

- The viable routes for the various gravity and pumping transmission mains for Cork City, Tramore Valley, and Glanmire/Little Island schemes.
- The location of the main pumping station for Cork City.
- The determination of the most suitable treatment processes to deal effectively with the wastewater contribution from all sections of the scheme.

2.2.1.1 Treatment Plant Site

In theory, the most suitable site for the treatment plant is the one that:

- Is near the outfall point, thereby serving as large a catchment area as possible upstream of same.
- Achieves an economically viable engineering solution to the provision of an appropriate collection system.
- Is capable of being developed as a treatment plant location.
- Is at an elevation that will minimise pumping costs for the various elements of the scheme.
- Has an acceptable environmental impact, and
- Is not in close proximity to densely developed residential areas.

A site for a wastewater treatment plant located at Carrigrenan is recommended on engineering, economic, and environmental considerations, and on the basis of sustainable development.

The engineering and economic reasons for this recommendation are:

- The location of the site is adjacent to the proposed outfall point, thereby maximising its use in relation to potential development in the area.
- Its elevation and size renders it suitable for development.
- The overall cost of the main drainage scheme based on this site compares favourably with the cost of the scheme based on any other site option.

- The elevation of the site allows for a gravity flow through the plant and to the discharge outfall.

The environmental reasons for this recommendation are:

- Less significant impacts will occur to the human and visual environment than with the other alternatives considered.
- The site is currently intended for industrial use as identified in the County Development Plan. Both the County Development Plan and the Land use and Transportation Study (LUTS) call for industrial development at Little Island.
- Impacts to flora and fauna can be satisfactorily ameliorated.
- The site is remote from areas of concentrated residential development and is more than 100m from the small number of existing houses at Clashavodig.
- The existing hillock at the southern end of the site can be retained as a screening measure.

For the following reasons the concept of sustainable development is adequately protected by adopting the Carrigrenan site.

- The use of the site is consistent with the County Development Plan.
- Development in the eastern corridor (Little Island to Carrigtwohill) is facilitated by the site.
- Location of the site in this area does not adversely affect the development strategies of the city and county authorities.
- The prospects of achieving the objectives of the LUTS study are enhanced by the location of a site at Carrigrenan. This is due to its strategic location in relation to existing and potential wastewater generation in the city and adjacent county areas.
- Development at this site will allow for continued industrial development of Little Island by providing adequate wastewater treatment capacity to encourage expanded industrial growth.

Plate No. 4.5.1 (Ref. Chapter 4) is an aerial photo of the Carrigrenan site.

2.2.1.2 Collection System

Cork City Drainage

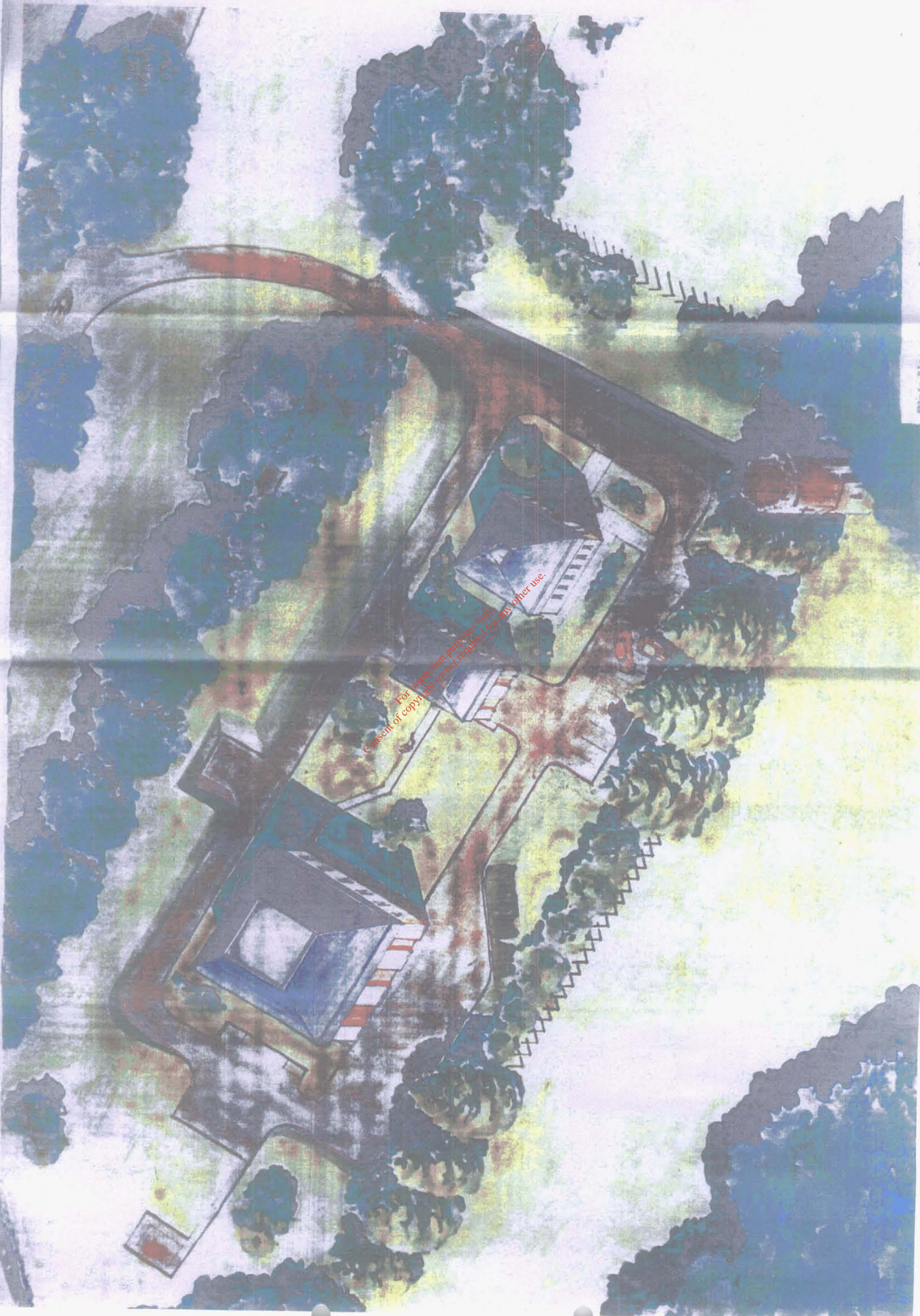
The elements of the city drainage system to convey wastewater to the Treatment Plant Site consist of:

- The linking of the existing main city outfalls at Penrose's Quay and Kennedy Quay.
- The interceptor system for the Glanmire Road/Tivoli Area.
- The collection system for Centre Island.
- The interception of existing city outfalls downstream of the Custom House.
- The Boreenmanagh Road drainage scheme.
- The Beaumont area sewerage system.
- The drainage system for Blackrock area.
- The linking of existing outfalls and pumping stations in the Mahon/Bessborough areas.
- The location of the Central Pumping Station.

Central Pumping Station

The location of the Central Pumping Station for Cork City was determined by the viability of routes available for the major sewers of the collection system. Based on analysis of various options the recommended location of the Central Pumping Station is at Atlantic Pond. The site is located off The Marina just south of the old railway line. As illustrated in Plate No. 2.2.2, the layout will include the pumphouse building, a services building, and an administrative building.

Due to the old railway line, the pumping station will not be readily visible from The Marina. In order to reduce the visibility of the pumping station from the railway line/public walkway, all natural vegetation will be retained along the line (except for the access road), and the pumping station will be landscaped as well. Because no form of wastewater treatment will be provided at this site and wastewater will not be exposed to the environment (i.e. in open tanks), possible odour



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emissions will be minimised by provision of a biological filter on the vent outlets.

It is proposed that twin rising mains (1,500mm diameter) would be laid from Atlantic Pond to a header chamber located at Mahon and twin pressure sewers of part 1950mm and part 1800mm diameter would be laid across Lough Mahon from this chamber to the site at Carrigrenan.

Tramore Valley

The existing pumping station at Ronaynes Court would be incorporated in the scheme. It is proposed to retain the holding tanks and outfall for emergency purposes.

Linking the Tramore Valley and Cork City schemes will be accomplished by pumping directly from Ronayne's Court to the header chamber mentioned above. Collection mains across the Douglas River will be attached to the existing bridge so as to avoid disturbing the ecologically sensitive mudflats and bird-roosting area in this part of the Douglas River estuary.

Little Island

The collection system for Little Island will consist of a 200mm rising main to convey the wastewater from the Courtstown Industrial Estate directly to the site at Carrigrenan via the foreshore and existing road at Clashavodig.

The collection system will also intercept existing outlets along the western side of Little Island and transport their wastewaters to Carrigrenan through a main in the foreshore.

The proposed collection system is illustrated in Map 2.2.1.

2.2.1.3

Wastewater Treatment Plant

This section of the EIS identifies and addresses each component of the proposed Treatment Plant.

The proposed wastewater treatment plant will meet the conventional effluent standard of 20 mg/l BOD and 30 mg/l Suspended Solids.

The effluent recipient water in the Lee Estuary has not yet been designated as a "Sensitive" or "Less Sensitive" area by the Department

of the Environment in accordance with the terms of the EC Directive on Urban Wastewater Treatment (91/271/EEC). Therefore nutrient removal (nitrogen and phosphorus) is not required at present. However, this situation may change in the future. The proposed Wastewater Treatment Plant is designed to allow easy retro-fitting of nutrient removal facilities at a later stage if required.

The proposed components of the wastewater treatment plant are as follows:

- **Stormwater Handling, Treatment, and Disposal.** The principal objectives of the stormwater handling and disposal strategy, as applied to the Cork Main Drainage Scheme, are to optimise the level of on-site stormwater treatment and maximise the quantity of stormwater that can be returned to the plant for biological treatment when capacity becomes available. The strategy will provide both an economically and environmentally acceptable system for effective control, treatment, and disposal of potentially large quantities of stormwater.
- **Screening.** The nature of the screening system required is generally determined by the nature and quantities of the raw wastewater to be screened. The recommended bar-spacing to be adopted in the preliminary treatment plant associated with the Cork scheme is 10mm. It is estimated that, following washing and dewatering, up to 4.5 tons of screenings with a dry solids content of 50% will be produced per day at design loadings. Screenings will be dewatered and bagged for ultimate disposal in a landfill.
- **Grit and Grease Systems.** The principal function of this system is the removal of grit particles and grease from the influent wastewater flow in order to protect pumps and mechanical equipment from damage and excessive wear in subsequent stages of treatment. Under design loading conditions, it is estimated that between 4m³ and 5m³ of grit per day will be generated at the treatment plant site. The ultimate disposal of the grit will be to landfill. Grease will discharge to the anaerobic sludge digestion process for treatment/degradation.
- **Primary Sedimentation.** The purpose of primary sedimentation is to remove the maximum amount of polluting matter in the form of readily settleable solids from the wastewater as quickly and as economically as possible.

To cater for design hydraulic-loading conditions, at a maximum throughput of 6 DWF, it is estimated that six 35m diameter radial flow tanks will be required for primary treatment for the scheme.

