90	<1.00	<1.00	20 - 40	20
Mercury (mg./kg.)	<0.50	<0.50	<0.50	16 - 25	16

5.7 Under the regulations issued in 1991 governing the use of sewage sludge in agriculture, the maximum amount of sludge which may be applied to soil has been defined to be 2 tonnes of dry matter per hectare per year in addition to compliance with the regulations governing heavy metal concentrations in sludge. For the proposed works in Midleton, the required spreading area for the Stage 1 domestic works would therefore be 82.1 hectares (203 acres) and the required area for the fully developed works would be 123.1 hectares (304.5 acres).

5.8 Nitrogen and phosphorous are essential nutrients for crop growth and it has been found that, for the production of silage as a fodder crop, 300 kg. of nitrogen per annum is required to sustain plant growth. For a two cut silage situation, the required phosphorous input to promote plant growth is 35 kg. of phosphorous per hectare. At an application rate of 2 tonnes per hectare per annum, as allowed under SI No. 183 of 1991, and taking the expected quantities of nitrogen and phosphorous in extended aeration sludge, the phosphorous requirement of the agricultural crop of silage would be fully met whereas the nitrogen requirement would have to be supplemented further by artificial fertilisers.

5.9 If the land application of the stabilised sludge to agricultural land is seen by Cork County Council as a workable alternative disposal option, adverse environmental effects may be prevented by ensuring that:

(a) Spreading of the sludge is carried out only when the soil and vegetation is capable of accepting and metabolising the sludge.

(b) A strict code of practice is followed, under which spreading would not be permitted near watercourses, sloping land where run-off is significant, or before, during or after heavy rain when the site has become saturated.

(c) The sludge and soil on which it is spread are regularly monitored for elevated levels of metals.

(d) Nutrient loadings are also carefully monitored.

6.0 DOMESTIC WASTE

6.1 The amount of domestic waste emanating from the sewage disposal works will be quite low since the labour force will generally work only at normal working hours. Assuming the plant was occupied on a full time basis, the expected volume of domestic refuse per week would be 0.5 cu.m. This refuse can be deposited off site to the Council tip.

7.0 SUMMARY OF WASTE PRODUCED

7.1 Based on the foregoing, the total volume of waste produced from the sewage disposal works and from the grit and screening removal equipment is in the region of 2.64 cu.m. from the Stage 1 works and 3.85 cu.m. from the fully developed works. The derivation of these volumes is given in tabular form below.

Waste Production at the Works

	Stage I	Ultimate
Grit (cu.m./day)	0.19	0.28
Screenings (cu.m./day)	0.20	0.30
Sludge (cu.m./day)	2.25	3.37
Total (cu.m./day)	2.64	3.95

7.2 It is envisaged that the grit, screenings and domestic waste would be disposed of on a weekly basis to the Local Authority Landfill. The disposal of the sewage sludge will depend on the disposal option chosen by the County Council. If the sludge is to be disposed at the Local Authority Tip the sludge would be removed on a weekly basis. Should the option be landspreading, the sludge would be removed to the sludge storage area on a daily basis or every other day.

8.0 IMPACT

8.1 The volume of wastes produced, along with their stable nature and means of disposal, will ensure there will be little impact on the environment from these wastes. The disposal of the sewage sludge by landspreading would be of beneficial use as the nutrients contained therein can be extracted by plants and converted into plant material.

SECTION 8

AIR EMISSIONS IMPACT

AIR QUALITY IMPACT OF PROPOSED WASTEWATER TREATMENT PLANT AT MIDLETON, CO. CORK

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1.0 INTRODUCTION

1.1 General

A proposal for an urban wastewater treatment plant at Midleton, Co. Cork for the surrounding area was assessed in relation to the potential for odour nuisance from the proposed plant. The potential for air quality impact arising from odour emissions from the domestic waste treatment plant were evaluated by examining local climatological characteristics, plant design and air dispersion modelling estimates. The proposed facilities will treat municipal wastewater from the Midleton catchment area which currently discharges directly into the Ballynacurra River at Rathcoursey about 5km downstream of the town.

1.2 Odours from treatment plants

Fresh wastewater arriving at a treatment plant via a properly constructed sewer system has a slight smell, normally described as musty in character. As long as a certain level of dissolved oxygen is maintained in the sewage anaerobic conditions will not take place. However, if the oxygen content of the sewage is used up then gases such as hydrogen sulphide, nitrogen and sulphur based organic compounds (mercaptans, ketones, amines, indoles and skatoles) are produced and a general septic condition occurs with typical pungent, putrid and nauseating odours being emitted.

Sulphide compounds which have very low levels of odour detection are a major component of odours from a waste water treatment plant. For example, hydrogen sulphide has an odour detection limit in the order of about 0.2-2 $\mu g/m^3$. Its characteristic smell of rotten eggs occurs at concentrations of about 3-4 times higher with odour nuisance complaints likely at even higher levels.

A sufficient detention time is required for the formation of anaerobic conditions and warm weather conditions above about 20C will also assist the rapid growth of anaerobic bacteria. The operation of a wastewater treatment plant involves many locations during the process where anaerobic conditions can occur; from poor maintenance of the inlet works, overloaded secondary treatment through to the dumping of the dewatered sludge in open skips prior to disposal off-site. In many cases the odour problem can be solved by housing the inlet works, covering collection skips, preventing blocking of channels and regular maintenance. Air from the sludge treatment phase of the process can also be collected and passed through a suitable odour control system to substantially reduce odours.

The majority of odour nuisance problems associated with wastewater treatment plants are due to the age of the plant or where the sewage loading arriving at the plant results in regular overloading of the facility. This tends to be the public perception of sewage treatment plants. However, with the modern technology available the plants can exist close to residential areas without causing any problems of odours in the surrounding area.

The rate of emissions of potentially odorous inorganic and organic compounds from wastewater treatment tanks depend on the tank surface area, organic concentrations and BOD of the tank liquor, volatility of the compounds and the evaporation rate from the tank. Unless there is a strong upward movement within the tank the volume of the tank is not important compared to the surface area with respect to the emission rate since compounds near the floor of the tank will not quickly diffuse to the surface. The rate of evaporation is lower from a quiescent liquid surface than from a turbulent surface with higher air temperatures and/or wind speeds increasing the evaporation rate. The degree of anaerobic activity within the effluent is also affected by weather conditions such as air temperature and humidity so that odours tend to be greatest during dry warm weather conditions. these conditions may also be associated with periods of low effluent flow through the plant which can significantly affect the efficiency of the plant.

The perception of odour at some point downwind of an emission source depends on the type of odour compound and the air concentrations of the odorous gas. The measure used to quantify odour nuisance potential is the odour concentration (odour unit per cubic metre, o.u./m^3). This concentration is equal to the number of times a sample must be diluted with odour free air before 50% of an odour panel cannot detect the odour.

2.0 LOCAL CLIMATOLOGY

2.1 Wind speed and direction

Wind speed and wind direction will affect the magnitude of any potential odour nuisance at a specific property in the surrounding area. At high winds any odour generated at the treatment plant will be rapidly dispersed in the air and so will quickly reach a concentration below which it is not detected. Conversely, during slack winds the odour plume from the plant may drift some distance before dilution of the odour is such as to be below the odour detection limit.

Results from Roches Point meteorological station (14 km to S) over a 24 year period indicate that the prevailing wind direction is from a S-SW and also a NW direction (Fig 1). The incidence of winds of 5 m/s or less is about 44% of the year with speeds of <2m/s (including calms) occurring about 10% of the time. Similar climatological data from Cork airport meteorological station which is located about 22 km to the W indicates a SW prevailing wind and a much lower incidence of low winds (6%

<2m/s) caused by its elevation. The Cork Harbour area will also create local wind flow patterns during calm weather conditions with on-shore winds during the daytime and off-shore at night-time. However, this type of local wind circulation flow will be quickly destroyed once the wind speed increases above about 3 m/s.

The greatest potential for odorous emissions is during the summer months when warm dry weather conditions can increase the rate of evaporation from exposed liquor tank surfaces and the rate of sludge decay. During the summer period (May to September) the incidence of wind speeds of <2m/s is about 13% with calm weather conditions recorded for about 4% of the time. During the winter months with damp, cool windy conditions prevailing the potential for odours from the treatment plant is much lower.

The nearest residential properties to the site are located about 200m to the N-NE of the treatment plant boundary site, separated by a large embankment constructed for the Midleton By-pass dual carriageway. There are a number of properties about 0.4-05 km to the west of the site with a large private residence (Ballyannan) approximately 0.45km to the south of the site boundary. Based on data from Roches Point the wind will blow towards the properties to the N-NE of the site for winds of < 5m/s for about 7% of the year with an incidence of 1.5% for winds of <2m/s. The wind speed frequency pattern during the summer months gives a similar incidence. These percentages included occasions when the weather may be overcast, raining etc. (when the odour potential is much lower) and so the maximum number of hours the wind is predicted to blow towards the nearby residential property to the N-NE of the site, at speeds of 5m/s or lower, is about 600 hours/yr. In the case of the houses to the west and to the south of the site the corresponding incidence is about 2.2 (190 hours/yr) and 2.4% (210 hours/yr) respectively.

2.2 Air Temperature

The annual mean air temperature for Cork Harbour is about 10.5 C with a range in daily averages of from about 6.3 C in January to about 15 C in July. There would be a small number of days when the maximum air temperature in the Upper parts of Cork Harbour can be over 25 C but generally a coastal sea breeze will tend to prevent stagnation of air flows in the area during these very warm conditions. However, the potential for odour nuisance from the treatment plant will be greatest during this type of weather as it will tend to be associated with low flow into the plant.

3.0 EXISTING AIR QUALITY

The proposed location at Garryduff is on a green-field site on the W bank of the River Owennacurra which flows into the NE reaches of Cork Harbour at Ballynacurra. The nearest house is about 150m to the NE with other houses 0.4km to the West and South of the proposed site. The land is agricultural grazing and during the site visit odours associated with livestock could be detected along the roadway which runs along the western side of the proposed site.

The air quality of the proposed site is generally good with no significant adverse impact of any air emissions from the built-up area of Midleton. There is a relatively new housing estate about 150-200m to the NE of the proposed site which will produce air emissions associated with space heating demands which may cause elevated levels of smoke and sulphur dioxide as well as certain hydrocarbons during the winter heating period. The Main Street of Midleton is approximately 1km to the NE of the northern corner of the site and so during calm weather conditions during the winter months emissions from space heating may again be detectable at this distance. However the maximum daily ambient levels of smoke and sulphur dioxide would be less than < 100 $\mu g/m^3$ compared to the EC Air Quality Directive Guideline value of 100-150 $\mu g/m^3$.

There is a major dual carriageway bordering the N-NE side of the site which is separated by a steep embankment. The impact on air quality of emissions from road transport would not be significant beyond a few tens of metres from the roadway given the volume of traffic using the bypass.

Occasionally, especially during warm dry weather conditions it is likely that odours typical of estuarine mud-flats may be detected near the banks of the river depending on the tidal range present at the time. However for much of the year due to the prevailing weather conditions odours are unlikely to be detected away from the foreshore.

4.0 PROJECT DESCRIPTION AND IMPACT ASSESSMENT

4.1 Plant size

The sewage treatment plant at Midleton is designed to cater for an influent capacity of about 15,000 per. equivalent. The 30 year design of the plant (design loading conditions for year 2022) is described in detail in the main report and may be summarised as follows in relation to the potential of certain components to generate odours.

4.2 Preliminary Treatment

4.2.1 Screenings

This part of a wastewater treatment plant can be a major source of odours especially if the incoming sewage becomes stale. Enclosing this part of the plant greatly reduces the potential for odours from this plant component. At Midleton the screening and grit removal systems will be completely enclosed in a section of the machine building. The screenings need to be collected and disposed efficiently and not left in a skip alongside the conveyor feed outdoors for long periods. Faecal matter trapped on the screenings can quickly become a major odour source if left outside in a skip for collection. The screening operation proposed for Midleton will include washing of screened material which is then compacted into bales for loading into a skip for disposal off-site at a designated landfill.

4.2.2. Grit removal

The grit trap is situated adjacent to the screening chamber in the enclosed inlet works. Removal of grit from the incoming flow to the wastewater treatment plant will be by an aerated grit trap which can be controlled to remove inorganic material as well as allowing from the removal of grease. The grit will be removed from the grit trap by an air lift system which will discharge the collected grit into the skip, housed indoors, used for the compacted screenings.

Odour emissions from the inlet components of the treatment plant will not be significant as the building will be enclosed and the skip used for collected screenings bales and grit will be housed indoors. Flow monitoring of the incoming sewage will ensure that strong odours are not formed due to the sewage becoming stale. The air will be ducted to the peat-bed bio-filter odour control system for the treatment plant.

4.3 Secondary Treatment

4.3.1 Bio- Reactors

The proposed method of treatment of the sewage at Midleton is by the process of bio-reactor extended aeration tanks. Three bio-reactor aeration tanks , operating in parallel are proposed with four sections in each. The first section is an anoxic zone where recycled effluent is thoroughly mixed with the incoming sewage and the other three sections of the tank have progressively higher levels of dissolved oxygen input so that full nitrification of the tank liquor is achieved. The flow from one end of the tank to the outlet is designed as a plug flow stepped aeration system. 4 DWF at the outlet end is returned to the anoxic zone with some of the sludge wasted to the sludge thickener tank. The effluent from the aeration tank flows over a weir at the outlet end before being recycled or discharged to the secondary clarifiers.

Much concern in relation to the generation of aerosols and odours from aeration tanks originates from the use of surface aeration shaft propellers which when operated without cowlings installed can generate significant aerosols and odours in the vicinity of the tanks. Reduction of surface turbulence will greatly reduce the potential for generation of aerosols and so a sub-surface diffused aeration system is the preferred option. Aeration of the 2nd, 3rd and 4th stage of the bio-reactor tank will be by means of fine bubble diffused aeration system. This will ensure that significant emissions from a turbulent tank liquor surface are virtually eliminated and odours will not be detected away from the sides of the tanks.

Emissions of odours and aerosols from this part of the treatment plant will be very low and only detectable on occasions in the immediate vicinity of the bio-reactor tanks. The overflow weir at the outlet to the tank is a potential source of odours due to the increased turbulence and hence emission rate from the liquor surface.

4.3.2 Secondary Clarifier Tanks

Three circular secondary clarifier tanks will be constructed as part of the secondary treatment process at Midleton. No sludge is wasted to the sludge thickening tank from these tanks and 1 DWF of settled activated sludge is returned to the bio-reactors for feed to the initial anoxic zone at the inlet to the bio-reactor tank. The settled sludge will be scraped from the sloping bottom of the clarifier into a central sludge hopper for return to the bio-reactor tanks. No turbulence of the liquor surface should normally take place apart from near the overflow weirs. However, the level of BOD in the effluent is very low at this stage to meet discharge standards and so no significant odour will be detected from the liquor surface under normal operating conditions.

Evidence from existing waste water treatment plants around Ireland indicates that odours from secondary treatment clarifiers are very low and are not detected beyond a few metres from the tanks. Even close to the overflow part of the clarifier no significant odour emission could be detected.

4.4 Sludge Treatment and Disposal

Treatment and disposal of sludge is generally the main source of odours at a wastewater treatment plant. The sludge may be de-watered in a relatively open building and deposited in an open skip outside that may be left for day or more before collection. The sludge will still tend to decay further especially during warm weather conditions and so collection, treatment and disposal of sludge requires good management procedures and some method of odour control if this part of the plant is not to be a source of community nuisance. Many modern plants are installing suitable air control systems and enclosing sludge holding tanks and generally upgrading the sludge handling management.

4.4.1 Sludge Thickener

The sludge wasted from the outlet of the 3 bio-reactor tanks is collected and thickened in the picket fence thickener prior to subsequent treatment. Open sludge thickener tanks can be a major source of odours especially if the draw-off of the bottom sludge and mixing causes turbulence in the liquor. The sludge thickening tank will be covered with the air drawn off from the surface of the tank and vented to atmosphere through ducting to the peat-bed biofiltration odour control system.

4.4.2 Sludge Digestion

The proposed method of sludge treatment at Midleton is thermophyllic aerobic digestion as anaerobic digestion is not possible due to the secondary treatment method of extended aeration. The digestors will be completely enclosed and so the emissions of odours from this part of the process will be negligible.

4.4.3 Sludge De-watering Building

De-watering and the disposal of sludge can be a major source of emissions if the operation is not enclosed or poor house-keeping results in the sludge being left in skips on-site where it can decay further. This is a source of odours in a number of plants around the country. The operation at Midleton will be carried out in an enclosed building utilising pressure double belt presses to produce a sludge cake of approximately 20-25% solids. This product will be disposed off-site at a designated landfill site or an alternative method of sludge disposal.

An adequate odour control system will be installed in the de-watering building with a satisfactory number of air changes per hour to prevent toxic fumes building up within the building and posing a threat to employees. A concentration of 14 mg/m^3 for hydrogen sulphide would represent the maximum level employees should be exposed to within the building in terms of occupational exposure thresholds over a normal 8 hour working day. An air change rate of 12 per hour will ensure that the actual levels indoors are much lower than this threshold value.

It is important that the sludge is disposed so that significant odours are not generated from the sludge becoming stale in a skip outside the building left standing for a considerable period of time.

5.0 ODOUR CONTROL

Control of odorous emissions by chemical scrubbing or treatment with an organic media of the gases emitted from various parts of the plant which might otherwise cause an odour nuisance in the surrounding area is an important part of modern treatment plant design. Each of the main potential sources of odours such as the sludge de-watering house or inlet works can have independent air filtration systems installed in the ventilation of the buildings or the air may be ducted to a central air purification system such as a peat bed filter.

At the Midleton treatment plant the main sources of odours are the inlet works (screening and grit removal), sludge thickener tank, digestor and the sludge de-watering building. It is proposed that gases and air ventilation from these four components will be combined and ducted to a peat bed odour control system. The peat bed biofilter would be located close to the machine house which combines the inlet and de-watering units. The peat bed bio-filter acts as a large surface area on which micro-organisms are cultured which treat the odorous components of the gas stream which is forced upwards through the bed. The important aspect of operation is to maintain a satisfactory population of micro-organisms which can adequately act on the gas stream and the humidity of the bio-mass material is critical in this regard. This type of odour control system is successfully used in a number of municipal and industrial waste treatment facilities in Ireland. The size and hence surface area of the peat bed will depend on the amount of waste gas to be treated. However, a biofilter system operating efficiently can provide an odour removal efficiency of 98% or higher.

6.0 ODOUR DISPERSION MODELLING

6.1 Introduction

Short-term odour concentrations downwind of the proposed plant site at Garryduff were computed using the Industrial Source Complex Short Term (ISC) air quality gaussian dispersion model developed by the U.S. Environmental Protection Agency. This model is widely used for modelling the air quality impact of a wide range of different types of emission sources, including wastewater treatment plants. Calculations were carried out to predict the rate of dilution from the boundary of the plant to the property in the neighbourhood where a potential odour nuisance could arise. The predicted concentrations were based on the worst case climatological conditions, i.e. the combination of wind speed and wind direction that result in the maximum short term ground level concentration at various downwind distances for each atmospheric stability category examined.

For the purpose of the modelling study 3 atmospheric stability categories were examined. These were unstable, neutral and stable weather conditions. The first type is commonly associated with warm sunny weather with relatively light winds (< 3m/s). Data for Roches Point meteorological station indicates an annual incidence of about 6% ; mostly occurring during May -September. Neutral atmospheric stability conditions are the most common category observed in Ireland and are characteristic of the prevailing westerly maritime weather regimes that dominate the weather; occurring about 79% of the time. Finally, stable weather conditions occur at night-time with relatively slack winds (< 3 m/s) and little or no cloud cover. This type of situation is likely to create a low level temperature inversion which restricts dispersion of air emissions. Stable conditions develop around sunset and can persist, depending on wind and cloud cover, until 1-2 hours after sunrise. Given the low incidence of low wind speeds in this part of Ireland the incidence of stable weather conditions is about 15%.

In terms of the potential for odour nuisance in the vicinity of the plant light winds during neutral or stable weather conditions will tend to result in the poorest dilution of any odour plume and hence highest ground level concentrations that can persist beyond a few minutes. Under conditions of unstable atmospheric stability due to the rapidly changing turbulence in the lower air layers any odours will be short-lived, especially with short-term fluctuations in the wind direction and speed.

6.2 Emission Estimates

The emissions from the inlet works and sludge handling odour extraction units were treated as a combined single point source as any emission will be exhausted to the atmosphere from the peat bed odour control system. The aeration and secondary clarifier tanks were treated as area emission sources as gaseous emissions will take place across the whole liquor surface. The rate of dilution of any malodorous gaseous emission from the surface of the liquor in the aeration or clarifier tanks are dependent on the dispersive properties of the lower air layers ; i.e. the atmospheric stability, which is strongly affected by the horizontal wind speed.