Secondary Treatment

The activated sludge process has been proposed for the treatment of the urban wastewater from the Cork Main Drainage Scheme for the following reasons:-

- It is a well documented treatment system suitable for large urban wastewater treatment plants. The system has been adopted universally for this purpose.
- It facilitates design flexibility to allow for future extension and for retrofitting for nutrient removal at optimum capital and operating/maintenance costs.
- It facilitates modular type design to cater for both present and future design loads.
- It allows for flexible control and operation.
- It minimises odour emission - the Aerobic Suspended Biomass System is less prone to odour emission compared to Biofiltration (Attached-Growth/Fixed-Film) system.
- It facilitates effective biological phosphorus and nitrogen removal if and when required.
- Clarification of the mixed liquor suspended solids from the aeration system will be carried out in radial flow settlement tanks.

2.2.1.4 Outfall Location

The proposed outfall location is at the deep water channel at Marino Point. This location was chosen following the mathematical modelling of the bacteriological and chemical constituents of the treated effluent (Refer Appendix 1) for outfall locations at Lough Mahon and Marino Point. The dispersion of the bacteriological and chemical constituents of the treated effluent has been modelled over a full range of tidal conditions and for present and future loadings.

An outfall at Marino Point has the following distinct engineering and environmental advantages:

- It is downstream of the dredged section of the Channel.
- It has an approximate depth of water of 8m at low tide, thereby ensuring its safety from damage by shipping.
- The depth available will provide excellent dispersion of the effluent.
- Its location is still within a reasonable distance of the city and is, in fact, the nearest point in the Channel where an adequate depth of water is available to achieve a safe and efficient outfall.
- The location is downstream of and adjacent to the proposed site for the wastewater treatment plant.
- The superior mixing characteristics associated with this location will ensure the minimum impact on Cork Harbour water quality.

The outfall pipe will extend from the southern end of the Carrigrenan site in a southerly direction, to a point at the deep water channel. It will consist of approximately 1km of 1,800mm diameter gravity main and a diffused pipe.

2.2.2

Design and Layout

The estimated overall land area requirement for the proposed wastewater treatment plant, including facilities for organic-material removal, nutrient removal, and advanced sludge treatment, is 20 hectares. This figure is based upon the sizes of the individual processes and the estimated sizes of the various service buildings. Some further optimisation of the final layout of the treatment plant will be carried out at the detailed process design stage prior to preparation of the contract documents for the scheme.

The schematic profile of the proposed treatment plant incorporating the preferred unit processes as identified in the preceding sections is shown on Fig. 2.2.1. The layout plan of the proposed wastewater treatment plant on the Carrigrenan site is shown on Fig. 4.5.1 (ref. Chapter 4).

In summary, the plant comprises the following:

- Screening, adopting 10mm bar-spacing together with treatment of screenings. Conveying, washing, pressing, and bagging will be carried out within an enclosed building.
- Grit and grease removal, utilising the spiral flow aerated grit system, and grit washing/classification will be carried out in a covered tank. The grease will be automatically discharged to an anaerobic sludge digester for treatment/degradation.
- Primary sedimentation of the wastewaters will be carried out in covered radial flow settlement tanks.
- High-rate activated sludge will be utilised for secondary treatment (carbon removal) followed by final clarification in radial-flow settlement tanks.
- Sludge treatment incorporates thickening of the primary sludge in picketfence thickeners and thickening of the secondary sludge in a pre-thickener unit prior to discharge to anaerobic digestion. The anaerobically treated sludge will then be mechanically dewatered utilising centrifuges or belt presses. The sludge cake at approximately 25% solids will then automatically discharge to the thermal drying plant. The dry granular sludge will be automatically bagged prior to ultimate disposal at municipal parks, golf courses and/or landfill.
- Nutrient removal facilities (retrofitted) incorporate biological nitrification and denitrification utilising the activated sludge process/recirculation method for nitrogen removal and biological excess phosphate removal supplemented with chemical precipitation of the residual phosphorus for phosphorus removal.

All sludge-thickening tanks and primary sedimentation tanks, will be covered. The sludge dewatering will be housed within the common building for the thermal drying plant and the screening plant/screenings treatment will also be housed. The extracted air from all the housed and covered tanks will be treated utilising biological scrubbers (Bioscrubber).

A three-dimensional drawing of the proposed wastewater treatment plant on the preferred Carrigrenan site is shown on Fig. 4.5.4 (Ref. Chapter 4). Photo montage (Plate No.4.5.2 -Chapter 4) gives an impression of the finished site.

2.2.2.1 Construction and Commissioning

EC Directive 91/271/EEC - Urban Wastewater Treatment - requires that wastewater from agglomerations of more than 15,000 population equivalent, shall, before discharge, be subject to secondary treatment at the latest by 31st Dec. 2000.

A target date has been set for the completion of the Cork Main Drainage Scheme by Oct. 1999 to meet this requirement and to allow some lead-in time for monitoring the effects of implementation to be carried out.

It is anticipated that planning and design of the scheme will commence in 1993 with construction commencing in late 1994. Fig. 2.2.2 shows in bar chart form the expected phasing of construction over a period of five years up to October 1999.

The Wastewater Treatment Plant will incorporate modern instrumentation, control and automation facilities. Skilled operating and maintenance personnel will be employed to operate the treatment plant to ensure that optimum performance from the facility will be achieved.

2.2.2.2 Associated Developments

In addition to the elements of the proposed scheme as illustrated in Map No. 2.2.1 and discussed in Section 2.2.1 (Project Elements) of this EIS, 11 pump stations will be incorporated into the scheme. Five of these pump stations will be located at the site of existing pump stations, and as such will constitute an upgrade of existing facilities rather than new construction. The remaining six pump stations will require new construction. These stations, as shown in Map No. 2.2.1 are located throughout Cork City, Blackrock, Mahon, Rochestown, and on Little Island.

Pump Station Number 1 will be the major pumping station for the scheme and will be constructed at a site near Atlantic Pond. Some filling will be required to bring the elevation of the site to 1.5m OD Malin Head.

Pump Station Number 2 will be located at the site of the existing Tramore Valley Pump Station (and outfall) and upgraded, and minimal new construction will be required.

Pump Station Number 3 will be located at the site of an existing septic

Fig. 2.2.2
Cork Main Drainage Scheme
Programme for Design & Construction

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Primary Report & Submission	█									
Environmental Impact Assessment		█								
Approval of Preliminary Report		█								
Financing Arrangements		█								
Acquisition		█								
Plant Trials		█	█							
Final Design		█	█	█	█	█				
Investigation			█							
Contract Documents			█	█	█	█				
Approval to Contract Documents				█	█	█	█			
Final Submission				█	█	█	█			
Final Reports / Approval				█	█	█	█			
Finalisation for Construction				█	█	█	█			
Final Construction (Fig. 3.11.2)				█	█	█	█	█	█	█
Final Commissioning (Fig. 3.11.2)									█	█

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Note : █ Denotes extension of plant for future loading, and / or nutrient removal.

Note : █

tank at Castle Road approximately 100m west of Blackrock Castle. A packaged type submersible pump will be used. A maximum of 0.2 hectare will be required.

Pump Station Number 4 will be located at the site of the existing Mahon North Pump Station, north of the playing pitches. Construction at this facility will require the installation of new pumps and, minimal site improvements.

Pump Station Number 5 is located at the site of the existing Mahon South Pump Station, south of the playing pitches. Existing pumps will be retained with minimal site improvements as necessary.

Pump Station Number 6 will be located at the site of an existing septic tank near Besborough. A packaged type submersible pump will be utilised. This pump station will impact an area of approximately 0.1 hectare.

Pump Station Numbers 7 and 8 will be located within the Tivoli Industrial Estate along the north shore of the River Lee. The 2 no. pump stations will require less than 0.2 hectares.

Pump Station Number 9 will be located on the western shore of Little Island south of the Mitsui-Denman facility. This site is at the location of an existing wastewater outfall for Little Island, at the extreme southern end of the public walkway. The pump station will require a maximum of 0.2 hectares.

Pump Station Number 10 will be located along the western shore of Little Island at a site near Wexport Industries. There is an existing storm sewer outfall in this area. This facility will encompass an area of approximately 0.4 hectares.

Pump Station Number 11 will be located in the Courtstown Industrial Estate on the eastern side of Little Island. An area of approximately 0.2 hectares will be required, and access will be facilitated by the extension of the Industrial Estate Road from Courtstown to Carrigenan.

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Chapter 3

EMMISSIONS TO THE ENVIRONMENT

CHAPTER 3

Emissions to the Environment

This section summarises the existing and proposed emissions relative to the Cork Main Drainage Scheme.

3.1 Urban Wastewater Discharge

Currently, six major outfalls discharge wastewater into the River Lee and Lough Mahon. These are identified as Penrose Quay (City North), Kennedy Quay (City South), Tramore Valley, Glanmire/Little Island, IDA Industrial Estate/Little Island, and Courtstown Industrial Estate/Little Island. Under the proposed sewerage scheme, each of these discharge outfalls would be intercepted, and the wastewater would be transported to the treatment plant at Carrigrenan for treatment prior to discharge at Marino Point.

Table 1.3 (Appendix 1) provides discharge loads from these existing outfalls under present and future conditions. Existing discharge loads are provided for dry weather flow (DWF), BOD, COD, Suspended Solids, Total Nitrogen, Organic Nitrogen, Ammoniacal Nitrogen, Nitrate, Total Phosphorus, and Total Coliform. This table indicates that the combined emissions into Lough Mahon from these six outfalls is a DWF of 67,395m³/day; 19,291kg/day of BOD; 38,767kg/day of COD; 18,260kg/day of Suspended Solids; 2,741kg/day of Total Nitrogen; and 717kg/day of Total Phosphorus. The future loadings were generated for use in the mathematical modelling of the harbour.

Future emissions of the wastewater treatment plant will meet conventional effluent standards of 20 mg/l BOD, and 30 mg/l of Suspended Solids.

3.2 Industrial Wastewater Discharge

An industrial wastewater survey incorporating on-site wastewater flow monitoring and sampling, assessment of completed detailed questionnaires and the results of laboratory analysis of the flow-proportional samples and metered water consumption was carried out. The results of this survey are presented in Appendix 2.

A 100% response from all industries, i.e. licenced and unlicenced, in both the city and county catchment areas was received. The present

daily industrial pollution load in terms of organic matter, nutrients, etc. for the various catchments has been determined based on the results of the survey.

The 1991 industrial pollution loads were compared to the 1965 and 1975 Review of the Cork Main Drainage Scheme, Appendix B Loads, in terms of BOD, Suspended Solids and hydraulic loads. The original estimate of the industrial pollution loads to be dealt with by the Cork Main Drainage Scheme in 1965 was 9,266 kg BOD/day and 3,815 kg/day of Suspended Solids. Following the 1975 review, the industrial BOD loading was reduced to 5,078 kg/day, and the Suspended Solids loading was estimated at 3,519 kg/day.

The corresponding 1991 BOD and Suspended Solids loadings are 4,583 kg/day and 2,769 kg/day, respectively. The industrial hydraulic load for the city has diminished slightly from 6,994 m³/day in 1975 to 6,890 m³/day in 1991.