The emission rates used in the dispersion model were expressed in terms of the odour dilution factor rather than as a specific pollutant compound emission rate due to the mix of compounds that may be emitted. The unit of measurement was odour units per m^2 per second (o.u./m^2.s) for emissions from the tank liquor surfaces and odour units per second (o.u./s) for the odour control peat-bed bio-filter (fugitive) emission sources.

The following odour emission rates were used in the model.

Extended Aeration Tanks - The area of each of the 3 aeration tanks is approximately 380m^2. An odour emission rate of Total emissions from each aeration tank were estimated to be 100 o.u./s.

Secondary Clarifiers - The area of each of the 3 tanks is about 284m^2, including peripheral channels, and based on a vertical exit velocity from the surface of the tank of 7m/hr and a near-surface concentration of 50 o.u./m^3 the emission rate was estimated to be a maximum of 0.1 o.u./m^2.s. Total emission from each of the secondary clarifier tanks were estimated to be about 28 o.u./s.

Peat Bed Odour Control Unit -The emission rates from the peat bed odour control unit was set at an odour emission rate of 500 ou/s. This is high given the modern design of the plant and the normal operation of the biofilter odour control system will have a substantially lower emission rate so that any odours are not detected more than a few metres from the unit. However, this allows a 'worst case emission' scenario to be employed in the odour modelling exercise.

6.3 Results of Dispersion Modelling

The intensity of an odour from the wastewater treatment plant will depend on the strength of the initial odour concentration from the surface of the tank or other emission source and the distance downwind at which the prediction, or indeed measurement, is being made. Where the odour emission plumes from a number of sources combine downwind then the predicted odour concentrations may be significantly higher than that resulting from an individual emission source. An odour concentration of 1 o.u./m^3 is the level at which there is a 50% probability that, under laboratory conditions using a panel of qualified observers, an odour may be detected. At levels below 1 o.u./m^3 the concentration of the gaseous compound causing the odour in the air will be less than the detection level and so although the gas is still present in the air no odour will occur.

The intensity of an odour ranges from 1 o.u./m^3 = odour detection, 2= slight odour up to 5 o.u./m^3 where the odour is strong and easily recognisable with higher levels likely to result in nuisance complaints by the neighbouring community. Since duration of the odour also determines whether or not a nuisance situation may occur an odour concentration of greater than 5 o.u./m^3 is widely used as a criteria for predicting the potential for complaints over periods of 15-30 minutes. Sensitivity to an odour also depends on the location; for example an odour from agricultural related activities will be tolerated by the community longer in a rural setting than in an urban area.

The results of the dispersion modelling study for the Midleton treatment plant are shown in Figs 2-4 for unstable, neutral and stable atmospheric conditions respectively. The contours are indicated in units of 0.5 o.u./m^3 and represent the maximum short-term ground level concentration predicted at various distances downwind under low wind speed conditions (< 3m/s). At higher wind speeds the resulting ground level concentrations will be even lower. It is evident that at the nearest residential property to the north of the treatment plant (on the opposite of the dual carriageway) the predicted odour concentrations are about 1- 2 o.u./m^3 during neutral and stable weather conditions and about 0.5 o.u/m^3 for neutral and unstable conditions. Beyond about 0.25km from the site the maximum odour concentration for all atmospheric stability conditions is about 1 o.u/m^3 and beyond a distance of about 0.4km the corresponding predicted value is 0.5 o.u./m^3.

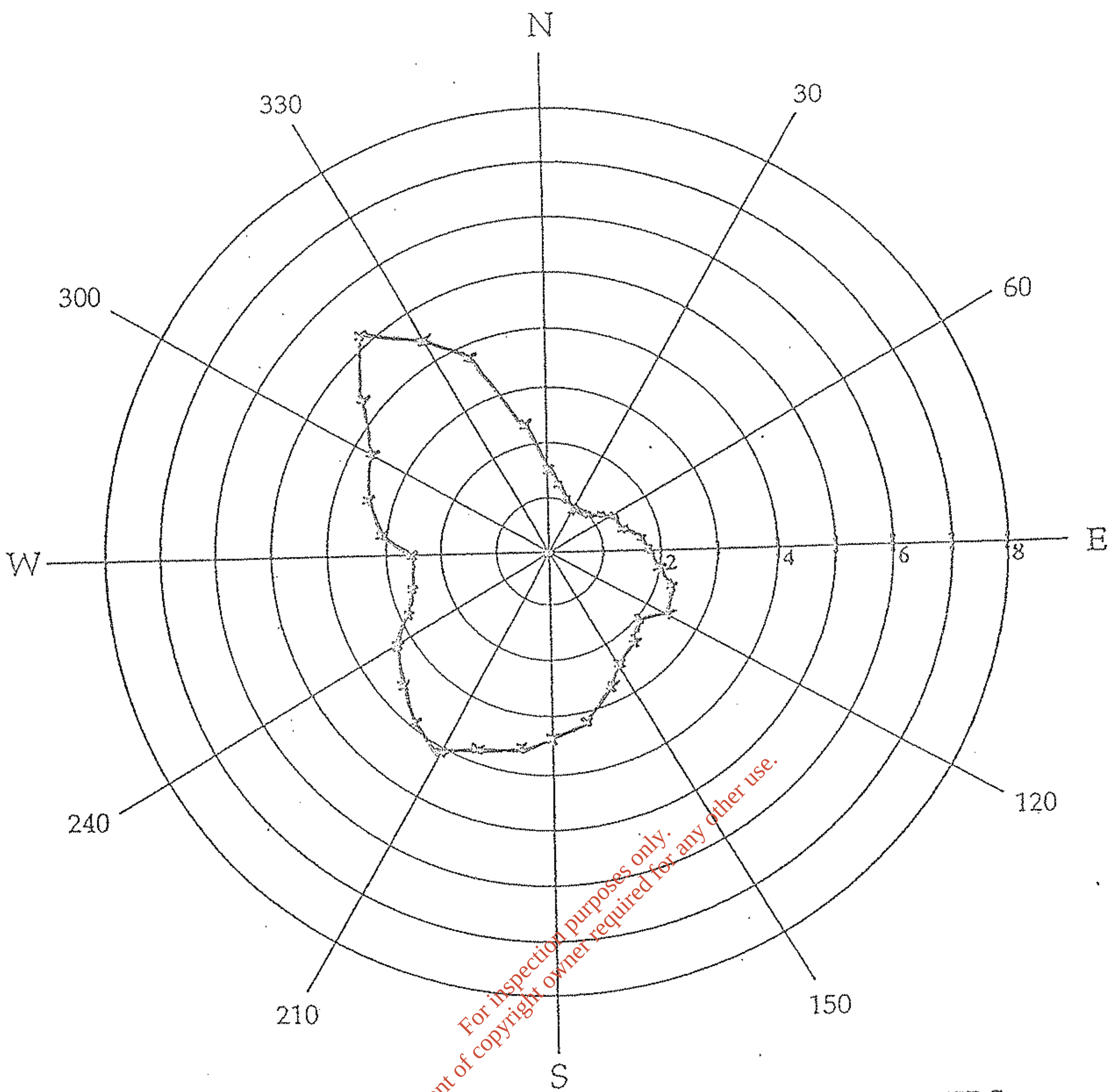
Generally an odour concentration in excess of 5 o.u./m^3 is needed before a significant odour nuisance is experienced by within the community. It is evident that the predicted short-term concentrations downwind of the treatment plant are significantly lower than this threshold value, even at the houses to the north of the site. In addition, the presence of the embankment of the elevated dual carriageway will further mitigate the potential for odours dispersing in this direction as ponding of the air layers, especially during calm wind conditions, upwind of the embankment is likely. At a distance of about 0.25km downwind from the proposed plant site boundary the predicted impacts due to odour are about 5 to more than 10 times lower than the nuisance odour level of 5 o.u/m^3.

7.0 CONCLUSION

Overall, the design and proposed operation of the domestic wastewater treatment plant at Midleton is one that ensures that odorous emissions are controlled by the installation of a high efficiency odour biofiltration system. The installation of sub-surface aeration diffusers instead of vertical shaft aerators for secondary treatment reduces the formation of odours and also aerosols from the extended aeration tank surfaces still further. Regulation by instrumentation of the flow of waste-water through the works, coupled with efficient plant design will also ensure that the material does not become stale resulting in anaerobic reactions which could cause significant malodours. These measures will reduce the potential for odour nuisance in the local community to a minimum as indicated in the odour dispersion modelling study.

The predicted short-term maximum ground level odour concentrations are very low at the nearest private properties and are below the values likely to result in nuisance complaints with a high odour removal rate from the peat bed filter. The prevailing weather conditions with a relatively low incidence of slack wind conditions will normally aid rapid dilution of any odours produced from the various components in the treatment plant.. Indeed the computed results indicate that odours are unlikely to be detected beyond the boundary of the plant during normal operating conditions. No adverse impact on the ambient air quality of the area around the proposed Midleton site is therefore predicted.

It should be emphasised, however, that efficient plant management and good house-keeping procedures are vital elements in the successful operation of the Midleton wastewater treatment plant and that the sludge and also the screenings/grit must be handled and stored correctly prior to disposal off-site so that further anaerobic reactions and hence odorous emissions are prevented at all times.



HOURLY WIND DIRECTION FREQUENCY - ALL WIND SPEEDS

Direction	Percentage Occurrence of Wind Speeds (m/s)					
	<2	2-3	3-5	6-8	>9	All
350-10	0.6	1.0	1.6	1.5	0.6	5.3
20-40	0.3	0.6	1.1	0.8	0.1	2.9
50-70	0.3	0.5	1.2	1.3	0.5	3.8
80-100	0.3	0.6	1.4	2.0	1.3	5.6
110-130	0.5	0.9	1.9	2.0	1.3	6.6
140-160	0.7	1.0	1.7	2.1	2.0	7.5
170-190	0.6	1.0	2.2	2.9	3.1	9.8
200-220	0.6	1.0	2.3	3.8	4.0	11.7
230-250	0.4	0.8	2.2	3.7	2.9	10.0
260-280	0.3	0.7	2.1	3.3	2.1	8.5
290-310	0.6	1.1	2.4	3.9	3.6	11.6
320-340	1.5	2.0	2.9	4.1	3.1	13.6
Calms	3.2					3.2
Total	9.8	11.2	23.0	31.5	24.5	100.0

FIG 1: FREQUENCY OF WIND DIRECTION AND WIND SPEED FOR HOURLY OBSERVATIONS AT ROCHES POINT (1963-86)

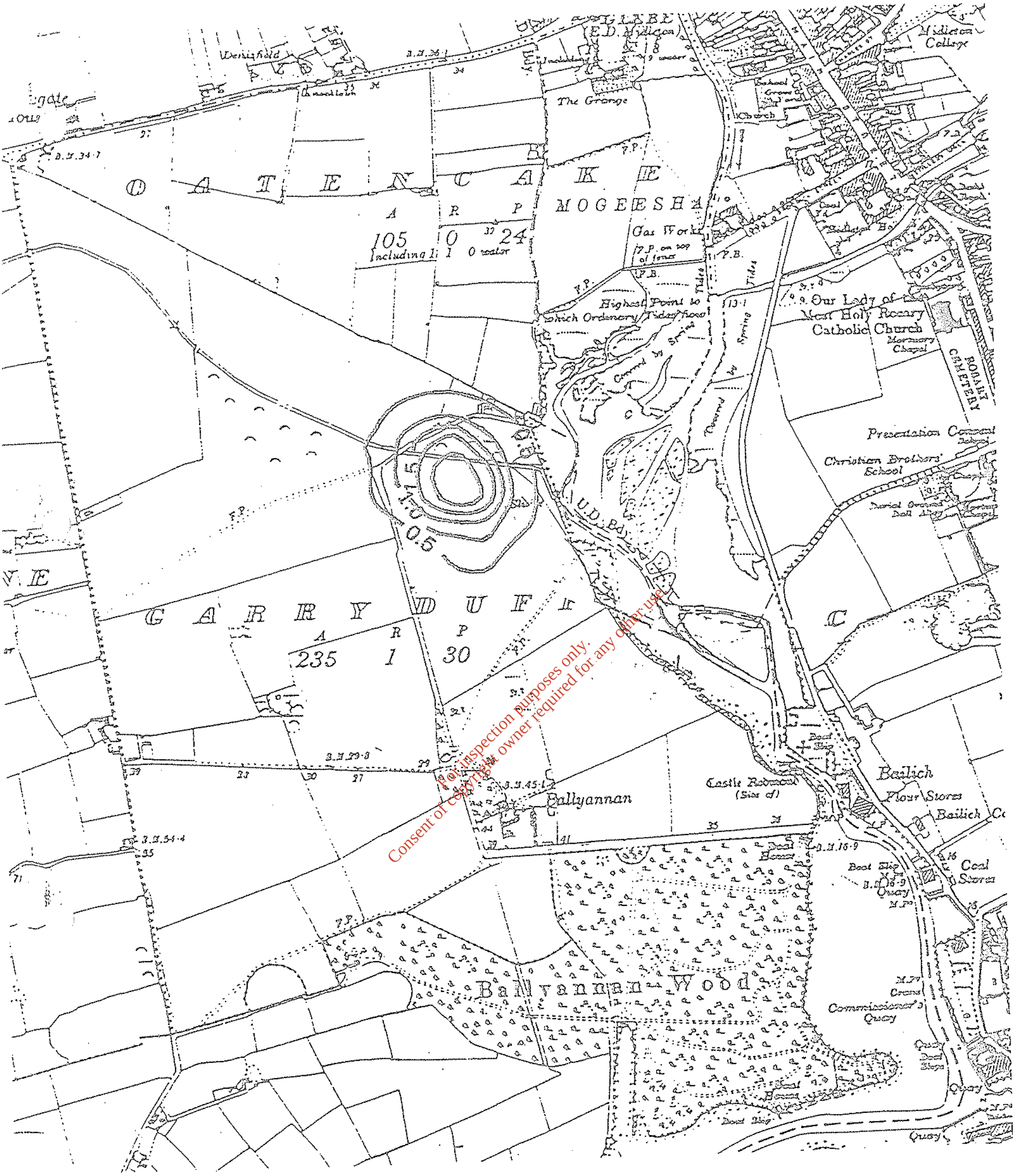


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FIG 2: PEAK SHORT TERM ODOUR CONCENTRATIONS UNSTABLE STABILITY CONDITIONS (o.u./m³)

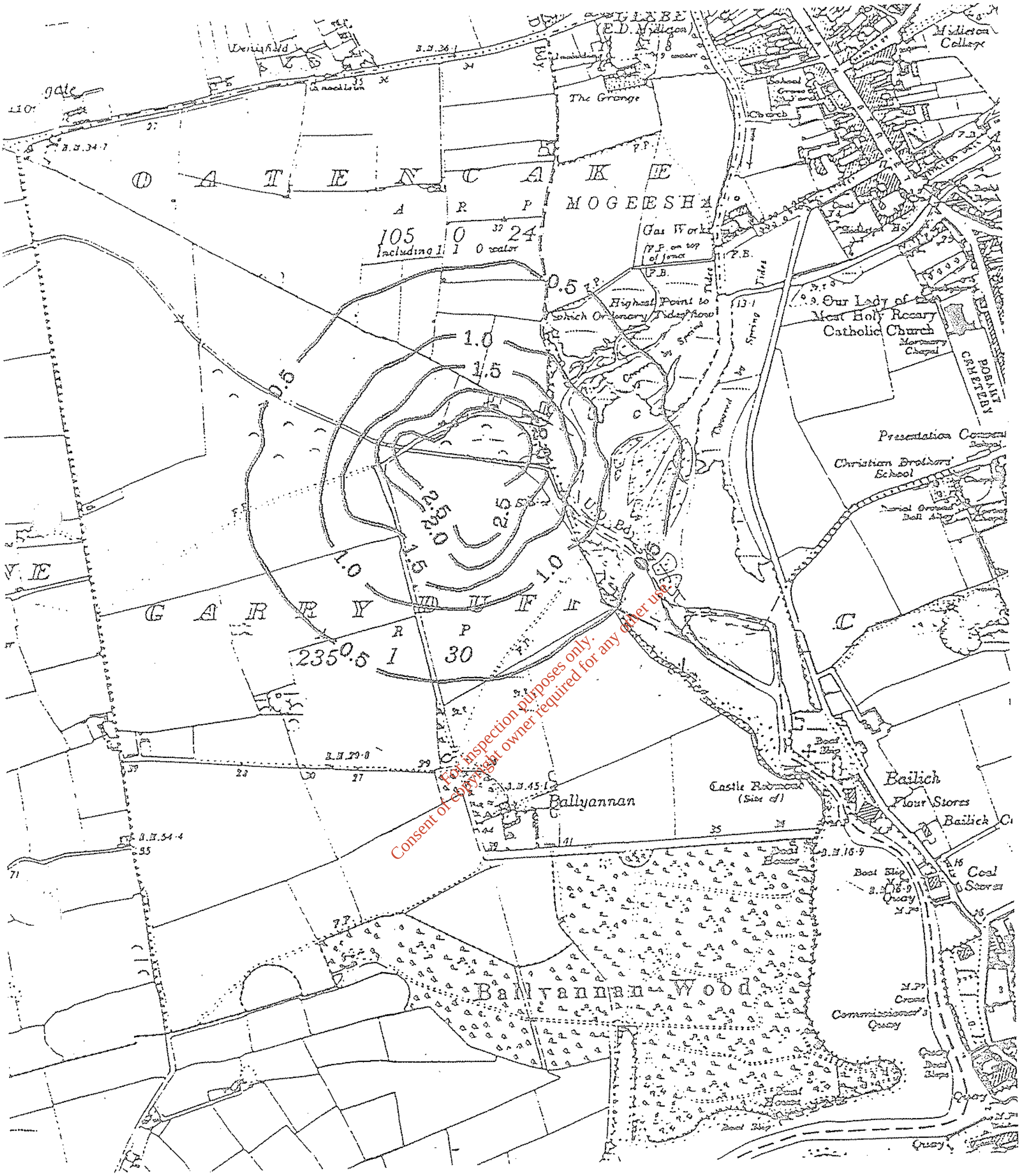

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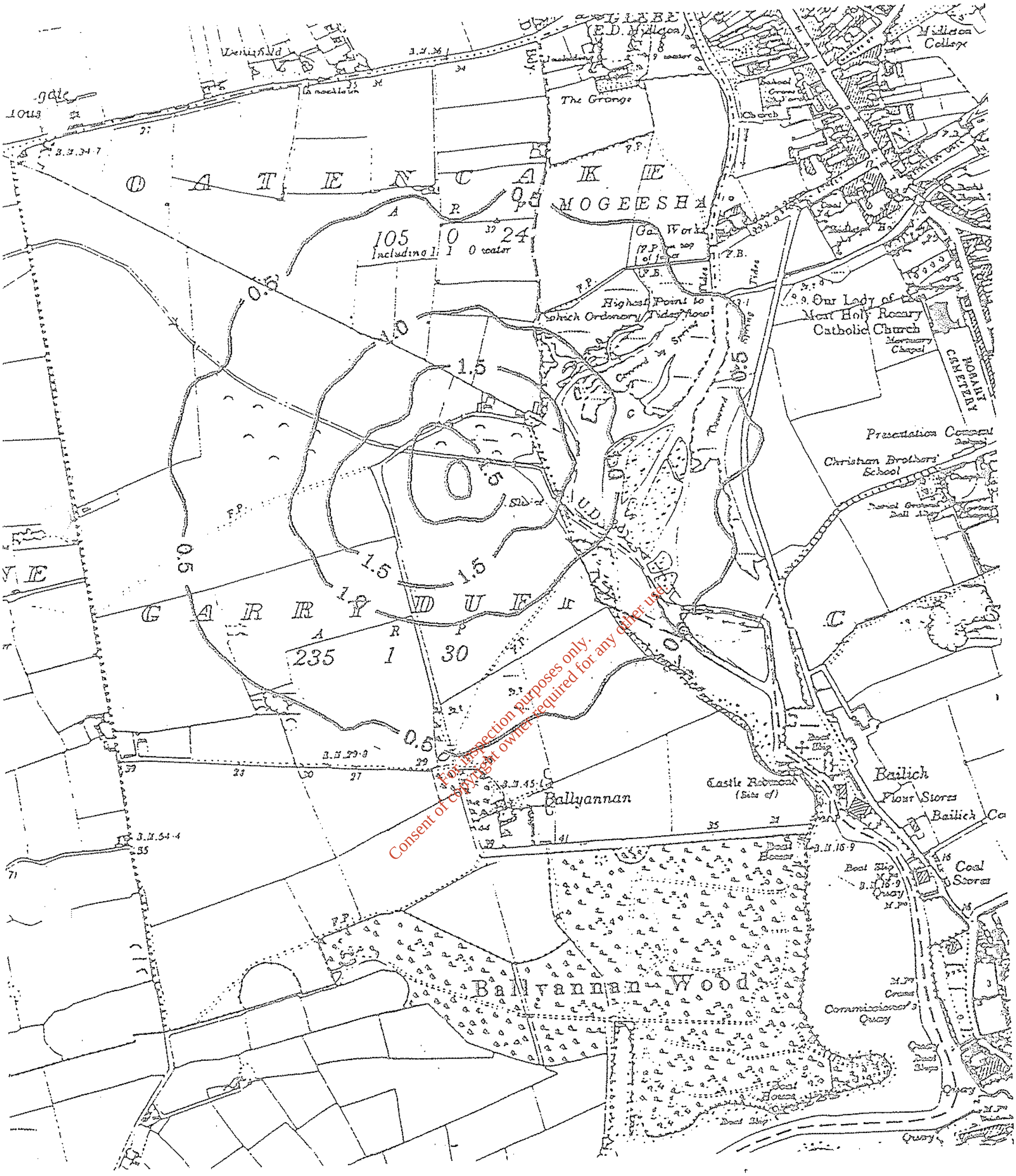
FIG 3: PEAK SHORT TERM ODOUR CONCENTRATIONS
NEUTRAL STABILITY CONDITIONS (o.u./m³)



ENVIROCON LTD

FIG 4: PEAK SHORT TERM ODOUR CONCENTRATIONS
STABLE STABILITY CONDITIONS (o.u./m^3)

SECTION 9

EXISTING HABITAT

MIDLETON SEWAGE TREATMENT WORKS
ENVIRONMENTAL IMPACT STATEMENT

FLORA, FAUNA, FISHERIES AND AQUACULTURE

A REPORT PREPARED FOR M.C.O'SULLIVAN

October 1993

NATURAL
ENVIRONMENT
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NON-TECHNICAL SUMMARY

1.1 An Environmental Impact Statement (EIS) has been prepared, in accordance with government regulations, for certain aspects of a new sewage treatment works (STW) at Midleton, Co. Cork. This part of the EIS is concerned with the flora, fauna, marine benthos and aquaculture/fisheries of the areas that may be affected by the proposed works.