Industrial wastewater discharges into the proposed collection system combining with the conventional domestic wastewater and stormwater. The combined wastewater will be transported to the treatment plant for treatment. Following treatment, the discharge will flow through the proposed outfall to the deep channel at Marino Point.

3.3

Stormwater Discharge

A number of storm overflow chambers have been constructed as part of the development of Cork City and Tramore Valley Drainage Schemes to-date and further chambers will be incorporated in appropriate locations when the interceptor system is extended.

An assessment of the impacts of stormwater discharge from existing overflows is contained in Appendix 3.

The results show that, by incorporating some modifications to 3 no. S O chambers, no adverse impact on the recipient waters will occur due to discharges from all the storm overflow chambers.

It is not intended to install overflow chambers on the interceptor system itself and consequently all storm water discharges to same will be conveyed to the wastewater treatment plant site as described hereunder.

All stormwater collected will be transported to the treatment plant. The system will involve stormwater separation at two locations on the main

wastewater stream through the plant. The first stormwater separation will occur immediately downstream of the grit and grease removal tanks where flow in excess of 6DWF will be overflowed to the storm water settlement tanks. The second separation will occur downstream of primary settlement and will be designed such that up to a maximum of 3 DWF only will be forwarded for biological treatment. Flows in excess of 3 DWF, i.e. between 3 and 6 DWF, will be overflowed to combine with the secondarily treated effluent and discharged to the recipient waters or, alternatively, directed to the stormwater settlement tanks.

The destination of this overflowed wastewater will depend essentially on the total hydraulic flow to the plant. When the total flow to the plant is between 3 and 6 DWF, the quantity in excess of 3 DWF will be directed to the storm water settlement tanks to utilise the available storage capacity and effect further settlement of the storm water. When the total flow to the plant is greater than 6 DWF, the wastewater is already highly diluted and, combined with the level of pretreatment (i.e. preliminary and primary treatment) provided, the pollutant concentrations will be reduced to within design discharge standards. No further benefit, therefore, is to be gained from utilisation of the storm tanks, and the overflow wastewater from the second storm water separation point combined with the treated effluent can discharge directly to the recipient waters.

Fig. 3.3.1 illustrates the strategy for storm water handling, treatment, and disposal. Design flows of storm water, and maximum BOD and suspended solids of the treated (clarified) storm water and the combined treated effluent and treated storm water prior to discharge are also shown.

3.4 Odours and Noise

Odour control is one of the more important aspects of the entire Cork Main Drainage Scheme. As such air quality dispersion modelling to assess the potential for significant odour emissions and identify mitigation measures, was carried out by Envirocon Ltd. This study is included in Appendix 4.

The areas of the large urban wastewater treatment plants that are particularly susceptible to odour emissions are as follows:

- Screening, screenings treatment, and screenings disposal.
- Grit and grease removal.
- Primary sedimentation tanks.

- All sludge-handling and treatment facilities.

Odours are mainly caused by sulphurous compounds (H₂S, mercaptans, organic sulphides), nitrous compounds (ammonia and organic nitrogen), and acid aldehyde- and ketone-type organic compounds. However, sulphur compounds represent the majority of odorous molecules found in an urban wastewater treatment plant.

The incorporation of odour preventative measures at the initial design stage is a necessary pre-requisite to achieving an effective odour control system. The object of this strategy is to eliminate any nuisance caused by odour but not necessarily to eliminate odour, as the latter is not practicable and may prove impossible. What is required, therefore, is to reduce the impact of the odour to a level where it does not cause a problem.

The previously listed areas of wastewater treatment plants that have been identified as prone to creating odour emissions, will be housed as in the case of the screenings, and sludge treatment systems, and covers provided on the primary sedimentation tanks and all sludge thickening storage tanks and grit removal systems. The extracted air will then be discharged to a suitably designed treatment system.

Based on the findings of the air quality dispersion modelling, the treatment plant is not anticipated to result in significant long-term odour-related problems.

Noise emissions resulting from construction activities (e.g. equipment, trucks, blasting, trenching, etc.) will be minor and short-term in duration. Any noise impacts will be minimised by permitting construction only during daytime hours. All trucks, equipment, and machinery will be maintained and installed with mufflers where appropriate to limit noise emissions. Noise emissions from operation of the wastewater treatment plant are not anticipated to result in significant noise impacts.

3.5 Sludge Disposal

A byproduct of any wastewater treatment plant is the generation of sludge. Since the quality and quantity of sludge generated relates directly to the method and subsequent feasibility of disposal options, the method of sludge treatment is critical in determining sludge disposal.

Based on the assessment/evaluation of various sludge treatment and disposal options, the thermal drying system for advanced sludge

treatment is the preferred option in the Cork Main Drainage Scheme. This is based on the following factors:

- It is an environmentally acceptable system for advanced sludge treatment because the entire process is completely contained within a closed-circuit system. Emissions to the atmosphere are minimised.
- The end product is clean, pasteurised, odourless and easy to handle and store. It is suitable as a soil enricher, assuming metal content is within the required limits.
- The sludge quantity for ultimate disposal is dramatically reduced.

The process of thermal drying is a unit operation that involves reducing the water content of sludge by vaporisation of water to air. This results in a dried product of 92% to 95% dry solids concentrated in the form of granules. Pretreatment of the sludge takes the form of digestion and dewatering, with the Biogas produced by the digestion process being utilised as an energy source for the dryer.

For the Cork Main Drainage Scheme, an estimated 18m³/d of product (16.7 t/d at 93% TS) would be produced at design loading. This product would be stabilised and pasteurised, i.e. free from pathogens and parasites. This sludge is usually suitable for land application, although this is dependent on the metal content of the feed sludge and on the presence of any other leachable components that may have been present initially because these are not removed in the process and will still be present.

The granular product is very easily stored on site, and trials to date have shown that there are no detrimental effects of long term storage of the granules. The granules can be bagged and are very readily transported for ultimate disposal.

Ultimate disposal options include use as a soil conditioner for golf courses and municipal parks, landscaping, and land restoration- assuming the heavy metal content is within allowable limits, and/or for landfilling.

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Chapter 4

DESCRIPTION OF ALTERNATIVES

CHAPTER 4

Description of Alternatives

The purpose of this section is to summarise the various alternative options relative to selection of the proposed wastewater treatment plant site, wastewater collection system, treatment system, and outfall location. A discussion of the economic, engineering, and environmental evaluation conducted during the selection process is provided.

4.1

Alternative Treatment Options

Development and evaluation of alternatives have dealt with a number of options based on the following:

- Consideration of separate collection systems and wastewater treatment plants for the north and south sides of the city.
- Consideration of the merits or otherwise of including Cork Co. Council's Tramore Valley Sewerage Scheme in proposals for completion of the Cork City Main Drainage Scheme.
- Consideration of the merits or otherwise of including Cork County Council's Glanmire Sewerage Scheme and Glounthaune/Little Island Sewerage Scheme in the Cork City Main Drainage Scheme.
- Consideration of the impact of incorporating industrial wastewaters from Little Island in the scheme.
- Identification of possible sites for a wastewater treatment plant(s) in the Cork Harbour area with a view to assessing their merits under various combinations of collection systems arising from the above.

A total of twelve treatment options were assessed and evaluated from engineering, economic and environmental standpoints.

The result of this assessment revealed two viable treatment options for the scheme referred to as Scheme A and Scheme B. These options were subjected to a more detailed evaluation as outlined in Section 4.1.1.

4.1.1 Alternative Treatment Plants

4.1.1.1 Treatment Systems

An assessment of the suitability of alternative treatment systems for the various unit processes (i.e. screening, grit removal, biological treatment, etc.) which comprise the overall treatment plant, was carried out.

The object of this assessment was to select suitable and effective systems for the individual unit process areas, capable of dealing with the loading conditions and wastewater composition. Based on this assessment, the following design philosophy was adopted in developing the overall conceptual design of the treatment plant.

- The total hydraulic load arriving at the individual treatment plant options will be screened and degritted.
- Flows in excess of 6 DWF will overflow to a storm holding tank immediately downstream of the grit removal system.
- Flows up to 6 DWF will discharge to the primary sedimentation tanks.
- Flows in excess of 3DWF (3DWF to 6DWF) will overflow immediately downstream of the primary sedimentation system to a storm sedimentation/holding tank.
- Flows up to 3DWF will receive full secondary treatment.
- The storm sedimentation/holding tank contents will be returned to the treatment plant at controlled flow rates following storm conditions to receive full treatment (i.e. at rates that ensure that the combined return storm flow and inlet flow do not exceed the design hydraulic capacity of the plant.

The two schemes identified for detailed evaluation in Section 4.1 above, are as follows:

Scheme A: Cork City and Tramore Valley would be combined in one treatment plant (Plant A1) and Glanmire/Little Island (including the industries) would be combined into a second treatment plant (Plant A2).

Scheme B: Cork City, Tramore Valley, and Glanmire/Little Island,

including the industries, would be combined in one treatment plant (Plant B).

A detailed engineering and economic evaluation of these alternatives was carried out. The purpose of this evaluation, in terms of area requirements and estimated capital and O&M costs, is to furnish sufficient detail to present a clear picture of the merits of each scheme.

The criteria adopted for carrying out a more detailed evaluation of the two alternative schemes (A and B) are as follows:

- Application of well-documented wastewater processes suitable for a large wastewater treatment plant.
- Minimisation of environmental impacts including odour, noise and appearance.
- Optimum capital and running (O&M) costs.
- Modular-type design to meet both present and future design loads.
- Design flexibility to allow for future extension or retrofitting for nutrient removed.
- Utilisation of biogas from sludge digestion tanks for electrical and heating purposes.
- Land area requirements.

The design effluent standard to be adopted, regardless of the specific treatment plant, is 20mg/l BOD, 100mg/l COD and 30 mg/l Suspended Solids.

For the purpose of a relative comparison between the two schemes (A and B), the design/unit processes and the mechanical components of the treatment plant remain the same in principle. The present and design loadings for the two alternative design schemes, A and B, are outlined in Table 4.1.1. The main plant sizes in terms of volumes and capacities of the various unit processes for organic removal (i.e. carbon - BOD/COD) are outlined in Table 4.1.2 for treatment plants A1, A2, and B, excluding advanced sludge treatment.

From an environmental standpoint, the critical factor in evaluating the potential environmental impacts from options A and B is the fact that for

Table 4.1.1
Wastewater Treatment Plant.
Alternative Schemes.