1.2 The objectives of the study were to establish baseline data for the elements mentioned above, to determine the impact of the proposed STW and any new outfall, and to propose mitigating measures where appropriate.

1.3 The present scheme involves the preliminary treatment of domestic and industrial sewage from Midleton which is comminuted and released to the north end of the East Passage via an outfall at Rathcoursey. Mean flow (1991-93) is about 6,50 cu.m./day with daily release of suspended solids amounting to about one tonne. The new plant will provide full secondary treatment of the effluent.

1.4 Two alternative sites for the STW have been examined: Site 1 close to the Midleton by-pass and Site 3, south of Ballynacorra. The preferred option for an outfall is to use the existing outfall at Rathcoursey but new outfalls at the alternative STW sites have also been considered.

1.5 Site 1 comprises a field of improved grassland which is of low ecological value, although it contains some good boundary hedges. Site 3 is under arable cultivation and is also of low ecological value. The field boundaries on the north, west and south sides of the site are of moderately high to high ecological value. Neither site is listed as an Area of Scientific Interest (ASI) or is otherwise protected under conservation legislation.

1.6 The site for the possible outfall at Site 1 is a tidal river channel (20 m. wide) with steep banks of rock armouring and with a widely-fluctuating salinity regime. The rock armouring is covered with a dense growth of brown seaweed (flat wrack) and the site supports a variety of typical upper estuarine species.

1.7 The outfall site at Site 3 consists of gently-sloping intertidal mudflat (c.90 m. wide), with rock and boulders at high water mark. A more varied fauna occurs here compared to Site 1 comprising typical estuarine animals such as the common goby, common shrimp, shore crab, edible periwinkle and polychaete worms.

1.8 At the site of the existing outfall at Rathcoursey grab samples were taken to determine the nature and composition of the bottom fauna. Hard gravel substrates, scoured by the strong currents, were found around the outfall and up to 250 m. north of it. A wide-ranging fauna here included starfish, brittle stars, sea anemones, sponges, crustaceans and molluscs. In the muddier conditions to the north the samples were dominated by small polychaete worms, with one species (Tharyx sp.) particularly abundant. Several species occur here which are indicative of polluted conditions.

1.9 The North Channel, particularly the western end, is an important area for wintering wildfowl and waders with peak counts of 5,000-7,000 birds in December to February. The large areas of intertidal mudflat provide rich feeding grounds and the area is protected as an ASI. It is also proposed as a Special Protection Area (SPA) under the EC "Birds Directive".

1.10 The North Channel is also an important location for oyster farming with three firms engaged in the cultivation of Pacific and native oysters. Total production is in the order of 450 tonnes per annum. Under EC regulations oysters marketed directly to retail outlets must undergo purification but, despite this, Atlantic Shellfish have suffered problems with bacterial and viral contamination. This issue will be addressed separately within the EIS.

1.11 Marine fisheries within the study area are limited to small-scale potting for green crabs and velvet crabs, with lobster as a by-catch. The Owenacurra and Roxboro Rivers receive good runs of sea trout and the Owenacurra also has a good run of grilse and salmon.

1.12 The impact of the proposed STW on terrestrial flora and fauna will be minimal at both sites. Site 1 is under improved grassland whereas Site 3 is under arable cultivation. Neither is of significant ecological value. The boundary hedges and trees at either site will not be affected significantly by the proposed STW.

1.13 The construction of an outfall at either site would have a small temporary impact on water quality in the estuary as silt is released from sediments. However, the discharge of treated effluent is not expected to have a significant impact on the marine environment provided that the characteristics of the primary effluent remain as they are at present. Fine organic particles from the outfall will be transported onto mudflat areas and will be absorbed within this system. There may be some increase in green algal growth as a result of organic enrichment.

1.14 Conversely, the change from release of primary- to secondary-treated effluent at Rathcoursey would provide positive benefits for the marine environment, should this option be pursued.

INTRODUCTION

1.0 BACKGROUND INFORMATION

History of the Scheme

1.1 In March 1972 M.C.O'Sullivan completed a preliminary report which outlined five options for the disposal of sewage from Midleton. At that time mainly untreated sewage was discharged via 10 outfalls directly to the Owenacurra and Roxboro (or Dungourney) Rivers, close to the town. The recommended option at that time was comminution plus tidal tanks and discharge at Rathcoursey but this was not proceeded with at that time. From 1977 to 1979 further studies on the sewage scheme were carried out, including dye studies to model the effect of a possible outfall at Rathcoursey. Local people and shellfish growers expressed their opposition to this outfall and called for secondary treatment of sewage.

1.2 In 1981, at the request of the Minister for the Environment, Midleton Urban District Council asked M.C. O'Sullivan to re-examine the proposals. The ensuing report (O'Sullivan 1981) confirmed the earlier advice that the best option was comminution of sewage and release via an outfall at Rathcoursey. Following further discussions with the Department of the Marine and the Department of Fisheries it was decided to include a tidal holding tank in Phase 1 of the Scheme. Secondary treatment was to be provided in Phase 2 of the Scheme. Construction work on the Scheme began in 1986 with discharge from the Rathcoursey outfall commencing in December 1988.

Description of Existing Scheme

1.3 The present Scheme serves a population of over 6,000 persons in Midleton Urban District and its environs together with Midleton's industrial plants. The industrial effluent load is comprised entirely of organic effluents from Campbell Irish Foods, Irish Distilleries Ltd, Nordic Cold Stores, Midleton Cattle Mart, etc. Nordic Cold Stores and Meadow Meats Ltd discharge their effluent directly into the North Channel via a separate outfall near Ballyannan House.

1.4 Domestic and industrial sewage is discharged to separate sumps in the main pumphouse at Bailick Road. From here the effluent is pumped to a second pumping station at Ballinacurra where it is comminuted before being discharged, via a tidal holding tank (capacity 2120 cu.m.), to the East Passage at Rathcoursey.

1.5 The effluent pipe consists of a 600 mm. steel pipe with a 125 mm. concrete surround and a 21 m. diffuser unit.

1.6 Monitoring by Cork County Council shows that between January 1991 and May 1993 an average of 6,534 cu.m. of effluent was discharged per day (range: 3,011 - 11,457 cu.m./day) with the higher flows due to storm water. The effluent contains an average of 0.95 tonnes/day of suspended solids.

2.0 THE PROPOSED PROJECT

2.1 In January 1990 the Government launched its "Environment Action Programme" which adopted a policy of providing full secondary treatment facilities for all coastal towns with a projected population of more than 10,000, in line with the requirements of the EC Directive on Urban Waste Water Treatment (91/271/EEC).

2.2 Two alternative sites for the Sewage Treatment Works are under consideration. These are: Site 1 at Garryduff, close to the Midleton by-pass and 1.0 km. SW of Midleton, and Site 3 at Ballynacorra 2.3 km. S of Midleton (Figure 0 - Main Report).

2.3 The four options for STW and outfall which are being considered are as follows:-

1. Site 1 + construction of a new outfall discharging to the Owenacurra River just south of Midleton by-pass bridge.
2. Site 1 + utilisation of the existing Rathcoursey outfall.
3. Site 3 + construction of a new outfall discharging to the Ballynacorra River from the southern end of the site
4. Site 3 + utilisation of the existing Rathcoursey outfall.

2.4 Any new outfall pipe would be similar in design to the existing Rathcoursey outfall pipe, i.e. a concrete-surrounded steel pipe with a diffuser.

3.0 SCOPE OF STUDY

3.1 The objectives of the study as agreed with M. C. O'Sullivan were:-

- To establish baseline data for marine fauna in the vicinity of the existing outfall and at the two alternative outfall sites.
- To research existing data, published or unpublished, on marine benthos, aquaculture and fisheries for the North Channel area of Cork Harbour.
- To describe and evaluate the existing terrestrial habitats, flora and fauna of the alternative sites for the proposed STW.
- To establish the distribution and importance of waterfowl populations in the North Channel and Ballinacurra areas of Cork Harbour.
- To determine the likely impact of the proposed STW and alternative outfalls on marine benthos, fisheries and aquaculture (excluding bacteriology), waterfowl and terrestrial flora and fauna.
- To propose mitigating measures to reduce impacts where possible.

4.0 THE STUDY AREA

Extent

4.1 The study area for terrestrial flora and fauna is clearly defined by the boundaries of Sites 1 and 3 and any areas above high water mark along the route of any new outfall pipe.

4.2 For marine/aquatic aspects of the Scheme attention has focussed on the areas most directly affected by the proposed outfalls at Sites 1 and 3 and the existing outfall at Rathcoursey. However, a larger study area has been covered in the case of the estuarine bird population, oyster cultivation and marine fisheries (the North Channel and the eastern part of the Lower Harbour) and salmonid fisheries (the Owenacurra and Roxboro [or Dungourney] Rivers).

Topography, Geology and Soils

4.3 Midleton lies at the head of the Ballynacorra Estuary near the north-east corner of Cork Harbour. The topography of this part of Co Cork is characterised by a series of elongated hills (anticlines) and valleys (synclines) orientated in an east-west direction, the result of the so-called "Armorican folding". Midleton and the North Channel lie in a broad vale of Carboniferous limestone. To the south, Great Island is formed by a steep ridge of Old Red Sandstone which is breached in only two places by former river valleys to form the East and West Passages (Whittow 1975).

4.4 The principal soils of this area are the Brown Podzolic and Acid Brown Earth. These soils have good structure, texture, drainage and depth features and are well suited to arable cropping and grassland (Gardiner and Radford 1980). The rich agricultural hinterland of Midleton and the surrounding area reflects these advantageous condititions.

Marine Areas

4.5 The North Channel and Ballynacorra Estuary are isolated from the rest of Cork Harbour, being enclosed by Fota Island, Great Island and the mainland at Rathcoursey. The main connection with the Lower Harbour is via the East Passage. This is only 350 m. wide at its widest point and water exchange at the top of the East Passage has been measured at 19%. Water exchange between the North Channel and Lough Mahon at Belvelly Bridge is insignificant as this channel is virtually closed.

4.6 For the most part the North Channel and the contiguous Ballynacorra Estuary consists of extensive intertidal mudflats. The central channel is deepest at the entrance to the East Passage (11.4 m. at ELWS), becoming narrower and more shallow to the west. Only a very narrow channel occurs in the centre of the Ballynacorra Estuary.

4.7 Salinities just north of Rathcoursey vary from 27.1% to 32.9% in July/August - i.e. almost full strength sea-water (Table 1). Even in spate conditions, salanities here remain relatively high. To the west of Rathcoursey the North Channel experiences similar or higher salinities while progressively lower salinities are recorded as one moves up the Ballynacorra Estuary (O'Sullivan 1981).

4.8 Full data on tidal currents, tidal exchange and water movement will be provided by the Irish Hydrodata study.

5.0 REVIEW OF PREVIOUS STUDIES

Terrestrial

5.1 As far as we know, no previous information is available on the flora and fauna of the two sites under consideration.

Marine

Benthic Surveys

5.2 The Cork Harbour Water Quality Report (ERU 1989) provides a useful and reasonably up-to-date review of information on Cork Harbour, especially for the many unpublished commissioned reports on Cork Harbour which are difficult to access.

5.3 Little is known about the sub-littoral fauna of Cork Harbour and in particular about the North Channel area. A preliminary survey of the Lower Harbour was carried out in March 1977 with grab samples taken at 67 stations (Myers et al 1977). The results indicated a Tellina fabula sub-community of the Venus striatula community, which is typical of shallow sublittoral muddy sands or sands. More specific studies have also been carried out of the Curlane Bank and White Bay (Myers et al 1978) and the Ringaskiddy outfall site (Keegan et al 1988) near the Harbour Mouth.

5.4 Benthic faunal surveys have also been conducted in the Lough Mahon/West Passage area involving grab samples taken at 22 stations in 1978 and 1980 (IIRS 1979; NET 1981). These areas are dominated by two species, Abra alba and Nephtys hombergi, which are typical of the more saline reaches of an estuarine environment.

5.5 More recently (1991) a baseline survey of the entire Harbour area has been carried out for Cork Corporation in relation to the proposed Cork Main Drainage Scheme (Aqua-Fact International Services Ltd 1991). Assessment of the sublittoral habitat was carried out at 18 stations using Sediment Profile Imagery (SPI) and van Veen grab sampling. Replicate grab samples were taken at three stations in the North Channel, two of them (Stations S6 and S7) close to the North end of the East Passage and the third (Station S8) further east, opposite Rossmore. Species lists for these stations are presented in Appendix IV as they provide useful comparative data.

Intertidal Surveys

5.6 A baseline survey of 17 shores in Cork Harbour was carried out in 1975 for the Cork Harbour Pollution Report (O'Sullivan 1977) using intertidal transects. Two of these were in the North Channel: Transect 16 (Opposite Brown Island) and Transect 17 (Rathcoursey). Twelve of these shores were re-surveyed for the recent Cork Corporation survey (Aqua-Fact International Services Ltd 1991) but this did not include either of the transects in the North Channel. No intertidal data is available from either survey for shores in the Ballynacorra Estuary.

Estuarine Birds

5.7 Waterfowl counts have been carried out in Cork Harbour at intervals over the past two decades. Data are available for the winters 1974/75 (Hutchinson 1979), 1978/79-1981/82 (Hutchinson and O'Halloran 1984) and 1984/85 to 1986/87 (Sheppard, in press). A new series of counts was initiated in 1991 (Coveney 1992) and unpublished data on the study area for the two most recent winters, 1991/92 and 1992/93, have been supplied by the Irish Wildbird Conservancy (J. Wilson, in litt.).

Fisheries and Shellfish

5.8 Little work has been carried out on the fisheries or fish/shellfish stocks of Cork Harbour (Paul Connolly (FRC) and BIM, pers comm).

5.9 Browne (1903) provides a full description and maps of shellfish beds in Cork Harbour at that time. The area of the North Channel now worked by Atlantic Shellfish Ltd was, at that time, a Public Oyster Bed but was supporting only two boats. A second Public Oyster Bed existed at Rostellan but, again, the productivity of the Bed at the time of Browne's survey was much reduced over previous years. At that time there were two private oyster beds at Rathcoursey which were used mainly for fattening and storing oysters. Bawnard Creek, in the Ballinacurra Estuary, supported a small cockle fishery in 1903.

5.10 There is little recent information available on oyster cultivation in Cork Harbour apart from a paper on oyster growth (Barry 1975) and a summary report on mariculture activities and potential (Partridge et al 1982).

5.11 In 1969 a BIM survey identified a number of mussel beds in the Ballynacorra Estuary (Meaney 1969). These occurred mainly in the intertidal zone and consequently were in poor condition and of little commercial value. A more sizeable bed covering about 1 hectare was found on the north bank, opposite Rathcoursey, with the majority of mussels thin-shelled and fast-growing. Meaney considered the North Channel might have potential for bottom laying of mussels but this idea was never developed.

METHODS

1.0 TERRESTRIAL FLORA AND FAUNA

Habitats

1.1 Habitats on each of Sites 1 and 3 were evaluated with a Phase 1 Habitat Survey using habitat types defined by the Nature Conservancy Council (Anon 1990). All the sites were visited on 29 September 1993 and habitats mapped at a scale of 1:2,500. Colour aerial photographs of both sites, taken in early September, were also used to verify the distribution of habitats.

Field Boundaries

1.2 The hedges were surveyed on 29 September 1993 and evaluated using a quantitative methodology devised by Clements and Tofts (1992). This gives weighted scores to various ecological attributes such as structure, diversity, connectivity (links with other hedges) and associated features (such as banks, drains and grass verges). All hedges were assigned a grade on a scale of 1 to 4 signifying the following levels of ecological value:-

Grade 1:	High to very high value
Grade 2:	Moderately high value
Grade 3:	Moderate value
Grade 4:	Low value

1.3 Each of these grades is further sub-divided into three categories with the use of + or - symbols (e.g. 1+, 1, 1- etc.).

2.0 MARINE BENTHOS

Field Survey

2.1 To establish existing conditions in the vicinity of the Rathcoursey outfall a grid of 18 stations was set up for benthic sampling. The grid was laid out to coincide with the likely movement of effluent emerging from the outfall, as determined by tides and tidal currents (Figure 4).

2.2 Sampling was carried out on 27 August 1993 from the 13 m. trawler "Skye Maid" using a Day Grab which sampled 0.1 sq.m. of the sea bed. Grab samples could only be obtained at the northernmost 8 stations, due to the hardness of the bottom in the East Channel and to the north of the outfall (Figure 5). In this area qualitative samples of the benthic epifauna were obtained using a Naturalist's Dredge, although in some areas (e.g. stations M5 - M7) even this did not produce a sample.

2.3 Position-fixes (Table 2) were obtained using an on-board satellite navigation system (Raytheon Raystar 920 GPS). As the accuracy of fixes obtained using standard GPS in the Cork Harbour area is open to question (Irish Hydrodata, pers comm) position fixes in the vicinity of the East Channel were checked at identifiable land points using a hand-held Trimble Transpak GPS. These gave accurate readings, thus the co-ordinates obtained for sampling stations are thought to be accurate. Nonetheless, a maximum error of 100 m. must be allowed for in sampling station positions.

Physical Measurements

2.4 Particle size analysis (PSA) was carried out by the Aquatic Services Unit, University College Cork, on samples of sediment taken from 11 stations. This excluded hard substrates at the southern end of the sample grid but included two additional stations at the northern end (M19 and M20). Samples were oven dried, dry sieved - using a standard range of Wentworth sieves (0.063 - 5.6mm) - and fractions weighed, following the methodology recommended by Buchanan (1984). The data were analysed graphically by plotting cumulative frequency curves on a log-transformed Wentworth scale as described by Buchanan (1984). The raw data are presented in Appendix III.

2.5 Total organic carbon (TOC%) was measured at twelve stations where undisturbed sediment samples could be obtained. The modified Schollenberger chromic acid oxidation technique (Buchanan 1984) was used (Table 3).

2.6 A visual estimate of the Redox Potential Discontinuity (RPD) depth was made in order to provide an indication of the degree of anoxia in the sediments. The RPD occurs at the boundary between the lighter-coloured, oxygenated surface sediments and the deeper grey or black anoxic sediments, although this does not necessarily correspond exactly with the point at which Eh = 0.

Processing of Faunal Samples

2.7 On collection, samples were placed in heavy-duty polythene bags and were later sieved through a 1.0 mm. steel sieve to remove excess sediment. The retained organisms, sediment, pebbles and shell debris were preserved in sample jars to which 4% saline-buffered formaldehyde was added. Rose Bengal was used as a vital stain to assist manual sorting. All visible organisms were picked out of all grab samples except for two stations (M9 and M18) where the large number of organisms made it necessary to sub-sample.

2.8 Identification and analysis of faunal samples was carried out by the Field Studies Council Research Centre, Pembroke, South Wales. Where possible, all organisms in each sample were identified in the laboratory to species level. Forty nine taxa were identified from the 8 grab samples and these are shown in Appendix I. A further 37 taxa were identified from the qualitative grab and dredge samples (Appendix II), making a total of 86 taxa for the sub-littoral stations.

Analysis of Macrobenthos

2.9 The following analyses were carried out on the grab sample by the Field Studies Council Research Centre, Pembroke, South Wales. The results are presented in Appendix I.

Calculation of Diversity and Dominance Indices

2.10 The following three indices were used:-

- Shannon-Wiener Information Function, H(s) (Lloyd, Zar and Karr 1968) which is the most widely-used index in the analysis of benthic fauna and gives a measure of both diversity and evenness.

- Pielou's Evenness Index (j), (Pielou 1966) which is based on Shannon-Wiener and measures how evenly spread the individuals are over all the species in the sample.

- Simpson's Index of Dominance (c), (Simpson 1949) which gives the probability of two randomly-chosen individuals in a sample belonging to the same species.

Determination of Numerically Dominant Taxa

2.11 For each station the taxa were ranked according to the percentage they contribute to the total number of individuals. The percentage contributions of the most abundant taxa were summed until 50% of the total is reached. Taxa occurring within this arbitrarily-defined group are regarded as numerically dominant.

Rarefaction Curves (Hurlbert 1971)

2.12 Rarefaction curves were plotted by interpolating the expected number of taxa (S) for progressively reduced sample sizes (N) calculated from actual values of S and N.

Classification and Ordination of Stations

2.13 These analyses proceed from a similarity matrix for all pairs of stations based on the Bray-Curtis similarity co-efficient (Bray and Curtis, 1957).

2.14 The similarity matrix was then subjected to the following analyses:-

- *Group average clustering* (Lance and Williams 1967). This is an agglomerative hierarchical technique which clusters those stations showing the greatest similarity, with the results being plotted as a dendrogram.

- *Non-metric multi-dimensional scaling* (MDS) (Kruskal 1964). This is a non-linear ordination procedure which is based upon ranked distances between samples in the "variable space". It gives the best representation of n related objects in two dimensions such that the inter-point distances correspond as nearly as possible to the relationships between the objects.

3.0 INTERTIDAL SAMPLES

3.1 Intertidal samples were collected in the areas which might be affected by the outfalls at the two alternative sites (Site 1 and Site 3).

3.2 At Site 1 the intertidal zone consists of seaweed-covered rock armouring which shelves steeply into the Owenacurra River. Here, a timed search (10 minutes) was made of the weed and stones and a sample of the infauna was taken from gravel at the edge of the river. A pond net sample of mobile fauna was also taken. Samples of sediment were taken for PSA and TOC analysis.

3.3 At Site 3 the shore consists of mudflat with weed-covered rocks on the upper shore. A 0.1 sq.m. quadrat was used to obtain semi-quantitative samples which were sieved and later picked out for faunal identification. At the higher shore stations (2c-2e) only the top 4 cm. of sediment was removed and sieved. Qualitative samples of deeper burrowing organisms were taken from amongst stones and gravel.

3.4 At the highest station (2e) a timed search (10 minutes) was carried out as above. A pond net sample of mobile fauna was taken at the edge of the channel, deep mud preventing access to deeper parts of the channel. Samples of sediment were taken from all stations for PSA and TOC analysis.

4.0 FISHERIES AND AQUACULTURE

4.1 Data on oyster cultivation was obtained through discussions with Bord Iascaigh Mhara (BIM), the Department of the Marine and the main oyster cultivators in the North Channel. Data on marine fish and fisheries in the study area are sparse but some information was obtained from local fishermen. Data on salmonids were provided by the South-Western Regional Fisheries Board.

5.0 ESTUARINE BIRDS

5.1 The principal ornithological interest of the intertidal area is the populations of wintering waterfowl which reach a peak in mid-winter. Given the timescale of this report, it was not feasible to carry out an adequate field survey of waterfowl. However, the Irish Wildbird Conservancy made available recent survey data for the study area for the winters 1991/92 and 1992/93. In addition, published data on the birds of the area were reviewed.

THE TERRESTRIAL ENVIRONMENT

1.0 GARRYDUFF SITE (SITE 1)

General Site Description

1.1 The site is in an area of relatively level agricultural land on the west side of the Owenacurra Estuary. It comprises a single field which is bordered by mature hedgerows on the south and west sides and by the embankment of the Midleton bypass road to the east. There are small patches of mixed broad-leaved woodland outside the boundaries of the site and a small freshwater stream flows along its northern boundary.

Field

1.2 The field vegetation on the site is entirely comprised of dry, improved grassland. This is reseeded pasture which has not been intensively used in recent years. It is dominated by several common grasses including cock's foot (Dactylis glomerata) and Yorkshire fog (Holcus lanatus) with red clover (Trifolium pratense) and creeping buttercup (Ranunculus repens). The low intensity of management has allowed extensive invasion by nettle (Urtica dioica) and creeping thistle (Cirsium arvense). The field vegetation is unsuitable for nesting birds because it is grazed during the summer months. The low floral diversity would also make the grassland unattractive to many invertebrate species. The field is thus of low ecological value.

Field Boundaries

1.3 The south and west boundaries of the site consist of old drystone walls with mature hedgerows whose total length is 770 linear metres. The canopy is mainly dominated by hawthorn and blackthorn with occasional elder. Most of the standard trees are ash but oak also occurs. Mature trees are relatively few and there are many gaps in the hedges. The ground beneath the hedges has good cover of bramble (Rubus fruticosus) and there is extensive growth of wild clematis (Clematis vitalba) on trees and shrubs in the south-west corner of the site. An ecological evaluation of the hedges assigned both to a grade of 2+, indicating a moderately high value (Table 4). No faunal surveys of the field boundaries were carried out but it is likely that the hedgerows would hold a typical breeding bird community with a range of common species (see for example, Lysaght 1989). There is no evidence of any rare of uncommon species on the site.

Associated Features

1.4 Outside the southern boundary of the site is a small area of mature broad-leaved woodland which inter-connects with the southern hedgerow (no. 1). This is located on a series of limestone outcrops and is long-established secondary woodland. The canopy is dominated by ash with some oak, hawthorn and elder. The ground flora is impoverished due to heavy grazing and trampling by cattle. There is also much rabbit burrowing in the soil beneath the woodland. Outside the northern boundary is another small patch of broad-leaved woodland between the stream and a farm track. This contains ash, oak, beech and alder. The understorey includes hawthorn and blackthorn.

Evaluation

1.5 The site is not listed as an Area of Scientific Interest (ASI) although it is adjacent to the boundary of the North Channel ASI, which includes the intertidal area as far north as Midleton. The field itself is improved grassland and is of low ecological value. The hedgerows on the western and southern boundaries of the site are of moderately high ecological value. Two small areas of woodland outside the boundaries of the site are of some local ecological value but are not of scientific interest.

2.0 BALLYNACORRA SITE (SITE 3)

General Site Description

2.1 The site consists of an area of undulating farmland on the eastern side of the Ballynacorra Estuary in the townland of Ballynacorra. It is bordered on two sides, north and west, by a line of mature trees and a steep, shingle shore which leads onto an extensive area of intertidal mudflat. The site is divided into three fields.

Fields

2.2 The entire area is under arable cultivation with the exception of a small rectangular area in the centre which has been planted with spruce trees. The principal crop is cereals, although a root crop is grown in the field immediately to the south of the site. The field vegetation is entirely artificial and is thus of low ecological value.

Field Boundaries

2.3 The northern and western boundaries of the site are formed by two long shelterbelts of mature trees which have been planted along a steep slope between the field edge and the top of the shoreline to provide shelter from the wind. They contain a large mixture of exotic and native trees and shrubs including beech, oak, Scots pine, sycamore, ash, sweet chestnut, eucalyptus and elm. The hedge canopy is also formed by a mixture of shrub species including hawthorn, gorse and elder with some young conifers interplanted. In places the ground is shaded by a dense growth of bramble, but in other areas there are openings where grasses and mosses are dominant. Both field boundaries have been assigned a grade 2 rating, indicating that they are of moderately high ecological value.

2.4 Along the southern boundary of the site is a long hedgerow which contains a mixture of ash, sycamore and elm trees with hawthorn and elder forming the hedge canopy. It is a spine hedgerow and therefore probably older than the adjoining hedges. It is rated a grade 1 hedgerow, indicating high ecological value.

2.5 The internal hedges on the site are all of quite recent origin and have been planted to provide shelter for crops. They consist mainly of two exotic species, Italian elder (Alnus cordata) and Lawson cypress (Chamaecyparis lawsoniana). There are no standard trees and the hedges are heavily trimmed to a regular shape. These hedges are rated grade 3+ indicating moderate ecological value. No faunal surveys of the field boundaries were carried out but it is likely that the hedgerows (especially those around the perimeter of the site) would hold a typical breeding bird community with a range of common species (see for example, Lysaght 1989). There is no evidence of any rare or uncommon species on the site.

Evaluation

2.6 The site is not listed as an Area of Scientific Interest (ASI) although it is adjacent to the boundary of the North Channel ASI, which includes the intertidal area to the north and west of the site. The field itself is highly modified and is of low ecological value. The hedgerows around the perimeter of the site are of moderately high ecological value.

THE AQUATIC ENVIRONMENT

1.0 GARRYDUFF SITE (SITE 1)

1.1 The proposed outfall will be sited just south of the bridge which takes the Midleton by-pass over the Owenacurra River (Figure 1). The course of the river has been modified at this point and it is now confined within steep banks consisting of rock armouring (2.5 - 3.0 m. high). The river here is 20 m. wide and tidal, with considerable areas of mudflat just above the bridge which flood at high tide.

1.2 Salinity measurements 300 m. downstream of here indicate a widely fluctuating salinity regime which ranges from nil at low water in spring tides to 31.39% (almost full-strength seawater) at high water of spring tides (Table 1). Low dissolved oxygen levels in 1981 (Table 1) reflect high BOD loadings prior to the construction of the existing sewerage network.

1.3 The rock armouring is covered with a dense growth of flat wrack (Fucus spiralis) for about 2.0 m. above LWM, with some Enteromorpha. Faunal diversity is low but with shore crabs (Carcinus maenas) plentiful amongst weed and the amphipod Echinogammarus marinus present in large numbers. The burrowing polychaete Hediste diversicolor, which is often found in brackish conditions, was present in gravel at the edge of the channel. In the channel itself small flatfish were noted on the gravel bottom and large shoals of opossum shrimps (Neomysis integer), together with the common prawn (Palaemon serratus) and common shrimp (Crangon crangon) were present at the channel edge, amongst weed. Small eels (Anguilla anguilla), up to 120 mm. long, were also found. In deeper water, large fish, possibly mullet (Chelon labrosus) were seen feeding. Barnacles (Balanus balanoides) occur on the rocks at low water and on the bridge supports.

2.0 BALLYNACORRA SITE (SITE 3)

2.1 The proposed outfall at Site 3 would enter the estuary some 3 km. downstream from Midleton where the estuary broadens to expose large areas of mudflat. At low water the channel is some 50 m. wide. Salinities here (27% -33%) approach full-strength seawater at high tide, with surface salinities falling to 13.7% at low tide in July/August (Table 1), and probably lower in winter.

2.2 Over the 90 m. of shore from the channel edge to HWM the substrate changes from deep, fine mud to fine gravel/sandy mud and an upper shore composed of boulders and rock.

2.3 At the edge of the channel (Station 2a) the substrate is deep (55 cm.), fine, largely anoxic mud with a high (73.9%) silt/clay fraction (Appendix III) and very few organisms (Appendix II). Pond netting in the channel revealed common shrimp and shore crab. Shoals of juvenile mullet and the common goby (Pomatoschistus microps) were found in an intertidal lagoon nearby and these species are almost certainly present in the channel.

2.4 Higher up the shore (2b) the presence of large amounts of mussel shell provides a harder substrate inhabited by the burrowing polychaete Hediste diversicolor with common shrimp and shore crab amongst the shells.

2.5 At station 2c the substrate consists of a fine gravel/sandy mud with pebbles and a surface layer of dead shells. Hediste diversicolor burrows were again apparent and the surface layers contained shore crab. The bivalve mollusc Abra tenuis, which is a characteristic species of intertidal mudflats in estuaries, also occurs.

2.6 Further up the shore (2d) particles of fine mud overlie gravel. The fauna here is similar to 2c with the addition of the common cockle (Cerastoderma edule) and, in some areas, casts of the lugworm (Arenicola marina).

2.7 The upper shore has scattered boulders covered with knotted wrack (Ascophyllum nodosum) and bladder wrack (Fucus vesiculosus) resting on coarse sand and gravel. The fauna of the sand/gravel (2e) consists of Hediste diversicolor, as before, with shore crabs and the common estuarine amphipod, Corophium volutator. The timed search of shore and weed revealed the edible periwinkle (Littorina littorea), the flat periwinkle (L. littoralis), shore crabs, barnacles (Balanus balanoides), amphipods (Echinogammarus marinus) and, in the gravel, Hediste diversicolor and the common cockle.

2.8 The high water mark consists of bare rock with typical rocky shore zonation: Verrucaria and other lichens in the splash zone; a narrow band of channel wrack (Pelvetia canaliculata); and below that a band of flat wrack. With a fetch of less than 3 km. this shoreline is described as "extremely sheltered" in terms of wave exposure, according to the 8-point scale used by the Marine Nature Conservation Review in G.B. (Hiscock, 1990).

2.9 In total fourteen taxa were found at the five stations sampled on this transect reflecting the typically low faunal diversity of an upper estuary.

3.0 EXISTING OUTFALL AT RATHCOURSEY

Bottom Conditions

3.1 The East Passage is well scoured by strong tidal currents - up to 3 knots according to Admiralty Chart No. 1773. The bottom is, consequently, hard in the East Passage and for about 300 m. north of the existing outfall (Figure 5). Dredge samples showed the bottom here to consist of small stones (2-15 cm.), gravel and shell debris (Table 5).

3.2 North of this is a transition zone (stations M12 and M13) where mud overlies gravel. The particle size analysis (PSA) for station M12 indicates a poorly-sorted substrate with a mean grain size of about 1.0 mm.

3.3 This transition zone rapidly gives way to muddier conditions further into the North Channel. PSA for all stations here except, M18 indicated fine, well-sorted muds with a silt-clay fraction in excess of 50% and a mean grain size of $<63\ \mu m$. (Appendix III). As expected, the finest sediments occur at stations more remote from the influence of the currents on the east side (M14, M15 and M19) whereas slightly coarser and less well sorted sediments occur on the west side and closer to the mouth of the East Passage.

3.4 A visual estimate of the Redox Potential Discontinuity (RPD) depth was made at stations with soft sediments. This varied from 0.5 cm. at M15 to 3.0 cm. at M10 which is comparable to values obtained by Aqua-Fact (1991) at stations close by (2.34 cm. and 1.02 cm.). These values fall within the middle of the range occurring in Cork Harbour, which varies from 0.43 cm. in Lough Mahon to 5.0 cm. at the Harbour mouth.

3.5 Total organic carbon (TOC%) varied from 0.95% to 2.70% at the Rathcoursey grab-sample stations but there was no apparent relationship between TOC value and distance from the outfall. These values are within the range recorded for other stations in Cork Harbour in September 1991 (Aqua-Fact 1991).

Benthic Populations

3.6 The benthic populations of the outfall area clearly reflect the nature of the substrate which varies from coarse gravel where strong tidal currents occur to deep, fine mud in the areas away from the influence of the current. The total species list for the sample area, including both dredge and grab samples, is 86.

3.7 Qualitative dredge samples taken from the gravel areas (stations M1 - M8, M12 and M13) produced a varied fauna comprising 57 species including 17 polychaetes, 21 crustaceans, 9 molluscs and 4 echinoderms (Appendix II). Included amongst the echinoderms are Asterias rubens (not listed as it was identified on board) and the brittle stars Amphiura chiajei and Ophiothrix fragilis. Stones and shells from these samples were covered in barnacles Balanus balanus, the tubeworm Pomatoceros triqueter, spirorbid worms and bryozoans. Small crustaceans were extremely abundant amongst the shells and sponges.

3.8 Forty nine taxa were present in the grab samples taken from soft sediments, including a large number of polychaetes (26) and crustaceans (12). The polychaetes are the numerically dominant group at most stations, as would be expected, with five species making up the bulk of the numbers.

3.9 The cirratulid Tharyx sp. is the dominant organism at seven out of eight stations, reaching densities as high as 17,260/m2 at station M9. Scoloplos armiger is among the dominant species at stations M10, M11, M14, M15 and M16. Caulleriella sp. and is amongst the dominants at some stations but its dominance at M15 is probably due to the fact that this sample was sub-surface and the results are, therefore, unreliable. Finally, Melinna palmata and Myriochele sp. are co-dominant at stations M10 & M11 and station M9 respectively. The amphipod Corophium volutator is the second dominant at stations M18 and M10.

Evaluation of Results

3.10 In their classic review paper Pearson and Rosenberg (1978) describe the impact of a point source of organic enrichment on benthic communities. The first zone, closest to the outfall, is normally a "dead" zone, where no macrofauna survives. Outside this is a "polluted" zone containing opportunistic and pollution-tolerant species, including the polychaete Capitella capitata. Beyond the "polluted" zone lies the "subnormal" zone where the benthic fauna is modified, both in terms of species present and numbers of individuals, over the normal situation.

3.11 The Rathcoursey outfall produces approximately one tonne of particulate matter per day but because of the strong tidal currents the impact does not occur immediately around the outfall. This organic matter is probably dispersed widely throughout and beyond the study area. Although the typical zonal succession is not evident around the outfall itself there is evidence of enriched conditions in the softer sediments to the north, just beyond the area of scoured bottom.

3.12 Hard substrates extend for a distance of about 250 m. north of the outfall and, while Capitella was present in dredge samples, the fauna here is diverse and includes species such as Amphiura which are not normally associated with polluted situations. The availability of particulate matter from the outfall, as well as the strong currents, may explain the presence of suspension feeders (such as Antedon) here. In general, however, the epibenthic fauna is not regarded as a reliable guide to organic enrichment (Pearson and Rosenberg 1978).

3.13 The samples taken in the areas of soft sediment, some 250 - 400 m. from the outfall, contain several organisms which are known indicators of pollution. The dominant organism Tharyx sp. is not amongst these but its occurrence here in such large numbers and its dominance in the samples does indicate a correlation with the outfall (G. Hobbs,FSC, pers comm).

3.14 Amongst the known pollution indicators is Scoloplos armiger which was secondarily dominant at many stations. Several studies have shown that this species often occurs, along with Capitella and Nereis, close to sewer outfalls (Pearson and Rosenberg, 1978). Corophium volutator - which was abundant at M10 and M18 - is known to occur close to the anoxic zone and in polluted channels, while Eteone longa and Streblospio shrubsoli are also secondary indicators of polluted conditions.

3.15 Nephtys hombergi, which was present at all stations but one, is also a characteristic pollution indicator species and was consistently found at the most polluted stations in the Lee Estuary during the recent survey (Aqua-Fact 1991).

3.16 Comparison with the 1991 Aqua-Fact survey results for stations close to here (Appendix IV) shows that while species lists overlap and Tharyx sp. (T. marioni) was present it did not occur in such overwhelming numbers. There may be several explanations for this. First, the sediments sampled by Aqua-Fact may have been different from those in the present survey (position fixes are not given). Secondly, Tharyx may be patchily distributed in the area. Thirdly, it is quite possible that faunal communities have changed in the two years since the Aqua-Fact survey was carried out, under the on-going influence of the outfall.

3.17 Because of the difficulty of obtaining sample material at regular intervals along the enrichment gradient the Shannon Wiener Index H(s) and its evenness (j), which normally correlate well with species abundance along this gradient, are not as useful as expected. The diversity indices (Appendix I) are not directly comparable with those obtained in the Aqua-Fact study because the latter values were based on combined 0.1 sq.m. samples.

3.18 Similarly, rarefaction curves normally provide a measure of species diversity in relation to enrichment gradients but in the present study (Appendix I) these again show no clear correlation with distance from the outfall.

3.19 The group-average clustering and MDS plots place stations M11, M16 and M17 in one sub-group and M14 and M10 in another sub-group, with all belonging to the same loose group. M15 stands out alone but this anomaly is due to this sample being sub-surface. The small number of stations, and the difficulty of obtaining a regular grid of samples due to the substrate, means that no clear trends emerge in relation to the outfall as regards an enrichment gradient.

3.20 In summary, while there is no conclusive evidence that the Rathcoursey outfall is the cause of the pollution detected, it is likely that an input of approximately one tonne per day of particulate matter from this source (over the past five years) has had some impact on the North Channel. However, the presence of hard substrates close to the outfall makes the effect difficult to detect and, in addition, it is not clear how much other sources of effluent contribute towards the observed pollution.