(a) Present Loading

Scheme	Description	Hydraulic (max. pumped) m ³ /hr	HYD. 6 DWF m ³ /hr	HYD. 3 DWF m ³ /hr	Organic kg BOD/day	COD kg/day	Suspended Solids kg/day	Total Phosphorus kg/day	Total Kjeldahl Nitrogen kg/day	P ₅ Eq
A	A1 - CC / TV	28,046	15,483	7,741	16,712	32,691	16,800	673	2,523	
	A2 - GL / LI	3,427	1,420	710	2,580	6,076	1,459	44	218	
B	CC / TV & GL / LI	31,473	16,904	8,452	19,292	38,767	18,260	717	2,741	

(b) Design Loading

Scheme	Description	Hydraulic (max. pumped) m ³ /hr	HYD. 6 DWF m ³ /hr	HYD. 3 DWF m ³ /hr	Organic kg BOD/day	COD kg/day	Suspended Solids kg/day	Total Phosphorus kg/day	Total Kjeldahl Nitrogen kg/day	P ₅ Eq
A	A1 - CC / TV	38,340	24,704	12,352	22,882	44,450	22,602	898	3,374	
	A2 - GL / LI	4,914	3,454	1,727	4,019	9,303	2,658	90	409	
B	CC / TV & GL / LI	43,254	28,158	14,079	26,901	53,753	25,260	988	3,783	

Note :
 CC = Cork City
 TV = Tramore Valley
 GL = Glanmire
 LI = Little Island

Table 4.1.2
Volume & Capacities of Unit Processes - Carbon (BOD / COD) Removal
Design Loadings

Item	Description	Units	Plant A1	Plant A2	Plant B
1	Screen Construction Capacity	(m3/h)	38,340	4,914	43,254
2	Grit & Grease Removal Volume Total	(m3)	2,485	345	2,830
3	Flow Measuring Chamber Capacity	(m3/h)	25,560	3,276	28,836
4	Primary Sedimentation Volume	(m3)	16,473	3,224	18,700
5	Aeration Tank Volume	(m3)	22,838	3,930	26,368
6	Final Settlement Volume	(m3)	35,604	5,871	40,600
7	Primary Sludge Thickener Volume	(m3)	309	30	310
8	Biological Sludge Pre-dewatering Capacity	(kg SS/h)	730	330	840
9	Digester Volume	(m3)	7,580	1,027	8,640
10	Gasholding Tank (4 Hours) Volume	(m3)	1,155	148	1,310
11	Sludge De-waterer Capacity	(kg SS/h)	1,306	350	1,170
12	Storm Water Tank Volume	(m3)	4,545	487	5,030

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Option A, two plants would be required rather than only one, as in Option B. Assuming that all design/unit processes and mechanical components are the same, the volume and quality of the effluent should be similar for either option. The primary difference, however, is that the construction of two plants will result in environmental impacts at two different locations. By centralising all treatment plants into one location, all associated impacts are centralised, as well. It is environmentally preferable to utilize this one site rather than impacting two distinct areas.

4.1.1.2 Sludge Disposal Options

The possible disposal routes for sludge disposal may be summarised as follows:

Disposal to Sea

Constraints on the disposal of sewage sludge to sea are imposed by the EC Directive concerning Urban Wastewater Treatment (91/271/EEC). Article 14 of this Directive states the following:

- Sludge arising from wastewater treatment shall be reused whenever appropriate. Disposal routes shall minimise adverse effects on the environment.
- Competent authorities or appropriate bodies shall ensure that before 31st Dec. 1998, the disposal of sludge from urban wastewater treatment plants is subject to general rules or registration or authorisation.
- Member states shall ensure that by 31st Dec. '98, the disposal of sludge to surface waters by dumping from ships, discharge from pipelines, or by other means is phased out.
- Until the elimination of the forms of disposal mentioned in paragraph 3, Member States shall ensure that the total amount of toxic, persistent, or bioaccumulable materials in sludge disposed of to surface waters is licenced for disposal and progressively reduced.

Thus, it is clear that sludge disposal to sea is not an option for the Cork City Main Drainage Scheme.

Disposal to Landfill

This form of disposal does not entirely comply with Article 14 of the EC Urban Wastewater Directive, which requires reuse whenever appropriate and also requires that adverse effects on the environment be minimised.

It is also possible that additional constraints may be imposed in the future by a Directive, presently at the draft stage, on landfill of waste. The draft of the Directive states that sewage sludge may be co-disposed at landfill sites classified as suitable for municipal, nonhazardous, and other compatible wastes. However, prior to landfilling, the sludge must be shown to be nonhazardous or inert by meeting the requirements of an eluate test (national leaching characteristics) and must also be shown to be compatible with control procedures in the operation and after-care phases of the landfill. Additionally, it is expected that the dry solids contents of sludge for acceptance will be greatly increased. All of these controls and procedures, if they materialise, would have the effect of making acceptability at landfill sites more difficult.

In addition to the above, the volume of dewatered sludge generated at the Cork Main Drainage Treatment Plant would be approximately 100m³/day @ 25% total solids at design load. Landfill space for volumes of this magnitude, based on discussions with both Cork Corporation and Cork County Council, is not available in Cork, and therefore disposal of dewatered sludge without some form of advanced sludge treatment to reduce sludge volumes is not a viable option for this scheme.

Disposal to Land

Sludge can have valuable agronomic properties, and disposal to land (land spreading) would comply with the requirement for re-use as set out in the EC Urban Wastewater Directive. However, the use of sewage sludge must not impair the quality of the soil and of the agricultural products.

The Council Directive on the protection of the environment (86/278/EEC) governs the use of sewage sludge in agriculture. This Directive states that sludge shall be treated before being used in agriculture. The use of untreated sludge is permitted only if the sludge is injected or worked into the soil. The Directive also states that treated sludge is sludge that has undergone biological, chemical, or heat treatment, long-term storage; or any other appropriate process so as to significantly reduce

its fermentability and the health hazards resulting from its use.

In addition to treatment requirements, limits are imposed on the heavy metal levels in both the sludge and the soil on which it is proposed to spread the sludge. Limits are imposed on the sludge quantity spread per unit area and on the time lapse required preceding harvest or grazing subsequent to land spreading.

The Directive also states that the sludge shall be used in such a way that account is taken of the nutrient needs of the plant and that the quality of the soil and of the surface and groundwater is not impaired. Rigorous analysis of both the soil at the proposed land spreading site and of the sludge is required at regular intervals.

It is evident, therefore, that very specific constraints apply to the disposal of sewage sludge by spreading on land. In addition, there are inherent difficulties in dealing with the large quantities of sludge for disposal in the Cork City situation, e.g. transportation problems, limited spreading times (i.e. weather constraints, etc) with associated intervening long storage periods required at the treatment plant, and locating a sufficient number of farmers willing to take the sludge within a reasonable radius of Cork City. A minimum of 4,000 ha will be required for land spreading at a design load based on 2 tons/ha/annum, which is the limit established in Article 6 of SI 183 of 1992 EC (Use of Sewage Sludge in Agriculture) Regulations, which transpose the EC Directive (86/278/EEC) into Irish law. This is the minimum land area requirement, and site-specific constraints in relation to metals and nutrients, etc. may require that the area be increased due to reduced allowable loading rates. All of these conditions indicate that land spreading is not a viable option for Cork.

Advanced Sludge Treatment

It is evident from the foregoing that in the case of the Cork Main Drainage Scheme, advanced sludge treatment options will have to be evaluated. The principal forms of advanced sludge treatment are outlined below:

- Composting

This produces a compost product that has approximately 50% dry solids (DS). Traditionally, it has a high area utilisation with long storage requirements. The compost residue has many uses as a fertiliser in agriculture or municipal parks, or it may be sold if a market can be established. The approximate quantity of

compost produced in the scheme would be 50m³/day.

Although composting is a relatively simple process which utilises natural biological processes to aerobically decompose sewage sludges into an organic material suitable for use as a soil conditioner or fertiliser, the process does have drawbacks. The process requires that the sludge/compost material be exposed to the air and mixed periodically to ensure maximum aeration. This operation results in the production of odourous off-gases which require treatment by chemical or biological processes. Also, an end use for the compost must be secured for the long term. This requires considerable effort in identifying and marketing disposal pathways. As noted previously the process requires long storage (up to 2 months) with associated large land area requirements, and depends upon climatic conditions, volume of sludge produced, composition of the sludge, moisture, and bulking agents selected, etc. In addition the end quality of the compost is directly related to the input so that sludge with high metal content will produce a compost with high metal content. In addition to these environmental concerns, it is likely that future EC Directives and legislation will restrict the end use of compost material making the long-term viability of this option uncertain.

Drying

Thermal drying produces a granular or pelletised residue that has approx. 95% DS, i.e. approximately 18m³ of residue per day. This residue can then be landfilled or may be utilised as a soil enricher if a disposal route can be found. Alternatively, drying can be used as a form of pretreatment for other forms of advanced sludge treatment (see below).

Thermal drying is a viable option due to minimal environmental constraints. The volume of sludge is greatly reduced thus facilitating final disposal pathways. The product is stabilised and pasteurised (i.e. free of pathogens and parasites) and, depending on metal content, is suitable for land application. The process does not require large land area, and results in minimal odour emissions.

Incineration

This is a thermal reduction process, operated at high temperature, conventionally utilising sludge at 28% to 30% DS

(i.e. additional pretreatment in excess of dewatering may be required, e.g. predrying or low-pressure wet-air oxidation as a form of thermal conditioning).

The residuals produced are air emissions and ash. The air emissions will require treatment prior to release into the atmosphere. The ash can be landfilled, and some research work is currently being carried out in Europe into the possibility of landspreading. The approximate quantity of ash is 7.5 tons/day dry matter.

Of the sludge disposal options considered, incineration has the greatest potential for environmental impact. The incineration process creates air emissions (metals, SO₂, CO, etc) which require treatment and the resultant ash must be disposed of in a controlled landfill site. Other environmental impacts associated with incineration include noise, visual impacts, and siting the facility in an appropriate area (e.g. land use, human environment, etc). Due to the high capital and operating/maintenance costs, complexity of equipment necessitating skilled operation and maintenance personnel, and the need for stringent air emission control procedures, incineration is not considered a viable option for the Cork Main Drainage Scheme. It should be noted, however, that with a properly designed, operated and maintained incinerator system, environmental impacts can be satisfactorily ameliorated.

Wet Air Oxidation (High Pressure)

This is a process in which the sludge organic solids are oxidised in an aerobic, high-pressure, high-temperature environment. The process can achieve greater than 90% reduction in volatile solids, i.e. approximately 8 tons/day of ash is produced. It produces gas, liquid, and solid wastes. The gaseous emissions require further treatment prior to release. The liquid waste is returned to the main wastewater treatment plant for treatment, while the ash is dewatered and can be taken off site for landfilling.

In theory, wet air oxidation is a feasible option from a purely environmental standpoint because the sludge volume is drastically reduced, and emissions are lower than for incineration.

The most significant problems associated with this option are due to operational unknowns. Due to these problems the technology is not widely used. The process has potential for

production of odours, and safety is of concern given the high working pressures. Capital, operating and maintenance costs are also high.

Pyrolysis

This is a process whereby sludge is used to derive a fuel. Several variations of the process exist, such as the following:

(a) Gasification in which dried sludge is heated in an air-controlled environment to produce gas and ash. The gas is utilised to produce electricity, while the ash can be disposed of at a landfill. Approximately 4.5 tons of ash would be produced daily.

(b) Oil from sludge. This process involves heating dried sludge in an oxygen-free environment. The final products are gas, ash, and oil. The gas is treated prior to release. The ash can be landfilled or used as a replacement for light-weight aggregate in concrete mixes. Approx. 7.8 tons/day of ash (DS) is produced. The oil is a medium-grade oil and can be utilised in adapted diesel engines; it is anticipated that up to 3.8 tons/day of oil would be produced.

While this technology would appear to exhibit certain environmental advantages (reduced sludge volume, potential energy recovery, production of usable product, minimal land area requirement), the process is in the early developmental stages, is not well documented, and is not proven on a full-scale basis.

Based on an environmental and engineering evaluation of these options, the thermal drying option was determined to be the most favourable option for the Cork City Main Drainage Scheme.

4.1.1.3

Storm Water Handling and Disposal

The principal objectives of the storm water handling and disposal strategy, as applied to the Cork Main Drainage Scheme, are to optimise the level of on-site storm water treatment and to maximise the quantity of storm water which can be returned to the plant for full biological treatment when capacity becomes available. The strategy should provide both an economically and environmentally acceptable system for effective control, treatment and disposal of potentially large quantities of storm water.

An assessment of a number of strategies for the handling and disposal of storm water at the treatment plant site has been carried out. All the strategies (4 no.) incorporated screening of the full flow arriving at the plant. Flows up to 3 DWF receive full secondary treatment.

- The preferred storm water handling and disposal strategy as outlined previously is shown schematically in Fig.3.3.1 - Chapter 3.

The above strategy provides both an economically and environmentally acceptable system for handling and disposal of storm water.

Adopting this strategy, the quality of the combined discharge from the wastewater treatment plant results in a maximum BOD concentration of 24.8mg/l and a maximum Suspended Solids concentration of 30 mg/l under the most adverse flow conditions.

4.2

Alternative Treatment Plant Sites

Consideration is first given to the breakdown of the scheme into its various components such as would form a basis for separate schemes or combinations of schemes which could be treated in different locations around the River Lee estuary.

Table 4.2.1 sets out the options available for consideration in dealing with the various drainage areas to be dealt with under the Consultants Brief. It will be seen that a total of 12 options are possible, these covering the wastewater treatment plants for each drainage area on an individual basis, through combinations of areas to a single wastewater treatment plant for the entire scheme including all the County Schemes which are being considered.

The table makes a general reference to possible locations for a site to cover each option, and also gives the approximate area of land required.

It was then necessary to identify particular sites which would merit consideration as to suitability for further study.

A total of 12 sites were identified as possible locations for a wastewater treatment plant. These are spread around the Lough Mahon and Upper Harbour areas, five being located on the north side and seven on the south side.

It will be noted from the table that two possible locations for an outfall discharge point have been taken into consideration, as discussed later

TABLE No. 4.2.1

SITE SELECTION CHART

	Options	Population Equivalent (Design)	Area (Ha)	Location
City	North	180,067	7 - 10	Dunkettle , Little Island .
	South	146,300	6 - 9	Mahon , Hop Island , Centre Park Rd. , Downstream .
	South , excluding Mahon (Area)	135,531	5 - 8	Mahon , Hop Island , Centre Park Rd. , Downstream .
	Combined	326,367	8 - 12	Little Island , Mahon , Hop Island .
Tramore Valley	Separate	55,000	3 - 5	Ronayne's Court .
	+ City South	201,300	8 - 11	Mahon , Hop Island .
	+ City Combined	381,367	9 - 14	Little Island , Mahon , Hop Island .
	+ City South , Mahon Only (Area 1)	65,769	4 - 6	Ronayne's Court .
Glanmire / Little Island	Separate	66,983	4 - 6	Little Island .
	+ City North	247,050	8 - 12	Dunkettle , Little Island .
	+ City Combined	393,350	10 - 15	Mahon , Little Island , Hop Island .
	+ City + Tramore Valley	448,350	11 - 16	Mahon , Little Island , Hop Island Downstream .

- Notes :**
1. In addition to Area Required a buffer zone will be needed between site & nearest dwellings .
 2. Roadworks to be undertaken at Dunkettle will probably eliminate that location except for relatively small works .
 3. Reference to Hop Island covers possible land reclamation .
 - 4 Site areas are based on normal secondary Treatment Plant Requirements , without Advanced Sludge Treatment & Nutrient Removal .

in Section 4.4.

- Lough Mahon
- Marino Point.

It was considered that for initial assessment an outfall upstream of Lough Mahon was not a viable option while an outfall downstream of Marino Point would not have a major impact on the merits or otherwise of any of the identified sites.

Sites selected were as follows (See Map No. 4.2.1)

1. **Little Island** - North-West portion (Castleview) adjacent to the new two-lane primary roadway.
2. **Little Island** - Eastern end of Courtstown Industrial Estate.
3. **Little Island** - South-West adjacent to Mitsui Facility.
4. **Little Island** - South-Eastern end at Carrigrenan.
5. **Dunkettle** - Tivoli Industrial Estate, Eastern End.
6. **Ronayne's Court** - Existing Tramore Valley Sewerage Scheme Disposal Site.
7. **Mahon** - South of proposed Roadway to Downstream Crossing.
8. **East of Hop Island** - Mudflats to be reclaimed.
9. **Ringmahon** - Proposed fill area for excavated material from Downstream Crossing.
10. **Centre Park Road** - Coal Yard area adjacent to Centre Park Road.
11. **Passage** - Site on high ground South-West of Passage Town, Townland of Ardmore.
12. **Passage** - Site on high ground South of Passage Town, Townland of Maulbaun.

Table 4.2.2. sets out the pertinent engineering information relating to each site and from this the relative lengths of pipework required to

**TABLE 4.2.2
SITES FOR TREATMENT WORKS - ENGINEERING ASPECTS**

2 Location	3 Area (Ha)	4 Elevation MOD (MH)	5 Distance from City Outfalls	6 Distance from Lough Mahon Discharge Pt. (km)	7 Total Distances from Lough Mahon (km)	8 Distance from Marino Pt. Discharge Pt. (km)	9 Total Distance from Marino Pt. (km)	10 Pumping Head to Treatment Site (m)	11 Total Pumping Head to Lough Mahon Outfall (m) [Note (c)]	12 Total Pumping Head to Marino Pt. Outfall (m) [Note (c)]
Little Is. (N)	16.0	6.5	7.0	3.5	10.5	4.6	11.6	20.0 (a)	22.0	22.8
Little Is. (E)	28.5	15.5	10.2	6.5	16.7	1.6	11.8	30.8 (a)	30.8	30.8
Little Is. (SW)	8.9	4.0	6.4	0.9	7.3	5.5	11.9	17.2 (a)	20.7	22.9
Little Is. (SE)	32.0	11.0	9.4	0.9	10.3	0.6	10.0	25.7 (a)	25.7	25.7
Dunkettle	14.3	4.0	4.4	3.2	7.6	6.7	11.1	16.1 (a)	20.7	22.4
Donayne's Court	3.9	6.0	4.8	2.0	6.8	3.5	8.3	18.4 (b)	20.4	21.2
Mahon	18.3	10.0	5.6	2.1	7.7	3.7	9.3	22.8 (b)	22.8	22.8
Hop Island	21.4	4.0	6.1	1.2	7.3	2.7	8.8	17.0 (b)	20.6	21.3
Ringmahon Pt.	20.0	4.0	5.0	2.4	7.4	5.3	10.3	16.5 (b)	20.7	22.2
Centre Park Rd.	6.8	1.5	1.7	5.4	7.1	7.3	9.0	12.3 -	20.5	21.4
Passage 1	17.5	27.0	8.7	5.0	13.7	1.0	9.7	41.3 (b)	41.3	41.3
Passage 2	18.5	73.0	10.0	6.3	16.3	1.8	11.8	87.9 (b)	87.9	87.9

- Notes :**
- (a) Based on pump station at Trvoli, 2.7 km downstream of City Outfalls. Pump Sump level assumee at -10 m OD (Malin Head)
 - (b) Based on pump station at Atlantic Pond, 2.5 km downstream of City Outfalls. Pump Sump level assumee at -10 m OD (Malin Head)
 - (c) Pumping from treatment to discharge point occurs where site elevation is lower than 7.5 m OD (Malin Head)

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transport wastewater from the existing major outfalls to the sites and to convey treated effluent to the nearest possible outfall can be seen. This exercise does not take account of local wastewater networks and pumping stations to collect areas not yet served by the Main Drainage Scheme.

Analysis

An analysis of the Table No. 4.2.2 shows the following:

- For an outfall at Lough Mahon sites no. 1, 2, 4, 11, and 12 involve pipe lengths of 1.5 to 2 times those for the remainder.
- For an outfall at Marino Point (or downstream of same) all sites have comparable pipeline lengths.
- The greatest pumping heads are required for Sites No. 2, 11 and 12.
- Site No.s 3, 6, and 10 have limited areas available and would not be suitable for a large scale wastewater treatment plant but might be suitable for treatment of a combination of smaller schemes.
- In terms of proximity to potential outfall discharge points at Lough Mahon and Marino Point, Site No. 4 is attractively located.
- Site No.s 1, 3, 5, 6, 8, 9, 10 would require on-site pumping costs to discharge treated effluent against high tide - unless the sites or treatment plant were raised sufficiently to effect a gravity discharge. Both these options would involve additional construction costs.

4.2.2

Environmental Appraisal

The initial stage of the Environmental Impact Study was carried out in the form of an Alternatives Analysis for the above mentioned sites. This study serves to identify the advantages and disadvantages of each site and from it a comparative evaluation matrix was compiled; to highlight environmental issues in terms of high, medium and low impacts.

The following paragraphs provide a description of each of the proposed components of the Main Drainage Scheme i.e. Sites, Collection Systems, and Outfall Pipelines. The components are illustrated in Map No. 4.2.1 and are numbered to correspond to the appropriate

paragraphs of this Alternatives Analysis. The components are not discussed in any order of preference.

4.2.2.1 Wastewater Treatment Plant Sites

Alternative Treatment Plant Site 1: LI North-West (Castleview)

This alternative is located in the northwest portion of Little Island, south of and adjacent to a new primary route currently under construction. The site consists primarily of active pastureland situated on rolling terrain. Scattered pockets of rush-dominated wet meadow wetland occur in low-lying areas. A small unnamed perennial stream and associated riparian zone traverses the centre of the site. Land use in the general vicinity is primarily agricultural with some rural residential and public authority housing nearby.

The dominant vegetative community at the site is active pasture/hayfield that has been subjected to grazing and mowing. The site has little overall ecological value. Development of this site would be acceptable, particularly if the treatment plant design included preservation of the existing stream channel and riparian zone, and depressional wetland meadow areas.

The primary advantages of the site are its size, relatively level terrain, and low ecological value. The primary disadvantages include potential aesthetic impacts to housing on a nearby hillside overlooking the site, industrial intrusion into an agricultural area, potential cultural resource sensitivity, the existence of a BGE gas pipeline across a portion of the site, and its distance from and lack of direct access to, Lough Mahon.

Alternative Treatment Plant Site 2: (Courtstown Industrial Estate Little Island)

This location is at the far eastern end of Little Island within the Industrial Estate. Several specific potential sites are located within undeveloped portions of the Estate. In general this area is slightly rolling active pasture lands interspersed with dense hedgerows and slopes eastward to Lough Mahon.

The primary advantages of this area include its availability for industrial development, its relatively secluded nature and distance from residential homes, the generally disturbed nature of the vegetative community, and its close proximity to the deep-water discharge point in the Channel of Cork Harbour.