ESTUARINE BIRD POPULATIONS

1.0 INTRODUCTION

1.1 The intertidal areas of the Ballynacorra Estuary and the North Channel form a continuum with the rest of Cork Harbour although there are natural subdivisions at the East Passage channel (south of the Rathcoursey outfall) and at Belvelly Bridge (between Fota Island and Great Island). However, there is free movement of birds between all parts of Cork Harbour and there is no evidence to suggest that any one area holds a discrete population.

1.2 Cork Harbour has at least 1,400 hectares of intertidal mudflat and is the third most important wetland in Ireland in terms of its wildfowl and wader populations. It is of international importance for two waterfowl species, black-tailed godwit and redshank, and of national importance for a further 19 species (Sheppard, in press). In the latter group, the concentrations of shelduck and dunlin in Cork Harbour are the largest in Ireland.

1.3 In the recent count series (Coveney, 1992), Cork Harbour was divided into a total of 23 sub-sites. These were generally covered in a single day by a team of experienced observers. Counts were done within two hours of high tide when the birds would be close to or in their roosts. The distribution of the main high tide roosts was given by Hutchinson and O'Halloran (1984) and those in the study area are shown in Figure 3.

2.0 NUMBERS PRESENT

2.1 The study areas from Midleton to Belvelly Bridge was sub-divided into five sub-sites in the IWC survey (Figure 3). The total number of birds counted in the study area in the winters 1991/92 and 1992/93 is shown in Table 6. Peak counts of between 5,000 and 7,000 birds occurred in the period December to February each winter. The most numerous species were dunlin, shelduck, curlew, lapwing, redshank, wigeon and golden plover. A further 20+ species ocurred in smaller numbers (Table 7).

2.2 In relative terms, the western end of the North Channel holds the largest area of interidal mudflat in the study area and is the third most important part of Cork Harbour for wintering waterfowl (Coveney 1992). The eastern end of the North Channel and the Ballynacorra Estuary hold smaller, but significant, populations.

2.3 The main factors limiting the number of waterfowl in the study area are availability of feeding habitat and disturbance. The main feeding areas are the mudflats which occur primarily in the Rathcoursey area and on the northern and western shores of the North Channel (See Figure 3). The steeper rocky shores on the south side of the North Channel are of little importance for feeding birds. At the western end of the North Channel there is extensive encroachment on the mudflats by the introduced cord grass Spartina anglica which prevents some birds feeding here. Disturbance associated with aquaculture in the central and western parts of the North Channel may limit the use of some areas by birds at low tide.

3.0 PROTECTION OF BIRD HABITATS

3.1 The entire intertidal zone in the study area is listed as a Area of Scientific Interest (ASI) of regional importance because of its ornithological interest. At present ASIs have no legal status but they are listed for protection in the County Development Plan. All ASIs in the country are currently (1993) being reviewed by the Office of Public Works (OPW) and it is expected that an equivalent designation of Natural Heritage Area (NHA) will be given to most ASIs and that this will be covered by proposed amendments to the Wildlife Act, 1976.

3.2 The entire intertidal zone in the study area is also proposed (1993) by the OPW for designation as a Special Protection Area (SPA) under the EC Directive on the Conservation of Wild Birds (79/409/EEC). This is significant because any proposal for EC funding for a development which may affect the proposed SPA will be considered by the EC Commission's Environment Directorate (DGXI) to determine if there are any detrimental effects on bird populations. The EC Commission regards proposed SPAs, which qualify under the Directive, as meriting equal attention with designated SPAs.

FISHERIES AND AQUACULTURE

1.0 INTRODUCTION

1.1 As indicated in Section 2.5.4 there is a paucity of published survey data relating to fisheries and aquaculture in the North Channel area. Information on existing fisheries and oyster farming activities has been gathered through interviews with local fishermen and oyster farmers as well as staff of BIM and the Fisheries Research Centre (see 10.0).

2.0 OYSTER CULTURE

Introduction

2.1 There are, at present, three oyster farms operating in the North Channel: Atlantic Shellfish Ltd, Fota Island Oysters Ltd and Oysterhaven Shellfish Ltd.

2.2 Atlantic Shellfish Ltd, based at Rossmore, is the largest, producing 250 to 300 tonnes of oysters per year. The firm has been farming oysters in this area since 1963, growing both the Pacific oyster (Crassostrea gigas) and the native oyster (Ostrea edulis). Their oyster licence covers a large central area of the North Channel (Figure 6) although much of this is exposed mudflat and therefore unsuitable for oyster culture. They also control the oyster farming rights over a large area in the Lower Harbour as shown in Figure 7.

Cultivation of Native Oysters

2.3 Atlantic Shellfish is the only firm of the three cultivating native oysters. Twenty-one artificial spatting ponds (each holding about one million litres of sea-water) have been constructed on Brick Island and these are used for the production of native oyster spat. About 90% of Atlantic Shellfish's stock of native oysters was lost in 1986 as a result of the oyster disease Bonamia. However, stocks are now recovering and an increasing quantity of spat (on mussel shell) is being laid on about 50 hectares of hard bottom in the North Channel - as indicated in Figure 6. Bottom cultivation of native oysters is also carried out in the Lower Harbour, north-west of Rostellan (Figure 7).

Cultivation of Pacific Oysters

2.4 Fota Island Oysters and Oysterhaven Shellfish specialise in the production of Pacific oysters, farming blocks to the west of the Atlantic Shellfish holdings (Figure 6). Both operations began in 1986; by 1993 production was estimated at 180 tonnes (Fota 140t; Oysterhaven 40t) and expanding. Seed is bought in at 3-4mm, mainly from a UK hatchery, and is on-grown in mesh bags placed on iron trestles at low water mark. All produce is sold in bulk to wholesalers, for marketing mainly in France (also to GB and Northern Ireland), therefore purification is not required.

2.5 Since the demise of the native oyster the bulk of Atlantic Shellfish's production has been Pacific oysters. These were formerly grown on trestles in Ahanesk Bay but were moved to Rostellan after the start-up of the Rathcoursey discharge in 1988, following problems with bacterial contamination. Unlike the other two firms, Atlantic Shellfish sell oysters directly to hotels and other retail outlets, with markets mainly in London but also in Germany, France, Belgium and other parts of Europe.

Purification of Oysters

2.6 Oysters marketed directly for human consumption must now meet standards set out in the EC Directive 91/492/EEC ("Bivalve Directive"). This stipulates limits for coliform contamination of shellfish flesh marketed for human consumption, but does not deal with viruses which have, apparently, resulted in illness amongst UK consumers of "Rossmore Oysters" (Anon 1991). These can be long-lived in sea-water and can survive the normal depuration process. In order to avoid further problems of this kind Atlantic Shellfish depurate oysters destined for market by holding them for eight weeks in spatting ponds, followed by standard UV treatment.

2.7 The question of bacteriological contamination of oysters from the North Channel and its causes is beyond the scope of this report and will be dealt with in a separate report. A preliminary analysis of the problem has been carried out for BIM (Aqua-Fact International Services Ltd 1992)

3.0 MARINE FISHERIES

3.1 There have been no specific surveys of fish stocks carried out in Cork Harbour (P. Connolly, pers comm). Shore crab (Carcinas maenas) are fished by pot in the North Channel, north of Rathcoursey between mid-March and May. This area also hold good stocks of flounder (Platichthys flesus) and dab (Limanda limanda) but, due to the abundance of debris such as sticks, is difficult to fish. Good catches of velvet crab (Portunus puber) as well as lobster (Homarus vulgaris) are obtained along the east side of the East Channel where weed-covered rock occurs (V. Randall, pers comm).

3.2 In the Lower Harbour trawling for flatfish, rays, etc is common and there is good potting for common prawns (Palaemon serratus).

4.0 SALMONIDS

4.1 The Owenacurra River, which flows through Midleton to Cork Harbour, has a good run of sea trout (Salmo trutta) from July to September. There is also a grilse (Salmo salar) run in July and a good late run of salmon (P. O'Connor, in litt; Anon 1991).

4.2 The Roxboro (or Dungourney) River, which joins the Ballynacorra Estuary at Midleton, gets a small run of sea trout, with good numbers in the lower reaches. The only licensed draft net fishery in the area is located at Marloag Point, at the southern end of the East Passage.

4.3 Prior to the removal of the sewage discharges at Midleton fish kills occurred in the upper estuary but since the construction of the Rathcoursey outfall this problem has been resolved (P. O'Connor, pers comm).

IMPACT ASSESSMENT

1.0 GARRYDUFF SITE (SITE 1)

Terrestrial

1.1 The proposed sewage treatment works will be located entirely within the boundaries of the existing field at Garryduff and will not involve any significant loss of hedgerows or other boundary features. The majority of the site is under improved grassland and this is the only habitat which will be significantly altered by the development. However, as the grassland itself is of low ecological value, the effects will not be significant. The proposed outfall from the STW to the Owenacurra Estuary would run along the base of the embankment of the Midleton bypass road and would not involve any loss of natural habitat.

Aquatic

1.2 The edge of the channel at the proposed outfall site consists of steep rock armouring. Very little intertidal habitat would, therefore, be affected during the construction of any outfall. However, if an outfall was required at this site there may be a small temporary increase in the amount of sediment entering the Estuary as a result of earth-moving works. An outfall here would require a diffuser to be laid on the bed of the channel but this would not provide any obstacle to migratory fish.

1.3 With full secondary treatment of sewage the main constituents of the discharge are likely to be dissolved organic nutrients, fine organic particles, bacteria/viruses and fresh water. Assuming the characteristics of the primary effluent remain as they are at present and no significant amounts of toxic substances (e.g. heavy metals or PCBs) enter the STW from industrial sources, contamination of marine biota from this source should not occur.

1.4 Since the salinity regime fluctuates widely at this site the impact of further inputs of freshwater is not likely to have a significant impact on flora and fauna. Similarly, the additional fine sediment particles will be rapidly dispersed and will settle on intertidal mudflats in the estuary, with minimal effect on marine organisms, although an increase in the growth of green algae may occur due to organic enrichment.

1.5 The impact of bacteria/viruses on shellfish cultivation in the North Channel area will be considered in a separate report.

1.6 We conclude that any outfall at this site is unlikely to have a significant adverse effect on marine flora, fauna or fisheries. However, more precise conclusions on the effluent impact would require data on the likely composition and volume of the effluent, as well as dilution and dispersion characteristics of the receiving waters. These data were not available to us at the time this report was compiled.

2.0 BALLYNACORRA SITE (SITE 3)

Terrestrial

2.1 The proposed sewage treatment works will be located entirely within the boundaries of the existing fields at Ballynacorra and will involve the loss of internal hedgerows only (No 6 on Figure 2). These hedges are of recent plantings, containing only non-native shrub species and are of only moderate ecological value. If necessary they could easily be replanted following construction.

2.2 The majority of the site is under intensive arable cultivation and this is the only habitat which will be significantly altered by the development. However, as the arable land is of low ecological value, the effects will not be significant. An access road to this site, if carefully sited, is not expected to cause any significant loss of natural habitats.

2.3 The proposed outfall from the STW directly to the Ballynacorra Estuary would exit to the west of the site and would thus involve the removal of a narrow strip (10 m. wide) through the field boundary to the foreshore (No 4 on Figure 2). This boundary contains a number of mature trees with a range of exotic and native species and is rated of moderately high ecological value. The removal of this band of trees and shrubs is not significant in the context of the large number of trees in the field boundary.

Aquatic

2.4 The intertidal habitat at the proposed outfall site consists mainly of gently-sloping mudflat and areas of shell gravel, with rock at the high water mark. These support a typical range of estuarine organisms. The construction of an outfall here would result in a small permanent change in substrate conditions along the line of the outfall but no significant impact should occur provided the outfall trench is left level after back-filling.

2.5 The same comments as in 8.1.2 apply here, as regards the effluent characteristics. However, being further down the channel it is likely that effluent dilution will be greater and the impact of the effluent, therefore, less here than at Site 1.

2.6 The habitat surrounding the proposed point of effluent release is mainly tidal mudflat therefore the additional fine sediment particles will be absorbed within this system, settling out where current speed drops. Given that the quantities of particulate matter are likely to be low by comparison with the present outfall, the effect on marine organisms is likely to be minimal, although an increase in the growth of green algae may occur due to organic enrichment.

2.7 As at Site 1 there will be no impact on migratory fish stocks such as salmon providing the diffuser is well bedded down in the central channel.

2.8 Leaving aside bacteriological effects on shellfish, we conclude provisionally that an outfall at this site is unlikely to have a significant adverse effect on marine flora, fauna or fisheries.

3.0 EXISTING OUTFALL AT RATHCOURSEY

Change to Release of Secondary Treated Effluent

3.1 If it is decided to retain the Rathcoursey outfall the nature of the effluent released would change considerably from the present one, where levels of BOD, suspended solids, bacteria/viruses, etc, are high. As noted above (8.1.2) the main constituents of secondary-treated effluent are likely to be dissolved organic nutrients, fine organic particles, bacteria/viruses and fresh water.

3.2 Sea-outfalls have traditionally affected the sediment, and hence the benthic populations, in proportion to their size and the level of treatment. The major effects are an increase in the silt/clay fraction of the sediment due to inorganic particles and enrichment of the sediment by organic particles of sewage. In the case of the present outfall the effects are not readily detectable on account of the strong scouring effect of tidal currents in the vicinity of the outfall.

3.3 The proposed upgrading of the quality of effluent released is likely to have a beneficial effect on the marine biota of the East Passage and North Channel, although in the absence of data on the volume and composition of the effluent this is difficult to quantify. The most likely effect is a change in the character of sediments and the species composition of benthic communities close to the outfall (0 - 400 m.), as well as an increase in species diversity.

Removal of Rathcoursey Discharge

3.4 Should it be decided to construct a new outfall at Site 1 or Site 3 the outfall at Rathcoursey would no longer be required and discharges would cease. This would clearly have a beneficial effect on the flora and fauna of the East Passage and North Channel, and possibly on fisheries/aquaculture, although this would be offset by the need to release the effluent instead in the Ballynacorra Estuary.

MITIGATION MEASURES

1.0 TERRESTRIAL HABITATS

1.1 There will be extensive planting of broadleaved trees and shrubs around the proposed development providing additional habitats for flora and fauna. These new habitats will partly replace existing improved grassland if Site 1 is developed and arable land if Site 3 is developed, both of which are of low ecological value. The nett effect will be an increase in habitat diversity and a resulting increase in species of flora and fauna. Any small loss of trees and shrubs to accommodate the proposed outfall at Site 3 will be offset by re-planting after construction with standard trees.

2.0 MARINE AND INTERTIDAL HABITATS

During Construction

2.1 Construction of a new outfall at either site will result in the release of a certain amount of sediment. All measures possible will be taken to ensure that this is minimised. After laying of outfalls and diffuser the channels and intertidal habitat will be restored to their previous condition, in as much as this is possible. Any diffuser will be bedded as deeply as possible in the river channel to ensure that the passage of migratory fish is not obstructed.

Post Construction

2.2 Mitigation measures post-construction will be largely associated with the operation of the STW to its design specification. The quality of the effluent with regard to particulate matter, synthetic chemicals and heavy metals is of paramount importance and regular sampling at the works outlet is recommended.

2.3 It is vital that any new industrial discharges to the sewerage system receive adequate pre-treatment before being accepted, to ensure that substances which are potentially deleterious to the marine environment are not released from the outfall.

PERSONAL COMMUNICATIONS

NAME	ORGANISATION	SUBJECT
Con Guerin	Atlantic Shellfish Ltd	Oyster farming
David Hugh-Jones	Atlantic Shellfish Ltd	Oyster farming
Frank Kowalski	Oysterhaven Shellfish Ltd	Oyster farming
Stephen Kowalski	Fota Island Oysters Ltd	Oyster farming
Terence O'Carroll	Bord Iascaigh Mhara	Oyster farming
Bernie Comey	Dept. of the Marine	Oyster licences
Carmel Daly	Dept. of the Marine	Oyster licences
Patricia O'Connor	S.W. Regional Fisheries Board	Salmonid fisheries
Ronnie Randall	Local Fisherman, Cobh	Marine fisheries
Eugene Nixon	Fisheries Research Centre	Biological studies & fisheries
Dr Alan Myers	UCC Zoology Dept	Biological studies, Cork Hbr
Michael Lavelle	Cork County Council	Cork Harbour studies
Sean O'Donohue	Dept. of the Marine	Public health aspects
John Lucey	ERU (EPA)	Bacteriological monitoring
Edel Hennessey	Office of Public Works	ASI/SPA designations
Oscar Merne	Office of Public Works	ASI/SPA designations
Jim Wilson	Irish Wildbird Conservancy	Ornithological data
Paul Moore	Irish Wildbird Conservancy	Ornithological data
Dr John Coveney	Irish Wildbird Conservancy	Ornithological data

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SECTION 10

NOISE IMPACT

GR('P TECHNICAL & CONSULTANCY SERVICES

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Sheet No. 1 of 13 sheets

CONFIDENTIAL REPORT

Client	M.C. O'Sullivan Consulting Engineers Innishmore Ballincollig Co Cork	Title	Environmental Impact Statement - Midleton Sewage Treatment Plant : Noise Assessment
Report Ref.:	66740	Order No.:	Mr Pat Sheppard
File No.:	R.6/01696K	Report by.:	John Patterson J. P.
Recd.:		Approved by.:	Martin Reilly J.P. p.p. M. Reilly
Copies to:		Date:	16 October, 1996

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CONTENTS

1. INTRODUCTION:

1.1 This report was undertaken at the request of Mr Pat Sheppard of M. C. O'Sullivan, Consulting Engineers, Innishmore, Ballincollig, Co Cork M. C. O'Sullivan have been asked to prepare an Environmental Impact Statement (E.I.S.) for a proposed Sewage Treatment Plant at Midleton, Co Cork. This report is concerned with the noise impact part of the E.I.S.

2. NOISE BASELINE:

2.1 The site for the proposed plant is at Garryduff, Midleton, Co Cork (see enclosed ordinance survey map segment). The nearest residence is c. 100m from the nearest proposed installation on the site with the Midleton By-Pass dual carriageway intervening.

2.2 The local noise environment is dominated by the traffic on the dual carriageway which is part of the National Primary Road from Cork to Waterford.

2.3 Measurements were made of the pre-development noise levels at the site and outside the nearest residence to cover the periods of time representative of day-time, evening-time and night-time conditions. The locations of the measurements are shown on the layout drawing (1:1000 Site layout).

2.4 The equipment used for the noise measurements was a Bruel & Kjaer Noise Level Analyser, Type 4426; Microphone, Type 4165. The equipment was calibrated using a Bruel & Kjaer Sound Level Calibrator, Type 4420.

2.5 The noise level was sampled and the following "A-weighted" data was obtained for each 15 minute period.

$L_{(1)}$ The noise level equalled or exceeded for 1% of the measurement period. (This parameter gives a good indication of typical maximum levels.)

$L_{(10)}$ The noise level equalled or exceeded for 10% of the measurement period. (This is the parameter currently used in the assessment of traffic noise.)

$L_{(95)}$ The noise level equalled or exceeded for 95% of the measurement period. (This level is taken to represent the "background noise" level.)

L_{eq} The equivalent continuous noise level for the measurement period. The L_{eq} is an energy based average widely used in the assessment of environmental impact.

2.6 The results of the noise measurements are tabulated in Table 1. Location 1 refers to measurements made at the site. Location 2 refers to measurements outside the nearest residence. The levels at Location 1 are higher than those at Location 2 because the house is not in line of sight with the carriageway West of the underpass. The ambient levels are relatively high for this type of near-rural area. This is because the levels are due exclusively to traffic noise on the National Primary Route. The night-time measurements for 15.10.93 were made under calm conditions and show the background or ambient night-time noise levels in the absence of traffic.