The elevation of the site is unattractive, being relatively high and consequently involving high pumping costs.

Alternative Treatment Plant Site 3: (Mitsui Denman)

This alternative is located on Industrial Development Authority (IDA) land adjacent to the Mitsui Corporation's facilities and sludge fill areas. This alternative was originally considered to have potential due to its designation for industrial development and its desirable location. However, further evaluation determined the site to be unsatisfactory due to the fact that an insufficient amount of land was available. However reclamation of land from the Lagoon Area or alternatively the adjacent foreshore was considered as a means of augmenting the site area.

Alternative Treatment Plant Site No. 4: (Carrlgrenan)

This alternative is located at the south eastern end of Little Island near Carrlgrenan Point. As with Site No. 3, this scheme would not likely result in significant impacts to flora/fauna, odour, or noise. However, the treatment plant site would result in the permanent conversion of 20 hectares of agricultural (grazing) land to an industrial/utility use. This represents a significant change in the land use/landscape of the area.

The site is located in the proximity of scattered residential houses. In general this scheme would result in less significant impacts to the human and visual environment than other alternatives due to the distance of the site from densely developed areas. The collection and discharge mains would result in temporary impacts to the foreshore/marine environment, but these will be short-term in duration.

Alternative Treatment Plant Site No. 5: (Dunkettle)

This alternative is located on fill land west of Little Island on the north side of the River Lee. The site consists of filled mudflat land vegetated with a relatively low quality early successional herbaceous community.

This site has numerous desirable characteristics for the treatment plant,

including close proximity to the City of Cork and Lough Mahon, zoning for industrial development, level terrain, and low ecological value. However, this site is the property of Cork Harbour Commissioners and is designated by them for port-related industries. Also, discharge of treated effluent would require pumping to the outfall.

Alternative Treatment Plant Site 6: (Ronaynes Court)

This alternative site would be utilised if Cork County Council decided to treat wastewater from the Tramore Valley in a facility separate from the Cork Main Drainage Scheme. This site is adjacent to the existing Tramore Valley effluent outfall at the mouth of the Douglas River. The site consists of approximately 4 ha, of fill land deposited about 100 years ago. The level site supports a dense herbaceous plant community dominated by upland grasses and herbs.

This site is not large enough to accommodate a facility capable of treating wastewater for the City of Cork and Tramore Valley. However, the site may be an acceptable location for the Tramore Valley treatment plant if it is decided to treat wastewater from this area separately. The site may have adequate size for the Tramore Valley system alone (depending on facility design), it is adjacent to the existing outfall and Lough Mahon, and it has limited ecological value. The primary disadvantage would likely be related to the degradation of the aesthetic quality of the Lough Mahon waterfront. In addition, the concept of a separate wastewater treatment plant raises concerns about additional costs and environmental impacts.

Alternative Treatment Plant Site 7 (Mahon)

This alternative is located at the far eastern end of the City of Cork adjacent to Lough Mahon, north of the mouth of the Douglas River. The site is generally level to slightly rolling. It is vegetated with a mosaic of cover types, including active pastureland, hedgerow and early successional woodland. A portion of the site is managed by the City for the production of tree and shrub nursery stock used for planting on public works projects. The site has a relatively high ecological value due to the diversity of its cover types and its close proximity to the Douglas River estuary bird sanctuary and Lough Mahon mudflats. The site also has aesthetic and recreational value as evidenced by numerous pedestrians observed along the walkway in the general vicinity.

Portions of the site are being considered for use in the construction of a new tunnel access road and for a new housing development.

The major advantages of the site are that it is owned by Cork Corporation, is zoned for development, is centrally located and is adjacent to Lough Mahon. Drawbacks of the site include potential conflicts with a previously planned housing development scheme, aesthetic impacts to recreational users of the waterfront walkway, and adverse impacts to a relatively high quality ecosystem. However, the development and implementation of mitigation measures could reduce some of the potential adverse environmental impacts to a more acceptable level.

Alternative Treatment Plant Site 8: (Hop Island East)

This alternative site is located to the East side of Hop Island. The site is a large expanse consisting of an intertidal mudflat and saltmarsh. The mudflat area was observed to be utilised by numerous shore birds and waterfowl, including oyster catchers, curlews, cormorants, mallards, swans, snipe and various species of gulls.

In order to utilise this site, the area would require extensive filling to create a stable substratum at an elevation above the spring high-tide mark.

The major advantage of this site is that it could probably be easily acquired for a relatively low price. The major disadvantages of the site are related to the high cost of creating a stable construction surface, the aesthetic deterioration of the area, and the significant environmental impact that would occur as a result of filling the mudflat and saltmarsh.

Alternative Treatment Plant Site 9: (Ringmahon)

This alternative is located in the area of Ring Mahon Strand in Lough Mahon, just north of the proposed approach road to the River Lee Tunnel. The site currently consists of an intertidal mudflat, but it has been proposed to fill the area with material excavated during the construction of the new harbour tunnel. Presently, it is not known how much dry land will be created by this proposed fill, and whether there will be sufficient land area for the wastewater treatment plant.

The major advantages to this site are that it is close to the City of Cork and Lough Mahon, it would be built in newly reclaimed land lacking existing development in the area by the new roadway.

The major disadvantages include aesthetic impacts to the waterfront and potential significant ecological impacts if additional mudflat areas are filled to accommodate the size requirements of the treatment plant site.

Alternative Treatment Plant Site No. 10: (Centre Park Road)

This site is located adjacent to the Centre Park Road and consists of the coalyard occupied by M/S Tedcastle Oil Products. The area available is approximately 6 hectares and lies in an industrial zone with an adjacent amenity walk along the river bank (Marina Walk). The land is low lying, being below river level, (apart from the section used as a coalyard), and is protected by the embankment forming the Marina Walk. Filling would be required to bring the site to a suitable level for use as a treatment plant site.

The advantages of this site are its proximity to existing City Outfalls thereby involving relatively short sewer lengths to convey the wastewater to the treatment plant.

Its location would, however, involve bringing the wastewater from the south-eastern portion of the City (Mahon & Blackrock Areas) in towards the City for treatment, unless these areas could be incorporated in a separate scheme for treatment of wastewater from the Tramore Valley Scheme.

The disadvantages of the site are its limited area, its location in a most valuable property zone, and its proximity to amenity walks. It should be noted that an area of some 17 hectares would be required for treatment of the City Wastewater alone.

Alternative Treatment Plant Sites 11 and 12: (Passage)

These alternative sites are located south of the Town of Passage. The objective of a treatment plant in this area would be to serve the town of Passage and nearby localities and avoid the pumping of wastewater from Passage up to a Cork area treatment plant, and pumping treated effluent back down to a discharge point at Passage.

The sites are located in high ground in an area zoned for housing development in the County Development Plan. It is considered that these sites or indeed any suitably sized site in the Passage Area would involve considerable pumping costs and as such would impose a severe financial burden on the Local Authorities.

4.2.2.2 Wastewater Mains

This section addresses the alternative wastewater mains that would be constructed to convey untreated wastewater to the treatment plant site. These alternatives are previously indicated in Map No.4.2.1.

Location of Main Pumping Station

Initial consideration suggests that for possible treatment plant sites on the North side of the estuary, the pumping station should be on the North side while correspondingly, for sites on the South side the station would be best located on that side of the estuary.

The most suitable location for a pumping station on the north side of the River Lee is at Tivoli Industrial Estate as it is the nearest location to the City at which there is adequate area for a station. Consequently the sump level would be at the highest practical elevation. This would reflect favourably on pumping heads.

Other possible locations for the Pumping Station at Dunkettle and on Little Island itself were ruled out because of the long lengths of large diameter gravity sewer required to reach these sites.

Following analysis, it was concluded that locating the pumping station at Tivoli was not viable due to economic considerations and adverse impacts on traffic on the Lower Glanmire Road area during construction of the mains.

The Atlantic Pond site is considered to be the most favourable location on the south side for the main pumping station because:-

- It is sufficiently far downstream of the City to command the entire City Drainage Area by gravity with the exception of Mahon and minor adjacent developments.
- It is relatively secluded and has sufficient area to provide for suitable landscaping.
- It is a convenient location from which to pump the City Wastewaters to a treatment plant site even if this site were located at Little Island.
- It has the advantage that construction of the required large (3.0m) dia. trunk sewer on Victoria Road and Monahan Road would be in relatively easy conditions away from densely trafficked routes.

Recommended Location

It is concluded that the Pumping Station for the City should therefore be located at Atlantic Pond regardless of whether the site for a treatment plant is on the North side or South side of the River Lee.

It is proposed that the Pumping Station will be of the submersible type incorporating an above ground building with associated administration and services buildings - refer to figure No.s 4.2.1 and 4.2.2

Wastewater Main - Alternative 1:

This alternative would convey wastewater from the City of Cork to the various treatment plant sites identified on the north side of the River Lee and on Little Island. This alternative would include a crossing of the River Lee at the current discharge point. This crossing would direct wastewater generated on the south side of the River Lee to a pipeline conveying wastewater to a treatment plant on the north side of the river.

This alternative would follow existing roadways and/or railroad corridors to each of the respective treatment plant sites discussed.

Environmental impacts resulting from implementation of this alternative would be limited to temporary disturbances to the marine environment at the River Lee Crossing. Other impacts would be related to temporary nuisance impacts caused by construction noise, fugitive dust, and interference with normal traffic patterns.

Wastewater Main Alternative 2:

This alternative would convey wastewater from the City of Cork to the various treatment plant sites identified east and south of the City. This alternative would include a pipeline crossing of the River Lee at the current discharge point. This crossing would direct wastewater generated in the north side of the City to a pipeline conveying wastewater to a treatment plant on the south side of the river.

The actual pipeline main associated with this alternative would be aligned within an old railroad bed that is now used as a pedestrian/bicycle pathway. This pathway could be utilised for the pipeline beginning at the existing discharge point and extending beyond the town of Passage. Any of the alternative treatment plant sites on the south-eastern side of the City could be accessed via this route. It should be noted that disturbances to this pathway will be temporary, lasting for the duration of construction only. Following construction the pathway will be restored to its present grade and condition.

The primary advantage to this alternative is that the land is publicly owned and thus would not require the acquisition of a wayleave. Furthermore, there is ample working surface and stable foundation for

construction. Also, construction would create little nuisance impact in the form of traffic disruption and noise to residential and/or commercial areas.

The primary disadvantage to this alternative is that it would cause temporary disturbance along a heavily utilised recreational greenbelt. This impact would be temporary and would not be of long-term significance. In addition, construction may require the removal of well established hedgerow vegetation that bounds both sides of the pathway.

This hedgerow community is vegetatively diverse and likely provides important habitat for various songbirds and small mammals.

Wastewater Main Alternative 3:

This alternative would involve components of Alternatives 1 and 2 along with a segment installed in the proposed harbour tunnel. This alternative would be practical if one of Treatment Plant Sites 1 through 4 was chosen.