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TABLE 1

DATE	TIME	LOCATION	L_1	L_{10}	L_{95}	L_{eq}
4.10.93	12.00 - 12.15	No.1 (Site)	61	57	47	54
4.10.93	12.35 - 12.50	No.2 (Residence)	68	62	47	58
4.10.93	14.02 - 14.17	No. 1	63	59	49	56
5.10.93	11.30 - 11.45	No. 1	65	62	50	59
5.10.93	11.47 - 12.02	No. 1	65	62	51	59
5.10.93	12.15 - 12.30	No. 2	67	60	45	57
5.10.93	12.35 - 12.50	No. 2	66	59	43	56
5.10.93	14.00 - 14.15	No. 1	64	61	51	58
5.10.93	15.00 - 15.15	No. 1	64	62	52	58
5.10.93	15.25 - 25.40	No. 2	67	59	46	56
5.10.93	15.55 - 15.10	No. 2	70	60	45	58
5.10.93	21.00 - 21.15	No. 1	61	56	42	52
5.10.93	21.25 - 21.40	No. 1	62	57	40	53
5.10.93	21.50 - 22.05	No. 2	59	55	41	51
5.10.93	22.17 - 22.42	No. 2	59	54	39	50
6.10.93	01.20 - 01.35	No. 1	54	48	37	45
6.10.93	01.50 - 02.05	No. 2	53	49	37	45
15.10.93	01.15 - 01.20	No.1			33	35
15.10.93	01.25 - 01.30	No.2			31	33
15.10.93	01.40 - 01.45	No.1			31	33

3.0 NOISE EMISSIONS:

3.1 The site plan showing equipment layout is shown on the drawing titled "1/250 Layout Plan" Drawing No. 030, Rev. A.

3.2 The treatment plant's equipment with their installed electrical power is itemised as follows:-

Elements within Domestic Treatment Plant

Element	Installed kW	Hours Run/Day	Remarks
Fine Screen	2	24	Housed
Air Blowers Operating @ 75%.	4 x 37	24	Housed indoors complete with acoustic hoods.
Grit Trap (Aerated)			No noise
Digester Tanks (aerated)			No noise
Mixers	12 x 2 (Use 3 No.)	24	Immersed in Bio-Reactors
Sed. Tank Scrapers	3 x 0.55	24	Open
Sed. Sludge Return	3 x 0.1	24	Immersed
Denit. Sludge Return	2 x 0.25	24	Immersed
Waste Act. Sludge	3 x 0.2	20	Immersed
Sludge Sed. Tank	1 x 1.0	24	Open
Sludge Transfer Pump	0.5	24	Housed
Sludge Dewatering	7 kW	8	Housed
Plant Heat & Light	20	12	Housed
Ventilation	10	24	Housed
Generator (Standby)			Housed indoors complete with acoustic hoods.

3.3 Of the equipment itemised in paragraph 3.2, the only elements with significant noise levels are the Air Blowers, Sludge Dewatering and Generators.

Air Blowers: It is envisaged that the type of Air Blowers to be used is a Holmes Dresser Packaged Air Blower Unit, Type HR 32. The manufacturers have supplied the information that the noise level from this unit is 99 dB(A) (free-field) at 1m (without hood), 79 dB(A) (with hood). To supplement this information the noise levels from previous reverberation measurements made in the plant house of a treatment plant at Enniscorthy using a smaller Air Blower (same manufacturer) are given here:-

This unit was a Type HR 12 (15 kW).

Octave Band Levels

Hz:	63	125	280	500	1K	2K	4K	8K
dB:	80	85	75	75	75	78	77	67

Sludge Dewatering: For the sludge dewatering it is planned to use the same type of Filter Belt Press as has been installed in the treatment plant at Bandon. Noise measurements were made at this plant and are itemised here:

Reverberant levels in dewatering house:-

Octave Band Levels

Hz:	63	125	280	500	1K	2K	4K	8K
dB:	70	69	72	74	78	81	77	71

Measurements made outside building at distances from shut roller steel door.

5m	-	59 dB(A)
10m	-	51 dB(A)
20m	-	45 dB(A)

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Generator: It is planned that the type of generator to be used is a 40 H.P. Lister, 1450 rpm (with hood).
Measurements were made of the noise from this type of generator while operating outdoors in a field.

Octave Band Levels (1m distance).

Hz:	63	125	280	500	1K	2K	4K	8K
dB:	72	88	89	82	77	63	62	61

1m distance	:	83 dB(A)
5m distance	:	70 dB(A)
10m distance	:	65 dB(A)
20m distance	:	59 dB(A)

4.0 NOISE CRITERIA:

4.1 In general, noise criteria for industrial noise in European countries are related to zones such as residential, industrial, commercial etc. "Acceptable levels" in various countries can vary from 35 to 60 dB(A) at night and 40 to 70 dB(A) during the day, depending on the type of area.

Forbairt experience and precedents set in planning conditions in Ireland by various local authorities and An Bord Pleanala have shown that, for general acceptability, noise level criteria outside nearby residences should normally be selected within the following ranges:-

Night	:	35 to 40 dB(A)
Day	:	45 to 55 dB(A)

An important aspect of these criteria is the absence of prominent discrete tones or impulses.

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.

The following extracts are from the EPA Guidance Note for Noise in Relation to Scheduled Activities for Integrated Pollution Control Licensing.

"Ideally, if the total noise level from all sources is taken into account, the noise level at sensitive locations should be kept below an L_{ART} value of 55 dB(A) by daytime. At night, to avoid disturbance, the noise level at noise sensitive locations should not exceed an L_{AeqT} of 45 dB(A). In some particularly quiet areas, such as pastoral, rural settings, where the background noise levels are very low, lower noise limits may be more appropriate. Audible tones and impulsive noise at sensitive locations at night should be avoided, irrespective of the noise level".

Taking the above into account and the low level of night time background noise in the area of the proposed development we propose the following criteria as being appropriate for minimal impact on the existing noise environment:-

Night	:	40 dB L_{AeqT}
Day	:	50 dB L_{AeqT}

These are limit values for the noise from the proposed plant measured outside any permanent dwelling. These should not be any significant pure tones or impulsive elements in the noise spectrum.

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5.0 CONTROL OF NOISE EMISSIONS:

5.1 In general, the proposed development is amenable to noise control measures using proven and available technology. The following options are among those available to control noise emissions from the site.

i. Selection of low noise equipment

ii. Selection of building materials

iii. Selection of plant location and building layout on the site

iv. The use of local screening and enclosures

v. The use of buildings for screening

vi. The use of silencers and attenuators on individual plant items and equipment.

6.0 ASSESSMENT OF IMPACT OF PROPOSED DEVELOPMENT:

6.1 Estimates of the expected noise levels based on

(i) measurements of noise from similar items of equipment
(ii) visits to similar sewage plants
(iii) distances involved
(iv) barrier effect provided by road banking
(v) noise insulation provided by cladding of proposed buildings.

show that the environmental noise criterion of 40 dB(A) at night-time and 50 dB(A) day time will not be exceeded at the nearest residence by noise from the proposed development.

6.2 This assessment has been arrived at from examination of the preliminary proposed design. On the full completion of the design work a confirmatory assessment will be done on the completed proposals.

SECTION 11

VISUAL IMPACT

MIDLETON SEWAGE TREATMENT PLANT E.I.S.

Visual Impact Assessment

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16 Upper Fitzwilliam St., Dublin 2. Tel: 6687378 Fax: 6762461

MIDLETON SEWAGE TREATMENT PLANT E.I.S.

Visual Impact Assessment

GENERAL AREA

The area in which the proposed treatment plant is to be located lies to the south west of Midleton. The new Bypass Road forms an edge to the built up part of the town in this area. The land on the other side of this road is presently in agricultural use. Ballyannon Wood which is an important amenity to the town lies about half a mile further to the south west of the Bypass Road. It is proposed to site the treatment plant in the area presently in agricultural use lying between the town and Ballyannon Wood.

The Bypass Road (when travelling south) having passed the area in which it is proposed to site the plant, swings out across the Owenacurra River estuary towards Bailick.

SITE LOCATION

The proposed site lies immediately to the south west of the Bypass Road where this road (travelling south), passes the newly built up housing development called Riversfield and crosses the estuary.

The site is presently accessible off a narrow unsurfaced road, Beechers Bohereen, which continues on from the end of O`Dwyers Road. This road has traditionally been used as the main access to Ballyannon Wood.

It is proposed to locate the plant at the northern end of the big field immediately on the left having gone under the new Bypass when going towards Ballyannon Wood. The plant would be sited south of the stream which runs across the north east corner of the field.

The proposed plant would be bounded along its eastern edge by the new Bypass Road and on its northern and western sides by the existing hedgerow along Beechers Bohereen. These hedgerows are strong hawthorn hedges with some mature ash and sycamore.

POTENTIAL VISUAL IMPACT PROBLEMS

The existing field in which the plant is proposed lies approximately 4.0 m below the level of the Bypass Road. Because of this it would be expected that the plant would be very visible from traffic moving on the Bypass Road. This is not altogether the case. The site is not in fact visible from cars travelling south. While it would be more visible from coaches and trucks the plant would not be obtrusive when travelling in this direction as the road starts to curve away from the site at this point and the eye is drawn across the estuary towards the town.

The site is at present partly screened from traffic moving north by the existing planting of three rows of Poplars along the western edge of the road. Additional screen planting would be required along here. It is understood that Cork Co. Council propose to carry out further planting along this edge before work on the treatment plant commences. This is highly commendable. Such planting should broadly correspond with the planting recommended in the planting section of this report (p.5).

In addition to screening the Plant from the Relief Road it would be of equal if not greater importance to screen the plant from Beechers Bohereen, the traditional pedestrian access to Ballyannon Wood. In addition to this access a new pedestrian access to the Wood, along the southern end of the field in which the plant is proposed, appears to be being used by people who climb onto the Bypass Road off the Bailick Road and down the bank at the south end of the field. The treatment plant should be heavily screened along this edge also both from the point of view of pedestrians using this access and traffic travelling north on the Bypass.

The site is not overlooked by any residences and is screened from Riversfield by the elevated Bypass and a heavy grove of trees.

DOMESTIC TREATMENT PLANT

It is intended to locate the treatment plant in the northern portion of the site.The Control House and the Dewatering Building are all single storey buildings with pitched roofs. These are the tallest structures proposed. The remainder of the plant which is above ground consists of the Digestor Tanks which have concrete walls 3.5 – 4.0 m high and the Aeration and Settling tanks which have 1.0 m high concrete surround walls.

The plant would have to be surrounded by a security fence. Poorly designed or incorrectly located this could be unattractive and obtrusive.

PROPOSED VISUAL TREATMENT

(to be read with Landscaping Proposals Dwg. Nos. 3 and 4

Materials and Finishes

The overall visual treatment proposed is the complete screening of the treatment plant on all four sides. The plant would however be partly visible during the time it would take to get the screening established.

To minimise the obtrusiveness of the plant during this time it would be designed so that:

(i) All buildings would have pitched roofs with Black Stonewold concrete tiles. Walls would be plastered and painted with 2 coats of masonry paint colour BS 12B17, BS 10B17 or similar, i.e. warm `natural` colours which blend with the landscape.

(ii) Reflective metal or other surfaces would be avoided and potential eye catching geometric lines, such as the tops of the 1.0 m high concrete walls around the Settling and Aeration Tanks would be broken up using groups of evergreen shrubs and medium sized conifers where practical. These would also help screen the water surfaces in the tanks.

(iii) Any lighting required would be low level downlighters with columns finished in matt black.

Entrance to Plant

Since the overall objective is to fully screen the plant on all four sides then the proposed entrance would tend to disrupt this screening.

MAIN ENTRANCE

The main entrance would be off Beechers Bohereen. The curved wing walls at this entrance would be 1.0 m high uncut limestone walls. The dark green security fence would run in to meet the entrance gates, which would be a matching dark green. The Control House would be set back and screened as shown. The car park would take advantage of existing hawthorns in this area and these would be further infilled as indicated.

Planting

The treatment plant would be sited at the northern end of the large field bounded by the Bypass Road and Beechers Bohereen. It would be located immediately south of the existing stream in order to preserve the dense grove of trees which currently exists between this stream and the start of Beechers Bohereen.

The existing hedgerows along Beechers Bohereen would be retained and infilled with Hawthorn, Ash and Sycamore where appropriate. Inside the hedgerows a dark green plastic covered Pallisade fence would be sited and inside this again there would be a continuous screen made up of Hawthorn, Ash, Sycamore and evergreens including Pine (Pinus nigra) and Cypress (Cupressus macrocarpa and Cuppressocyparis Leylandii) and additional deciduous species including Poplar (Populus robusta), Oak (Quercus borealis) and Beech (Fagus sylvatica). Immediately inside the dark green plastic covered Pallisade fence there would be a continuous mixed planting of evergreen shrubs including Privet (Ligustrum ovalifoluim) and Laurels (Prunus laurocerasus and Prunus lusitanica). This continuous screen planting would have an average width of about 15.0 m but would not be less than 10.0 m.

There are already 3 rows of Poplars planted along the west bank of the Bypass Road. It is proposed to infill this planting with the same number of trees again consisting of the same species as above. The areas in between the trees would be planted with a mixture of Gorse (Ulex europaeus) – already growing there – and the evergreen shrubs listed above. This would form a dense solid visual screen at eye level so that the treatment plant would not be visible from the Bypass Road. The advance planting proposed by Cork Co. Council would be most helpful.

The southern boundary of the plant proposed would also require the dark green plastic covered Pallisade fence. The proposed planting inside this fence, (since there is no existing screening) would be increased in width to 20 m. It would consist of the same species of trees and shrubs as proposed for the other three sides of the treatment plant.

The proposed planting would have the effect of completely screening the entire treatment plant around all four sides. With adequate maintenance this screening would be established in 5 – 7 years.

SECTION 12

CONSTRUCTION IMPACT

SECTION 12

CONSTRUCTION IMPACT

1.0 GENERAL

1.1 It is anticipated that it will take some eighteen months to construct the sewage disposal works at Midleton. This process will give rise to a temporary impact which will be largely unavoidable because of the scale and scope of the work to be undertaken. The main impacts of the construction process will be:

(a) Construction traffic on adjacent roads.

(b) Additional noise from plant, machinery and vehicles.

(c) Dust emissions from the construction site during dry weather.

(d) The transportation of mud or soil from the site by vehicles leaving it.

(e) The visual impact of the construction site on the surrounding areas.

(f) The disruption due to the construction of the rising mains to the works and the outfall pipe from the works to the existing 750 mm. sewer on the Bailick Road.

(g) The disruption due to the construction of pumping stations and various new sewers not included in the present network.

1.2 These environmental impacts resulting from the construction of the treatment plant will be confined to the period when construction is taking place. Every effort will be made to reduce and minimise the temporary impact of the construction process and these are set out in greater detail in the following paragraphs.

2.0 TRAFFIC

2.1 The access route to the proposed sewage treatment site will be along a new road running from the existing secondary road between Whitegate House and Ballyannan. No traffic counts were taken on this road as it was felt that the impact of construction traffic would be minimal.

2.2 The level of traffic generated by the construction process will vary over the period of construction, but it is felt that on average the following increases in traffic movements would be typical:

(a) A labour force of 50 men producing an extra 100 traffic movements due to cars.

(b) 8 material deliveries to the construction site per day resulting in 16 heavy commercial vehicle traffic movements.

(c) Disposal of excavated spoil resulting in an increase in heavy commercial vehicles moving along the public roadways, though this traffic source is expected to be low as most of the spoil will be retained on site.

2.3 The new access road will be constructed and surfaced at the beginning of the job and all construction traffic will be required to use this access to the treatment plant site.

2.4 It is felt that the increase in traffic movements due to cars and light commercial vehicles will not have a major impact on the traffic movements on the public roads. The traffic movements due to heavy commercial vehicles will have a slight impact on the traffic along the narrow road to Ballyannan.

2.5 The disposal of surplus spoil from the excavations within the sewage disposal works site will cause a general increase in the heavy commercial vehicles on the public roads adjoining the site. The routes to be taken by these commercial vehicles will be largely dependent on the availability of a suitable spoil tip. The volume of surplus spoil however, will be small as it is intended to use most of the excavated material to form landscape mounds within the site.

3.0 CONSTRUCTION NOISE IMPACT

3.1 For the period during construction, the noise levels criteria set out in Section 10 of this Report may be exceeded. The use of heavy plant machinery during the construction process is unavoidable. However, good site management, plant maintenance and communications with adjoining property owners during calm weather or late working periods should minimise the temporary impact of this development on the surrounding areas. In as far as possible it is intended to restrict working to normal working days and hours. However, this may not be possible due to time constraints and construction operations.

4.0 DUST EMISSIONS

4.1 Due to the nature and scope of the work, which will be undertaken on the site, dust from the construction work may be blown by prevailing winds across adjoining lands near the site works. The Contractor will be required to keep dust emissions to a minimum in accordance with good site management procedures. If dust emissions from the site become a problem water sprays during dry weather will be utilised to ensure that dust does not cause problems for local land owners or residents in the area.

5.0 TRANSPORTATION OF MUD AND SPOIL ONTO PUBLIC ROAD

5.1 Vehicles leaving the sewage disposal works site, or working on the site perimeter may result in the deposition of mud or spoil on adjacent public roads. This will occur mainly during the start of the project when substantial spoil shifting is taking place. As it is intended to reuse most of the excavation spoil within the site in the formation of low mounds and landscaped rises, the transportation of spoil onto the public road will be kept to a minimum.

5.2 During the construction operation, it is intended to have a network of hardstanding aprons and roadways within the site to ensure clean working areas for the site vehicles. Prior to the commencement of work on the site it is intended to construct the site access road such that vehicles entering and leaving the site will have a sound and level surface to travel across.

5.3 The steps taken to ensure that the access road and the site development will have hardcore access roads and hardstanding areas will ensure that there will be a minimal deposition of mud and soil on the adjacent roads from vehicles leaving the site. In addition, the site supervision team will ensure that if mud or soil is deposited on the adjacent public roads, that these areas would be cleaned off on a daily basis.

6.0 VISUAL IMPACT

6.1 Even though the proposed works is set well away from built up areas there will be slight visual impact on the surrounding countryside due to construction work being carried out within the site. The use of cranes, excavators, and heavy earth moving machinery is unavoidable, but the remoteness of the site will help to minimise the visual impact of heavy plant on the surrounding countryside.

6.2 The early planting of appropriate trees, in advance of the commencement of construction would help to screen the works and Contractors compounds, offices and huts, could be painted matt green to blend in with the surroundings.

6.3 Good site management, control and supervision will ensure a clean and tidy site and will minimise the visual impact of the site on the surrounding countryside.

7.0 INLET AND OUTLET SEWER CONSTRUCTION

7.1 The installation of rising mains inlet and outfall pipework will be carried out strictly in accordance with normal wayleave maintenance and restoration requirements. Under these requirements, the required wayleave width, along the pipeline length is fenced off, the topsoil stripped and stored on site for reuse, the pipeline installed and the whole area reinstated, fertilised and cultivated subsequently. After a minimum period of six months, or sooner if the land owner requires, the wayleave will be handed back for the property owners use.

8.0 ASSOCIATED WORKS

8.1 In addition to the treatment works, rising main and outfall pipe, it is also planned as part of the same contract to construct:-

(a) A submersible pumping station at Ballinacurra.

(b) A submersible pumping station at Bailick Road.

(c) Rising main and gravity sewers from Ballinacurra and Castleredmond to the new pumping station at Bailick Road.

(d) Foul and storm sewers from Knockgriffin to the proposed treatment plant.

8.2 Interference with local traffic (pedestrian and vehicular) will be kept to a minimum and liaison will be established with local representatives to co-ordinate the work with local activities and to act as a forum for grievances should they arise.

9.0 SUMMARY

9.1 The construction of a major disposal works such as that proposed for Midleton will, unavoidably, cause some temporary impact on surrounding areas and residents. However, measures will be taken to minimise the temporary impact of the construction process in as far as is possible.

SECTION 13

ARCHAEOLOGICAL IMPACT

Midleton and Cobh Sewerage Schemes

ARCHAEOLOGICAL ASSESSMENT

By Dr Elizabeth Shee Twohig,
Department of Archaeology,
University College,
Cork.

*Commissioned by Mssrs Ml. C. O'Sullivan & Co. Ltd.,
Inishmore, Ballincollig.*

OCTOBER 1993

General Introduction

The East Cork area is rich in archaeological remains, dating from at least 5000 BC tothe recent past. Much of the traces of early activities would not be visible now on the ground. They could only be recovered through excavation, though some remains might be detected after fields have been tilled, as was the case in the Guileen area near the coast in this region. Accordingly, a first phase archaeological assessment of this type can only identify what is visible above ground; there is no guarantee that something may not come to light when work commences and provision will have to be made for this possibility.

Sources of Information

The principal source of information on archaeological sites in Ireland is now contained in the county *Sites and Monuments Records* for each county.
In County Cork the basic Sites and Monuments Record is available for consultation. The record comprises a listing of all known sites and their identification on copies of the Ordnance Survey 6" to 1 mile sheets.
These records were first consulted. A check was made of the files held in the offices of the Cork Archaeological Survey relating to each area to see if any more sites have been recorded since the compilation of the basic Record. No sites are recorded on the relevant maps: however, since recording for the Archaeological Survey does not necessarily involve every field being examined individually on the ground, the lack of sites on the Sites and Monument Record cannot be taken to prove that nothing of archaeological significance exists. It is necessary to inspect each site individually. In fact the maps for Cobh show that the proposed treatment plant there is on the site of the Old Gas Works. The first editions of the Ordnance Survey maps were also checked.