Wastewater generated in the north part of the city would be conveyed to the plant via Wastewater Main Alternative 1 described above. Wastewater generated in the south part of the City and from the Tramore Valley would be conveyed along the abandoned railroad corridor (see Alternative 2) to the point of intersection between the harbour tunnel access road and the old railroad corridor. At that point the pipeline would traverse along the new harbour tunnel road and cross under Lough Mahon through the tunnel. Wastewater from the south would then join with Wastewater Main Alternative 1 on the north side of Lough Mahon and continue on to the treatment plant site.

The primary advantage to this alternative is that it would minimise the impact to the River Lee resulting from an open trench crossing. The primary disadvantage is that it would add substantially to the overall length of the wastewater main, thus increasing costs, environmental impacts, and the likelihood of engineering constraints.

Wastewater Main Alternative 4:

This alternative would involve using Wastewater Main Alternatives 1 and 2. This alternative would be utilised if the decision is made to build two treatment plant facilities, one north and one south of the River Lee.

The major advantage to this alternative is that it would not require a pipeline crossing of the River Lee. The primary disadvantage to this alternative is related to the overall disadvantages of having

two treatment plant facilities (e.g. increased engineering costs, construction costs, environmental impacts, and maintenance costs).

4.2.2.3 Treated Effluent Pipelines:

The following section discusses each of the alternative pipeline mains that would convey treated effluent from the proposed treatment plants to the outfall location(s) in Cork Harbour.

Water-Based Outfall Main North of Lough Mahon and the River Lee:

The topic of the location of outfall mains has not yet been thoroughly discussed in this Study, particularly for alternative treatment plant sites on Little Island (Sites 1 - 5).

If a treatment plant site is selected on Little Island the outfall pipe would run directly to Lough Mahon or alternatively to a point downstream. The submerged portion of the pipe would then traverse a near-shore portion of Lough Mahon in relatively shallow water to the selected outfall location. The outfall main would be aligned under water in order to avoid the need to acquire land-based wayleave on Little Island. This submarine outfall main must be located in shallow water near the shore to avoid the dredged portion of the channel. Due to the location of this route in the near-shore area, it is likely that construction would impact the marine environment and fishery resources of Lough Mahon. Impacts would typically result from trenching, siltation, and maintenance/replacement activities. Map No. 4.2.1 shows possible outfall mains for alternative treatment plant sites on Little Island. If the discharge point is located downstream of Lough Mahon, a considerable extra length of pipeline would be required.

Land-Based Outfall Main North of Lough Mahon and the River Lee:

The alternative would follow a route similar to the route discussed above. However, this main would be located on land at or above the high-water level. This would avoid any impacts or disturbances to the marine habitat/near-shore area.

Water-Based Outfall Mains South of Lough Mahon and the River Lee:

This alternative outfall main would be considered for treatment plant sites south of the River Lee (Sites 6 to 10). This route would be aligned in shallow water along the south side of Lough Mahon, south of

the dredged deep water channel. This outfall main would extend to one of the outfall locations discussed later.

The major advantage of this alternative is that it would result in the shortest possible route to the outfall point. Furthermore, it would minimise disturbances to land-based resources and uses. The major disadvantage is the high level of disturbance that would occur to the estuarine environment during construction. Due to the location of this route in the near-shore area, it is likely that construction would impact the marine environment and fishery resources of Lough Mahon. Impacts would typically result from trenching, siltation, and maintenance/replacement activities.

Land-Based Outfall Main South of Lough Mahon:

This alternative would run along the abandoned railroad corridor as discussed above for Alternative Wastewater Main 2 and would be primarily applicable to Treatment Plant Sites 6 to 10. For this alternative route, the outfall main would be land-based near to the point of the chosen outfall location, and then would traverse under water to the actual outfall.

The major advantages of this alternative are that the route would be aligned primarily along a publicly owned abandoned railroad corridor and it would minimise disturbances to the marine/estuarine environment. The primary disadvantages of this alternative are that it will cause temporary disruption of recreational usage of the pathway, some damage to hedgerow habitats along the pathway, and may be slightly greater in length than other outfall main routes depending on the treatment plant site selected.

4.2.2.4

Conclusions

In general, alternatives that avoid disturbances to natural ecosystems, cultural resources, aesthetic values, and the marine environment, while at the same time result in effective flushing and dispersion of wastewater best meet the overall objectives from an environmental standpoint.

Based on a preliminary review of the various environmental features of the project components, familiarity with the area, and analysis of the comparative impact evaluation matrix Table 4.2.3 it has concluded that a Cork Main Drainage (CMD) Scheme can be designed and constructed with minimal adverse long-term impacts on the local environment. All adverse impacts can be minimised through proper

**TABLE 4.2.3
CORK MAIN DRAINAGE SCHEME - ALTERNATIVES ANALYSIS
COMPARATIVE EVALUATION MATRIX**

PROJECT COMPONENT	AIR/ NOISE/ODOURS	TOPOGRAPHY	SURFACE WATER	MARINE ENVIRONMENT	MATERIAL ASSETS	HUMAN ENVIRONMENT
PLANT SITE 1	●	●	●	●	●	●
PLANT SITE 2	●	●	●	●	●	●
PLANT SITE 3	●	●	●	●	●	●
PLANT SITE 4	●	●	●	●	●	●
PLANT SITE 5	●	●	●	●	●	●
PLANT SITE 6	●	●	●	●	●	●
PLANT SITE 7	●	●	●	●	●	●
PLANT SITE 8	●	●	●	●	●	●
PLANT SITE 9	●	●	●	●	●	●
PLANT SITE 10	●	●	●	●	●	●
PLANT SITE 11	●	●	●	●	●	●
PLANT SITE 12	●	●	●	●	●	●
WASTEWATER MAIN 1	●	●	●	●*	●	●
WASTEWATER MAIN 2	●	●	●	●*	●	●
WASTEWATER MAIN 3	●	●	●	●*	●	●
WASTEWATER MAIN 4	●	●	●	●*	●	●
OUTFALL MAIN 1	●	●	●	●	●	●
OUTFALL MAIN 2	●	●	●	●	●	●
OUTFALL MAIN 3	●	●	●	●	●	●
OUTFALL MAIN 4	●	●	●	●	●	●
OUTFALL LOCATION A	●	●	●	●	●	●
OUTFALL LOCATION B	●	●	●	●	●	●

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Key :
 ● :Low impact/constraint.
 ● :Medium impact/constraint.
 ● :High impact/constraint.

* During Construction.

Note: This matrix is intended to illustrate the relative impacts of one alternative versus another. It is not intended to illustrate actual significance of impacts.

TABLE 4.2.3(contd.)
CORK MAIN DRAINAGE SCHEME - ALTERNATIVES ANALYSIS
COMPARATIVE EVALUATION MATRIX

PROJECT COMPONENT	FLORA/FAUNA	LAND USE/ LANDSCAPE	VISUAL/ SCENIC AMENITIES	AGRICULTURE /FORESTRY	TRANSPORT -ATION	COMMERCIAL FISHERIES
PLANT SITE 1	●	●	●	●	●	●
PLANT SITE 2	●	●	●	●	●	●
PLANT SITE 3	●	●	●	●	●	●
PLANT SITE 4	●	●	●	●	●	●
PLANT SITE 5	●	●	●	●	●	●
PLANT SITE 6	●	●	●	●	●	●
PLANT SITE 7	●	●	●	●	●	●
PLANT SITE 8	●	●	●	●	●	●
PLANT SITE 9	●	●	●	●	●	●
PLANT SITE 10	●	●	●	●	●	●
PLANT SITE 11	●	●	●	●	●	●
PLANT SITE 12	●	●	●	●	●	●
WASTEWATER MAIN 1	●	●	●	●	●*	●
WASTEWATER MAIN 2	●	●	●	●	●*	●
WASTEWATER MAIN 3	●	●	●	●	●*	●*
WASTEWATER MAIN 4	●	●	●	●	●*	●
OUTFALL MAIN 1	●	●	●	●	●	●*
OUTFALL MAIN 2	●	●*	●	●	●	●
OUTFALL MAIN 3	●	●	●	●	●	●*
OUTFALL MAIN 4	●	●*	●	●	●	●
OUTFALL LOCATION A	●	●	●	●	●	●
OUTFALL LOCATION B	●	●	●	●	●	●

* During Construction.

Key :

- :Low impact/constraint.
- :Medium impact/constraint
- :High impact/constraint.

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siting and mitigation. The long-term impacts to Lough Mahon will be positive in that the current discharge of untreated wastewater into the Lough will be eliminated.

This initial exercise in the development of options points to a number of important issues as follows:

- The elevation of any proposed site for a treatment plant should, if possible, be such that the total pumping head is kept to a minimum. Every metre saved will result in an annual saving in running costs of £10,000 at design flows for Cork City alone. Savings for other drainage schemes would be proportionately smaller.
- The elevation of any proposed site lower than 7.5m OD Malin Head(i.e. sites number 5, 8 and 9) will involve on site pumping of the treated effluent to ensure discharge against high tide. This will involve construction of a major on-site pumping station.
- The alternative to this is to raise site levels and/or treatment plant units to an appropriate elevation to achieve a gravity outfall.
- Sites Nos. 2, 11 and 12 are not viable options as they involve total pumping heads of 1.5, 2 and 4 times those for the other sites.
- Reclamation of the Foreshore would be required for sites 8 and 9.
- The exercise has dealt with prospective sites in relation to the City Drainage Scheme only, more detailed development of the viable options is necessary to evaluate their potential in relation to the other Sewerage Schemes being considered in this Report.

4.3

Potentially Viable Treatment Plant Sites.

This section addresses each of the potentially viable treatment plant sites from Engineering, Economic and Environmental standpoints and evaluates each in terms of impacts, advantages, and disadvantages. Estimated capital and operation-and-maintenance (O&M) costs for the associated pumping plant and collection system are also provided. The capital and O&M costs for the Wastewater Treatment Plant are common to all sites at £28.0M or £35.2M including nutrient removal.

The potentially viable treatment plant sites identified above are as

follows:

- Site No. 1 Little Island (Castleview)
- Site No. 3 Little Island (Mitsui)
- Site No. 4 Little Island (Carrigrenan)
- Site No. 7 Mahon
- Site No. 7A Lakeland Strand*
- Site No. 8 Hop Island East
- Site No. 9 Ringmahon
- * Site No. 7A was added as an alternative to Site No. 7 to avoid development on existing lands zoned for residential and amenity purposes.

4.3.1 **Engineering and Economic Appraisal**

4.3.1.1 **Site No. 1 at Little Island (Castleview)**

This site is located in the north-west portion of Little Island, South of and adjacent to a new two-lane primary roadway currently under construction. The site consists mostly of active pastureland situated on rolling terrain. Scattered pockets of rush-dominated wet meadow wetland occur in low-lying areas. A small unnamed perennial stream and associated riparian zone tranverses the centre of the site. Land use in the general vicinity is generally agricultural with some rural residential and public authority housing nearby.

The Site - Advantages and Disadvantages

The site at Castleview has the following advantages:

- Its location in an area zoned for industrial use.
- It is of adequate area to contain a treatment plant to deal with the wastewater from the Main Drainage Scheme.
- Its proximity to the National Primary Road thus having easy access.
- Its suitability as a location for the treatment of wastewater from Little Island.