Inspection of Sites:

Midleton Sewerage Treatment Plant

Site No. 1. Ballyannan

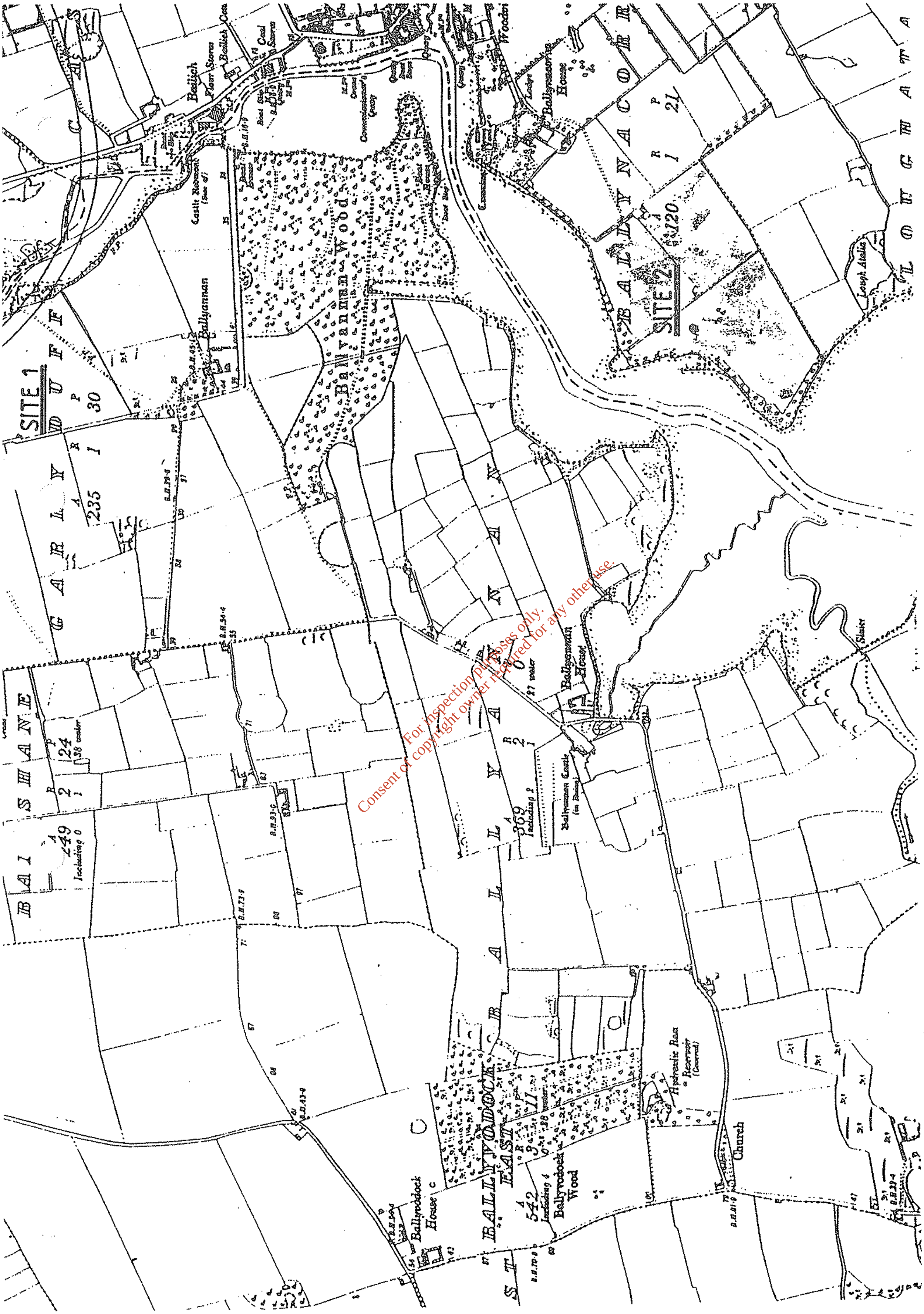
This site lies south west of the town, on the western side of the river. A small stream crosses the north end of the site. The area north of the stream is completely overgrown.
The owners gave permission to walk over the site.
It is in long term pasture, quite wet in places, with some traces of reed growth. No distinct archaeological features could be identified. Some low ridges running east-west probably represent the old field fences which are shown on the 1840s edition of the Ordnance Survey map.
Two aerial photographs were inspected but neither the ridges or any archaeological features were identified on these.

Recommendation:
It would be necessary for an archaeologist to monitor any work of levelling, clearance or foundation digging in this site.

Site No. 2. Ballynacorra.

This site lies south of Midleton on the eastern shore of the estuary. It was not possible to inspect this site as the Landowner, Mr Allan Navratil, does not now permit access to anyone in connection with the proposed treatment plant. His reasons for this are set out in a letter dated 28 May 1993, addressed to T. Coughlan, Senior Executive Engineer, County Hall from J.P Walsh and Associates, Engineering and Planning Consultants, Annsgrove, Carrigtwohill. As Consulting Engineers, I would have assumed you would have been made aware of the contents of this letter and would have intimated them to me when you commissioned me to carry out this assessment.
Not having been able to visit the site I cannot offer a valid archaeological assessment except to point out that it is quite likely that shell middens could be sited along the shoreline, and these would require archaeological investigation. This area would also be likely to have *fulachta fiadh* (ancient cooking places).

Recommendation:
In view of the circumstances outlined above it is not possible for me to make any report or reccommendation in regard to this particular site.


SITE 1
SITE 2
Ballyannan Wood
Ballyannan
Ballyannan House
Ballyannan Castle (in Ruins)
Castle Redmond (Site of)
Ballynacorra House
Lough Atalia
Bailick
Coal Stores
Commissioners' Quarry
Ballyrodock House
Ballyrodock Wood
BALLYRODOCK EAST
Hydraulic Ram & Reservoir (Covered)
Church

8.1.3. Midleton WWTP (Option A) Technical Appendices

Comhairle Chontae Chorcaí
Cork County Council

C.B.Devlin.
B.E., C.Eng., F.I.E.I.
County Engineer
Cork County Council

MIDLETON
Sewage Treatment Plant

ENVIRONMENTAL IMPACT STATEMENT

TECHNICAL APPENDICES

NOVEMBER 1996

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Document Reference: 702/93

MIDLETON SEWERAGE SCHEME

MARINE OUTFALL

HYDROGRAPHIC SURVEY REPORT

Prepared for:-

Cork County Council,
County Hall,
Cork.

Prepared by:-

Lish Hydrodata Ltd.,
Rathmacullig West,
Ballygarvan,
Co. Cork.

Consulting Engineers:-

M.C. O' Sullivan & Co. Ltd.,
Inishmore,
Ballincollig,
Co. Cork.

November 1993

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LIST OF FIGURES

1. INTRODUCTION

1.1 BACKGROUND TO THE STUDY

1.1.1 During recent years work has been progressing on uprating and refurbishing the drainage system in Midleton. This work has been conducted under the auspices of the Midleton Sewerage Scheme prepared for Cork County Council by their Consulting Engineers, M.C. O' Sullivan. The sewage disposal installation is presently a pumped system discharging effluent to Cork Harbour via an outfall located some 5km from the town at Rathcoursey Point on the East Passage.

1.1.2 In the future it is envisaged that a treatment works will be built in or adjacent to Midleton. The proposed works will provide for secondary treatment of sewage in accordance with the E.C. Directive 91/271/EEC. The Consulting Engineers are currently preparing an environmental impact assessment of the scheme.

1.2 STUDY BRIEF

1.2.1 This marine survey was commissioned to assist with the planning of the treatment works and siting of the associated outfall. The inner areas of Cork Harbour including the North Channel presently support extensive shellfish producing facilities and a primary concern was to safeguard the future environmental quality of the receiving water.

1.2.2 The main objectives of the study as defined by M.C. O' Sullivan were to:-

- confirm the basic dispersive characteristics of the receiving waters as recorded in previous studies by the use of dye tests;

- to assess the likely fate of treated municipal effluent discharged from potential outfall sites using predictive numerical models.

1.2.3 The preliminary assessments of available data by the Engineer had led to the selection of three possible marine outfall locations. One was the existing outfall to the deeper waters off Rathcoursey Point, while the other two are proposed new outfalls positioned in the Ballinacurra River Estuary.

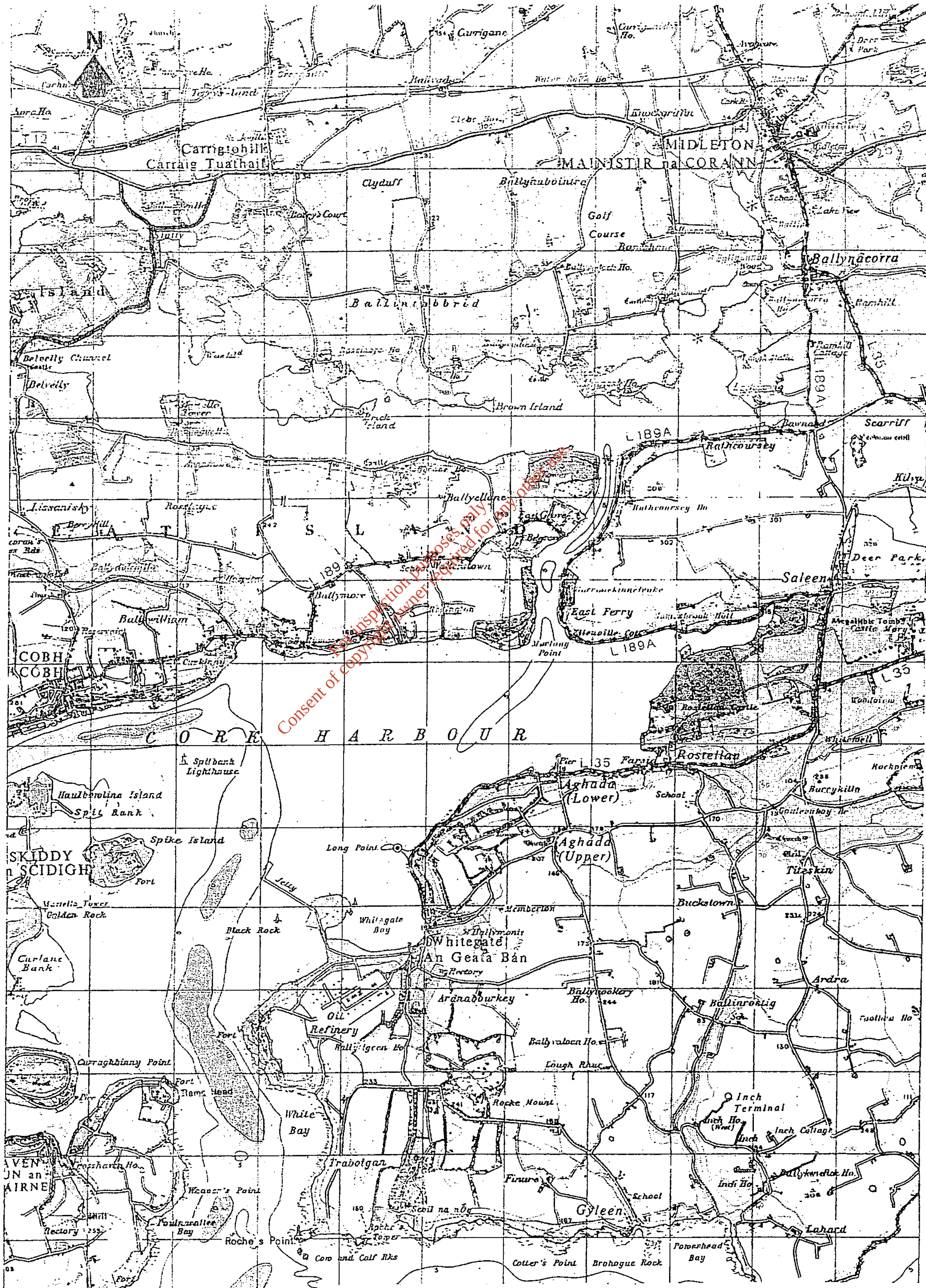
1.2.4 Figure 1.1 taken from a portion of an Ordnance Survey 1:63,360 map shows the outfall sites and the surrounding areas. Figure 1.2 shows the general bathymetry of the survey area.

1.3 SUMMARY OF FIELD WORKS

1.3.1 Following a full review of available data and bearing in mind the stated objectives of the study the following field works and instrument installations were undertaken at various stages during the survey period.

- deployment of recording tide and current gauges for the duration of the survey works;

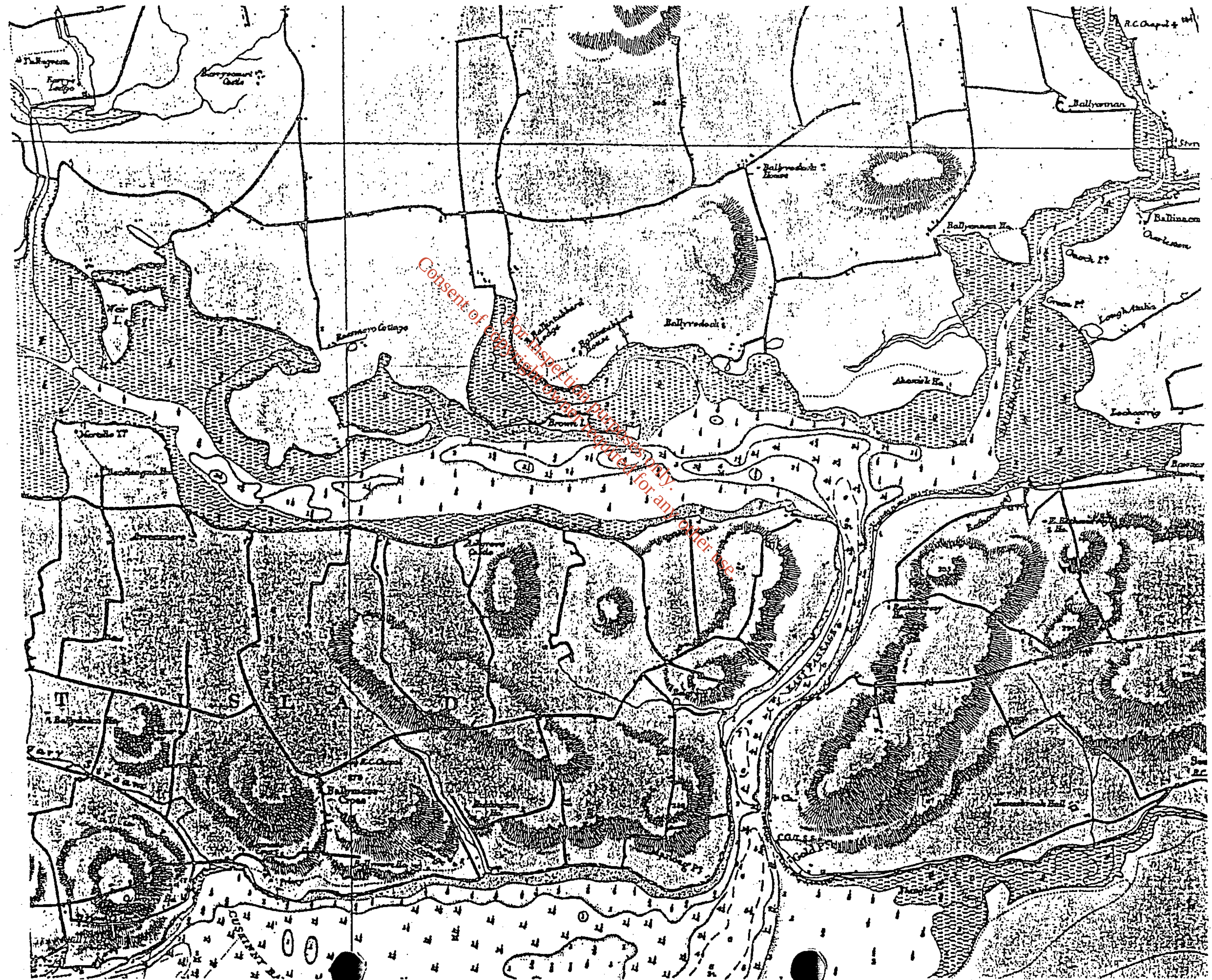
MIDLETON SEWERAGE SCHEME OUTFALL STUDY 1993



Scale: 1/63,360

Figure 1.1 Outfall Sites and Surrounding Areas.

MIDLETON SEWERAGE SCHEME OUTFALL STUDY 1993



Taken from
Admiralty Chart
N0. 1765

Depths in
fathoms.

- current profile measurements in the East Passage;
- continuous (12.5 hour) dye dispersion and advection experiments. One release from each of the proposed outfall points;
- discrete dye release from Rathcoursey;
- drogue tracking experiments.

1.3.2 All field works were undertaken during the period 15th September to 11th October 1993.

1.4 NOTATION

1.4.1 Throughout this report the following conventions and units are used.

Current speeds are presented in metres per second (m/s). Current directions are given in degrees relative to true north (°T) and indicate the direction to which the current is flowing.
Wind speed and direction are given in metres per second (m/s) and degrees true (°T). Note that wind direction refers to the direction from which the wind blows. (Note 1 knot = 0.51m/s).
Water depths are given in metres relative to Malin Head datum.
Times are given in hours British Summer Time.

2. FIELD STUDIES

2.1 CURRENT AND TIDE MEASUREMENTS

2.1.1 Two recording current meters were deployed in the North Channel at the locations shown in figure 2.1, for a 17 day period. The meters were attached to U-moorings and set to record the currents at 1.3m above the seabed every ten minutes.

2.1.2 Data from the current meters are shown in figures 2.2a, 2.2b. At the site off Brown Island the flows were regular and peak flood tide speeds of 0.4m/s were reached during the large spring tides of 17th/19th Sept. Ebb tide values almost reached 0.3m/s. During average spring tides the corresponding values would be approximately 0.35m/s on the flood and 0.26m/s on the ebb. During the average neap tides of 24th/25th Sept. flood tide speeds fell to 0.2m/s and ebb values to below 0.1m/s.

2.1.3 The current meter to the north of Bagswell's Hill was deployed to record the water movements within the gyre which forms in this area. This was achieved and, as figure 2.2b shows, the flow direction is towards the east for about 9.5 hours of each tidal cycle. Only for a very short time (<2 hours) at the start of the flood does the flow at this location travel in a westerly direction.

2.1.4 Peak current speeds within the gyre reached 0.55m/s for a short period during each tide over the spring tides of 17th/19th Sept. These were directed to the east. For much of the time the speed was in the region of 0.3m/s. For the short period of flood a peak speed of 0.2m/s was recorded. These speeds were recorded on large spring tides and could be expected to reduce by about 15%

for average springs. During the neap tides of 24th/25th Sept. no particularly strong flows were evident and recorded speeds were generally in the range 0.15m/s to 0.20m/s for much of the tidal cycle.

2.1.5 Current profile measurements were made in mid-channel at the site of the existing outfall off Rathcoursey. The measurements took place over a 12.5h tidal cycle on 25th August during mean tide conditions and results, figure 2.3, compare favourably with data recorded at the one third points on the channel section recorded previously by M.C. O' Sullivan. Peak surface speeds of 0.9m/s were observed during the flood with a slightly lower value of 0.8m/s during the ebb. Nearbed speeds of 0.7m/s were recorded during both the ebb and flood. The flood tide was observed to last for approx. 6.0 hours while the ebb was slightly longer at 6.5 hours.

2.2 DROGUE TRACKING

2.2.1 A limited drogue tracking exercise was conducted to provide information for verification of the numerical model. This took the form of a drogue released on each side of the East Passage channel at Rathcoursey at approx. LW+1 hour on 16th Sept. One drogue travelled to the east up the Ballinacurra estuary and the other to the west along the North Channel. The paths are shown in figure 3.7a-c of Section 3. Drogue sails were set at 1.5m below the surface.

2.3 DYE RELEASES

2.3.1 Three continuous dye releases were made, one from each of the proposed outfall locations, to provide information on the likely trajectories of the effluent plumes on the ebb and flood tides. An FMI dosing pump was used to deliver a continuous accurate flow of Rhodamin B dye solution over the discharge period (approximately 50kg in 12.5 hours). A fast shallow draft survey launch fitted with a Turners Designs Model 10 fluorometer was used to track the plume. The boats position was logged in real time on a PC from a Sercel NR53 DGPS unit.

2.3.2 The dye plume was tracked throughout the period of the discharge and on the following two days at the high water times. Temperature and salinity measurements were made at spot locations throughout the tracking.

2.3.3 To make the dye plots inter comparable the measured concentrations have been normalised. On the plots showing the developing plume during the release period the measured concentration (units dye/m^3) has been divided by the dye injection rate (unit dye/second). On the plots showing the dye distribution at 24h and 48h after discharge the measured concentrations (units dye/m^3) have been divided by the total amount of dye released (units/dye).

2.4 DYE RELEASE NO. 1 - RATHCOURSEY - 14th SEPTEMBER 1993

2.4.1 This dye release took place during average spring tide conditions. An inflatable boat with the dye dosing equipment was moored over the existing outfall and the dye released on the surface. The dye release commenced at

0848hrs (BST) and continued until 1920hrs. Low water (Cobh) was at 1055hrs and high water at 1654hrs.

2.4.2 Tracking of the dye continued throughout the day with the survey vessel continually traversing through the plume. From the start of release the dye travelled down the East Passage into the lower harbour with traces of dye detected off Lower Aghada by low water (figure 2.5).

2.4.3 At low water slack, @ 1100hrs, a large patch of dye lay between the discharge point and the western side of the channel. By 1130hrs the flood had commenced and the dye plume was travelling in a north westerly direction. Approximately 2 hours after low water the dye was distributed as shown in figure 2.5. The relatively large patch of dye travelling along the North channel is the result of the dye patch forming around the discharge point at low water slack. Traces of dye were also detected in the Ballinacurra channel but concentrations were much lower.

2.4.4 Tracking later in the day at LW+4hrs showed the concentrated patch of dye to have moved over 2km westwards past Brick Island and to have elongated and widened to almost the full width of the channel (figure 2.6). At this time also the main plume was travelling almost due north from the discharge point towards Ahanesk before splitting into two streams, one travelling to the east and the other to the west. The plume to the west, which contained the greater concentration of dye, moved along the northern shore to Brown Island before beginning to extend southwards across the channel.

2.4.5 At high water (1700hrs) dye was detected throughout the North Channel and all the way up the Ballinacurra Estuary to Midleton (figure 2.7). Highest concentrations were detected in the North Channel and the concentrated patch which developed around the release point at low water slack had travelled westwards to Weir Island. Water depths limitations prevented tracking any further in this direction.

2.4.6 Shortly after high water, at 1716hrs, the dye plume was observed to be travelling in an eastward direction from the release point before turning southwards and travelling downstream. As the ebb became more established the plume travelled down the middle of the channel and mixed rapidly. Two hours after high water dye was detected in a plume extending almost 2km into the lower harbour as shown in figure 2.8. Later again at HW+4h the plume had moved further out the harbour and low dye concentrations were detected off Lower Aghada pier as indicated in figure 2.9.

2.4.7 On the following day, 15th Sept., dye concentrations were measured throughout the survey area at low water (1200hrs) and high water (1800hrs). The dye was found to have been fully mixed with similar concentrations in all areas. Figure 2.10 shows the dye distribution at high water (1800hrs). The dye was just detectable towards the upper end of the East Passage and at the extent of tidal travel, towards Belvelly and Ballinacurra, concentrations increased to 3×10^{-8}. Some traces of dye were also detected close to the shore off Rostellan as shown in figure 2.10.

2.4.8 Further tracking on the following day showed that concentrations had fallen to close to background over much of the area. The highest values were recorded at the western end of the North Channel near Weir Island as shown by figure 2.11.

2.5 DYE RELEASE NO. 2 - BALLINACURRA - 21st SEPTEMBER 1993

2.5.1 This continuous dye release took place from a point just below the N25 road bridge (M9) crossing the Owenacurra River upstream of Ballinacurra. The release commenced at 0845hrs while the tide was still flooding and continued until 2130hrs. A partial blockage in the dosing pump early in the day reduced the rate at which the dye was being released and only 20kg in total was released. High water on the morning of release was at 0940hrs and low water at 1613hrs. Tidal ranges correspond to mean tide conditions and weather conditions were good with light winds.

2.5.2 Slack water at the discharge point was observed to occur at 0920hrs and the plume began to move downstream along the western bank. The first tracking exercise commenced at 1130hrs (HW+2h) from the leading edge of the plume, which lay off Green's Point, upstream to the discharge point (figure 2.12).

2.5.3 At HW+3h the leading edge of the plume had reached Ahanesk and low concentrations of dye were detected in the waters towards Rathcoursey Pier (figure 2.12). Tracking later in the day between HW+4h and HW+5h showed that the dye in the East Passage was well mixed (figure 2.13).

2.5.4 Tracking was conducted in the outer harbour at low water. Dye concentrations were generally low and the dye was distributed over a wide area. The highest concentration was recorded near the shoreline to the west of Aghada pier. At LW+1hr the tide had turned and a patch of dye was detected moving toward East Ferry (figure 2.13). Tracking in the East Passage showed the dye to be well mixed over the channel cross section.

2.5.5 Tracking between LW+2.5h and LW+3.5h showed that the dye had travelled along the North Channel towards Belvelly as shown in figure 2.14. Tracking up the Ballinacurra channel showed a steady increase in concentration up to the release point.

2.5.6 Tracking at high water (1130hrs) on the following day, 22nd Sept., showed that appreciable concentrations of dye remained in the Ballinacurra estuary. Low concentrations were detected in the North Channel as far west as Weir Island (figure 2.15).

2.5.7 Tracking at high water (1230hrs) on 23rd Sept. showed that the dye was distributed more evenly throughout the area (figure 2.16). Concentrations were still highest near Ballinacurra and concentrations near Weir Island had also increased somewhat. Off the East Ferry low concentrations of dye were also detected.

2.6 DYE RELEASE NO. 3 - GREEN POINT - 8th OCTOBER 1993

2.6.1 This dye release took place during average neap tide conditions and moderate easterly winds. The inflatable boat with the dye dosing equipment was positioned in mid channel to the west of Green Point. Dye injection commenced at 0800hrs and continued until 2040hrs. Forty seven kilograms of dye were released over the 12.6 hour period. High water on the day was at 1040hrs and low water at 1721hrs.

2.6.2 From the time of release the dye plume moved upstream towards Ballinacurra on the flooding tide. A track at High Water showed low dye concentrations as far upstream as the quays (figure 2.17).

2.6.3 At the change of tide the plume began to move downstream. The large 'patch' of dye that formed around the inflatable during the slack water period moved to the west, probably due to the easterly wind, and became lodged in Ballyannan bay.

2.6.4 At HW+2h (1130hrs - 1230hrs) the plume was travelling in a south westerly direction and lay along the shoreline at the southern end of Ballyannan bay (figure 2.17). From here the plume travelled towards the East Passage and quickly mixed evenly across the channel. Some traces of dye were recorded in the gyre to the north of Bagwell's Hill. This was probably the result of the easterly wind, which by 1200hrs had increased to a fresh 7-8m/s, moving the surface waters towards and into the gyre. Tracking further down the East Passage showed that by HW+2.75h the dye plume had reached Marloag Point.

2.6.5 Tracking in the lower harbour at low water showed the dye to be distributed over a wide area as seen in figure 2.18. By the time the survey boat reached the North Channel the tide had just begun to flood and the plume lay in an east-west direction off Ahanesk and a large patch of dye had begun to move westwards. No further tracking was conducted on this tide.

2.6.6 On the following day 9th Oct. dye concentrations throughout the survey area were recorded at both high and low waters. The dye distribution at high water (@ 1130hrs) is shown in figure 2.19. The highest levels were recorded upstream of the release point while levels in the North Channel were highest off Brick Island. Dye concentrations fell to near background levels in the outer bay past Marloag Point.

2.6.7 Tracking at high water (@1230hrs) on 10th, figure 2.20, showed that most of the dye had dispersed and that there was only a small increase in levels from Rathcoursey up to Midleton and along the North Channel to Belvelly.

2.7 DYE RELEASE NO. 4 - RATHCOURSEY - 11th. OCTOBER 1993

2.7.1 A discrete release of dye was made from the site of the existing Rathcoursey outfall a flooding tide in order to obtain information for the numerical model set up.

2.7.2 One litre of dye was released on the surface at HW-3h and tracked as it travelled northwards and then to the west along the North Channel. The positions of the resulting patch are shown in figure 2.21. The tidal range on the day was 2.3m corresponding to large neap conditions and weather conditions were good with calm seas and slack winds.

2.7.3 During each tracking period the survey vessel travelled through the patch in a Zig-Zag pattern recording the dye concentration levels. Most of the dye moved along the North Channel though some entered the shallow bay to the north east of Brown Island. Tracking ceased when the patch had widened to the full width of the channel.

2.8 ANALYSIS OF DYE STUDY RESULTS

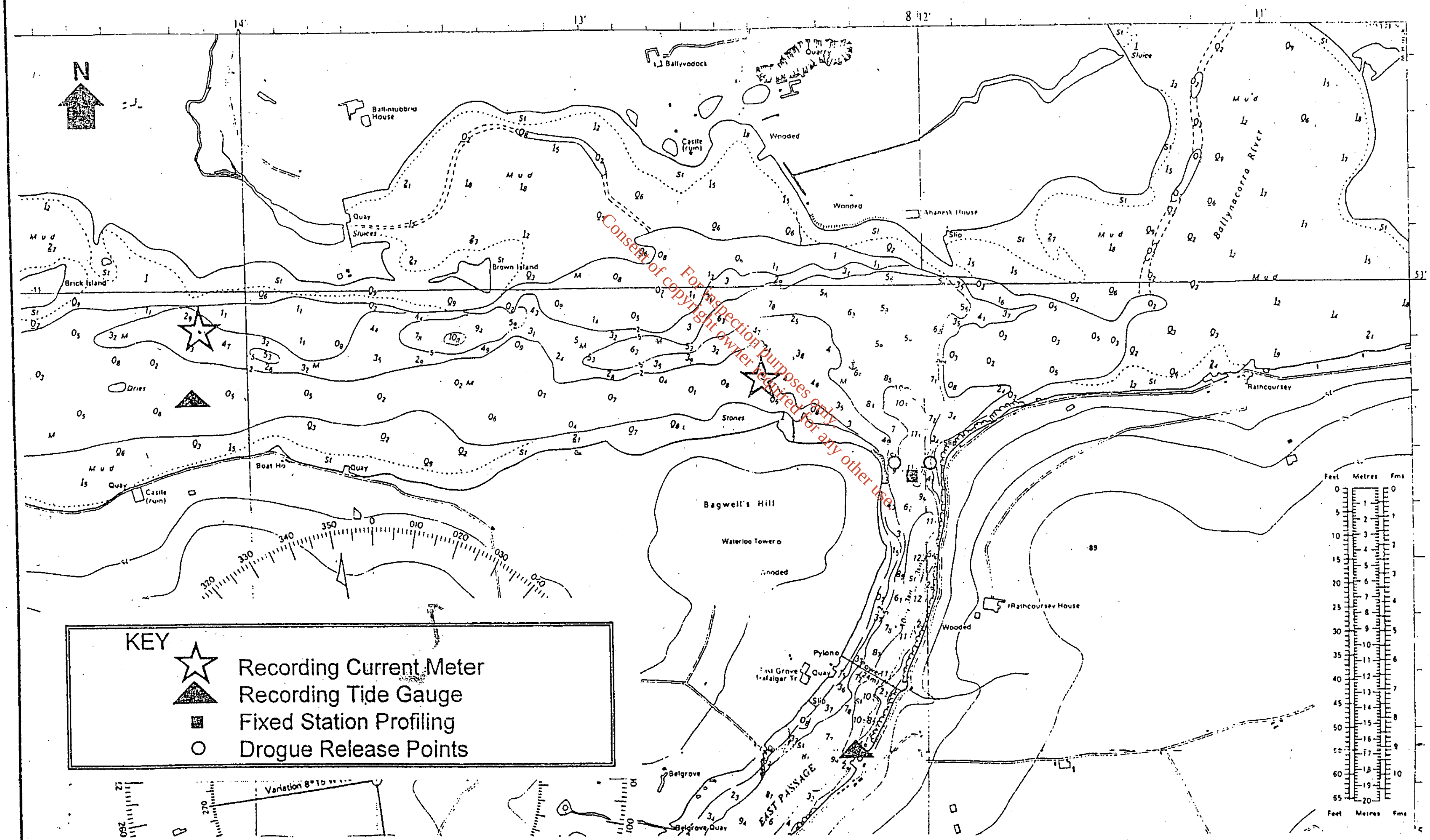
2.8.1 Results from the three dye releases have shown the likely path of an plume effluent discharging from each outfall site. The plume from Rathcoursey travels down the East Passage on the ebb tide and out into the lower harbour. On the flood it travels northward towards Ahanesk before dividing with the greater portion going to the west along the North Channel towards Belvelly.

2.8.2 The plume from an outfall at Ballinacurra travels down the East Passage and into the lower harbour. On the flood the dye moves back up toward the East Passage with some going towards the East Ferry as shown in figure 2.13. Dye contaminated waters also travels along the North Channel and at the outfall site itself the plume pushes back upstream against the freshwater inflow from the Owenacurra River.

2.8.3 The plume from the Green Point outfall site follows a similar path to that from Ballinacurra with the easterly wind on the day showing how dye from the surface waters can move across and into the gyre on the western side of the East Passage during the ebb tide.

2.8.4 From the results of three dye releases and the decrease it at average dye concentration between high waters on Day 2 and Day 3 the average tidal exchange factor has been calculated to be 0.30. This is in general agreement with the factors of 0.19 and 0.24 determined by M.C. O' Sullivan in the Cork Harbour Pollution Report.

MIDLETON SEWERAGE SCHEME OUTFALL STUDY 1993



Scale: 1/18,000

Figure 2.1 Instrument / Measurement Locations

MIDLETON SEWERAGE SCHEME

MEASURED CURRENT SPEED AND DIRECTION OFF BROWN ISLAND

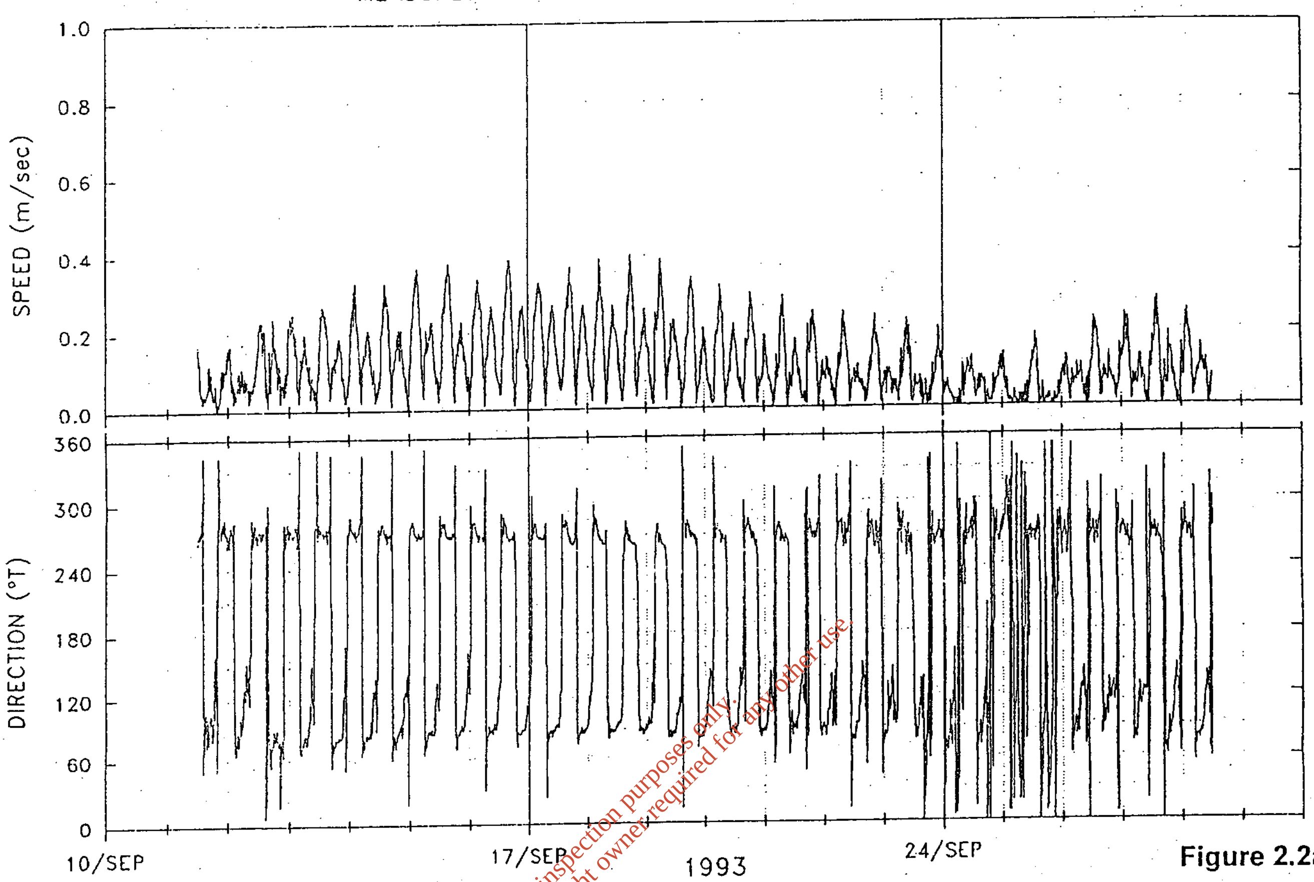


Figure 2.2a

MIDLETON SEWERAGE SCHEME

MEASURED CURRENT SPEED AND DIRECTION IN GYRE OFF NW CORNER OF EAST PASSAGE

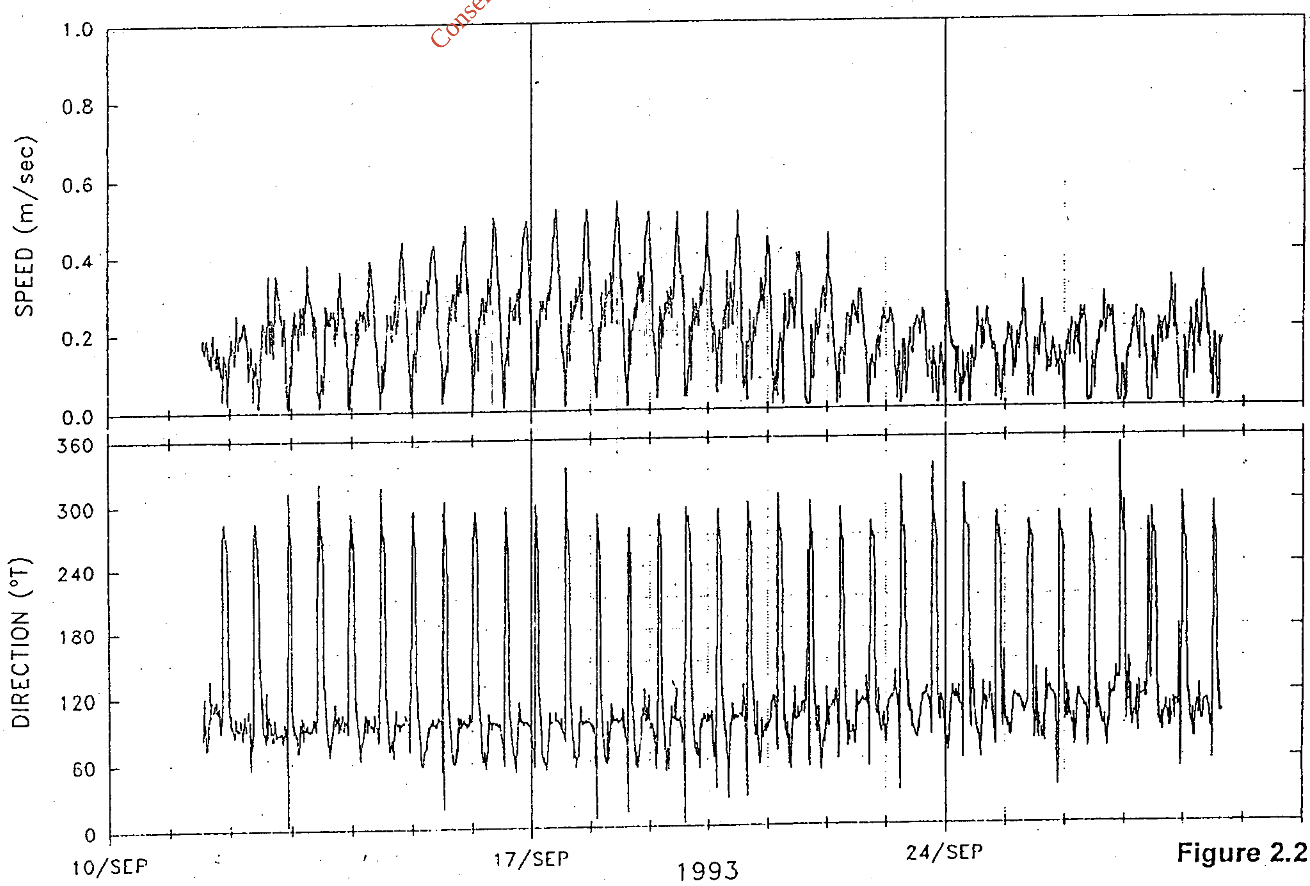


Figure 2.2b