The disadvantages associated with this site are:

- The site is adjacent to existing Housing Development at St. Lappan's Terrace.
- The site would require to be raised by some 3 metres to achieve an acceptable elevation. This could impact adversely on the drainage of the surrounding areas.
- A stream traverses the site which would affect layout of the plant.
- The pipeline route for the Outfall would be longer than for other sites in Little Island.
- Pumped outfall required.
- The site is traversed by an existing BGE gas pipeline.

The Collection System

The collection system associated with this site is as follows:

- Twin 1500mm dia. rising mains from the Atlantic Road Pumping Station, across the River Lee and via Tivoli, Dunkettle and alongside the N25 National Primary Road to the Treatment Plant Site. Twin mains are proposed to cater for security and flexibility of design.
- On-site pumping of the treated wastewater to achieve discharge against high tide, through an 1800mm dia. main and diffuser outfall.
- Wastewater from Little Island, including that from industries, would be pumped to the Treatment Plant Site in a series of linked pumping stations.
- Wastewater from the Tramore Valley Scheme would be pumped directly across the estuary to the Treatment Plant Site.
- Mahon and Besborough drainage would be pumped to the Blackrock System and thence to the Atlantic Road Pumping Station.

The estimated cost of the collection system for this option is £53.13M.

4.3.1.2 Site No. 3 at Little Island (Mitsui)

A site of approximately 11 hectares in IDA ownership lies behind the sea wall to the south of the Mitsui facility in Little Island. Some low lying land of approximately 10 to 12 further hectares exists at the northern side of the site. This latter is leased to Mitsui Denman Ltd. manufacturers of Electrolytic Manganese Dioxide. Slurry resulting from the manufacturing process is disposed of in a series of bunded lagoons, lined with an impermeable membrane. Long term use of this area is envisaged for industrial/warehousing/storage purposes.

The Site - Advantages and Disadvantages

The site at Mitsui has the following advantages:

- Its location in an area zoned for and heavily committed to industrial use.
- Conveying of wastewater to the site requires relatively low pumping heads for all major contributors to the system.
- It is easily accessible.
- Its suitability as a location for the treatment of wastewater from Little Island.
- There is no residential development in the immediate vicinity of the site.

Disadvantages associated with this site area;

- Unless the area leased to Mitsui for bunded storage of waste becomes available, the site would be too small to accommodate the plant.
- The alternative of reclaiming the foreshore to make up the deficiency in area would be costly.
- The overall routes for pipework including the outfall, although shorter than those for Castleview, is longer than those for sites on the South side of the estuary.
- Pumped outfall required.

The Collection System

The collection system associated with this site is as follows:

- Twin 1500mm dia. rising mains from the Atlantic Pond Pumping Station, across the River Lee and via Tivoli, Dunkettle and alongside the foreshore at Inchera to the Treatment Plant site. Twin mains are proposed to cater for security and flexibility of design.
- On-site pumping of the treated wastewater to achieve discharge against high tide, through an 1800mm dia. main and diffuser outfall.
- Wastewater from Little Island, including that from industries, would be pumped to the Treatment Plant Site in a series of linked pumping stations.
- Wastewater from the Tramore Valley Scheme would be pumped directly across the estuary to the Treatment Plant Site.
- Mahon and Besborough drainage would be pumped to the Blackrock System and thence to the Atlantic Pond Pumping Station.

The estimated cost of the Collection System for this option is £49.50M.

4.3.1.3

Site No. 4 at Little Island (Carrigrenan)

Consideration is given in this option to the location of a treatment plant in the townland of Carrigrenan at Little Island. The townland of Carrigrenan occupies an area of 32 ha. and comprises a promontory at the south-eastern tip of Little Island. Its elevation varies from 2 to 22m OD Malin Head and it is a relatively undeveloped non-residential area currently used for agricultural purposes. The area is designated for industrial development under the County Development Plan.

The Site - Advantages and Disadvantages

The site at Carrigrenan has the following advantages:

- Its location in an area zoned for industrial use.

- It is of adequate area.
- Its suitability as a location for the treatment of wastewater from Little Island.
- Its elevation which, although higher than some others being considered, provides the conditions necessary for a gravity outfall discharge.
- Its proximity to a potential outfall at Marino Point.

Disadvantages associated with this site are:

- Its distance from the existing City outfalls entailing some 9km of large diameter pipework. This is offset somewhat by the short length of outfall required to discharge at Marino Point.
- Higher pumping heads resulting from its elevation and distance from the City.
- Some houses located nearby to the North of the site.

The Collection System

In considering a Collection System for this site, two route options were assessed.

Option 1

Rising mains from the Atlantic Pond Pump Station direct to the Treatment Plant site at Carrigrenan via Tivoli, Dunkettle and the foreshore to the South of Little Island. In this option Tramore Valley Scheme and Little Island wastewaters would both have to be pumped to the site in separate rising mains.

Option 2

Rising mains from the Atlantic Pond Pumping Station to a header chamber at Mahon and thence via pressure gravity mains across the Lee Estuary at Lough Mahon to the Treatment Plant Site at Carrigrenan. In this option Little Island wastewaters would have to be pumped directly to the Treatment Plant site but the Tramore Valley Scheme would be pumped to the nearby Header Chamber.

A comparison of costs between these two options showed the latter to be more cost effective as the Pressure Gravity Sewer caters for the Tramore Valley Scheme, which eliminates the necessity for a separate rising main from Tramore Valley to the Treatment Site. For this reason Option 1 was eliminated.

The Collection System for the preferred route to this site can be described as follows:

- Twin 1500 diameter rising mains from Atlantic Pond to Mahon where a header chamber would be constructed.
- Twin 1950mm diameter gravity pressure pipes from the header chamber to the foreshore at Lakeland Strand and twin 1800mm diameter gravity pressure mains from this foreshore across the Lee Estuary at Lough Mahon to the Treatment Plant Site at Carrigrenan.
- Wastewater from Little Island, including that from industries, would be pumped in a series of linked pumping stations to the Treatment Plant Site.
- Tramore Valley Scheme would be pumped from the existing pumphouse at Ronaynes Court, across the Douglas Estuary via the Old Passage Railway Line, to the header chamber at Mahon.
- Besborough and Mahon areas to be pumped to the header chamber.
- 1800mm diameter gravity main and diffuser outfall from the Treatment Plant site to Marino Point.

The estimated cost of the Collection System for this option is £46.22M.

4.3.1.4

Site No. 7 at Mahon

In this option the proposed site for a treatment plant is located at Mahon on the south-eastern side of the proposed Southern Ring Road leading from the Douglas Estuary to the Downstream Crossing. The site consists of approximately 18.75 hectares.

The elevation of the site varies from 2 to 12m OD Malin Head and is currently used, part as the Cork Corporation Garden Nursery, and partly as agricultural (grazing) land. A 1200mm diameter watermain crosses

through the northern portion of the site. A 600mm diameter watermain and a 300mm diameter gas main also encroach on the site.

The Site - Advantages and Disadvantages

The site at Mahon has the following advantages:

- It is of adequate area to contain a treatment plant to deal with the wastewater from the main drainage scheme..
- The proposed site has an ideal elevation from which the treated wastewater can gravitate to discharge under its own head at all stages of the tide.
- Its proximity to the proposed South Ring Road which will afford it easy access.
- The South Ring Road will create a suitable buffer zone between it and development to the North.
- Its proximity to the Tramore Valley pumping station at Ronayne's Court.
- Relatively low pumping costs.

Disadvantages associated with this site are:

- Its location in an area of high amenity value.
- Long length of 3000mm diameter gravity outfall to Marino Point.
- Water main diversion would be required.
- Adverse visual impact on development to the South of the Douglas Estuary.
- Conflicts with Development Plans.

The Collection System

The principal features of the Collection System associated with this site are as follows:

- Twin 1500mm diameter rising mains from the Atlantic Pond, laid along the Old Passage Railway (now a pedestrian walkway) to the Treatment Plant Site.

- Wastewater from Little Island, including that from industry, would be collected and pumped across the Lee Estuary at Lough Mahon to the Treatment Plant Site.
- The Tramore Valley Scheme would be pumped from the existing pumping station at Ronaynes Court, across the Douglas Estuary to the Treatment Plant Site.
- The treated wastewater would be conveyed to the proposed outfall and diffuser point in a 3000mm diameter gravity pipe laid in the main along the southern foreshore of Lough Mahon.

The estimated cost of the Collection System for this option is £45.88M.

4.3.1.5 Site No. 7A at Lakeland Strand

The establishment of a treatment plant site at Lakeland Strand as an alternative to one at Mahon is dictated by the need to preserve existing developable land in the area and at the same time retain the main elements of the option for the Mahon site. This site would involve reclaiming approximately 20 ha. of foreshore to an elevation of 4m OD Malin Head. This would ensure that the treatment plant would be above high tide and therefore free from the possibility of flooding.

The Site - Advantages and Disadvantages:

The site at Lakelands has the following advantages:

- It leaves the Mahon site free for development of housing as indicated in the Waterfront Study Report of July 1991.
- The proximity of the proposed South Ring Road will provide easy access.
- The South Ring Road will create a suitable buffer zone between it and development to the West.
- Its proximity to the Tramore Valley Pumping Station at Ronaynes Court.
- Relatively low pumping costs.

Disadvantages associated with the site are:

- Costly reclamation required to achieve a suitable elevation.
- Pumped Outfall required.

The Collection System

The principal features of the Collection System associated with this site are as follows:

All collection systems serving Blackrock, Besborough, Tramore Valley and Little Island will be similar to those described for the Mahon site. There would however be on site pumping of the treated wastewater to the outfall discharge point due to low site elevation.

The estimated cost of the collection system for this option is £45.17M.

4.3.1.6**Site No. 8 at Hop Island East**

This site would be located on a section of reclaimed foreshore approximately midway between Hop Island and the town of Passage. The location is chosen as being at a reasonable distance from developments on the Rochestown Road to the west and from those at Passage to the East. It would facilitate the linking of Passage Sewerage Scheme to the Main Drainage Scheme by providing a treatment plant within reasonable distance of the town.

The Site - Advantages and Disadvantages

The site at Hop Island (East) has the following advantages:

- The nearby Rochestown Road affords easy access.
- The location ensures that all drainage is carried well downstream thus commanding all possible developments on the southern side of Lough Mahon.

Disadvantages associated with the site are:

- Costly reclamation required to achieve a suitable elevation.
- Pumped outfall required.

- Relatively long pumping main from the City with associated high costs.

The Collection System

The principal features of the Collection System associated with this site are as follows:

- Twin 1500mm diameter rising mains from the Atlantic Pond, laid along the Old Passage Railway Line to a header chamber situated at the southern side of Rochestown Road.
- A 2100mm diameter gravity pressure main from this header chamber to the Treatment Plant Site.

Wastewater from Little Island, including that from industry, would be collected and pumped across the Lee Estuary at Lough Mahon to the Treatment Plant Site.

- The Tramore Valley Scheme would be pumped from the existing pumping station at Ronayne's Court to the header chamber at Rochestown.
- Wastewater from the Besborough and Mahon areas would also be pumped to this header chamber.
- The estimated cost of the Collection System for this option is £45.12M.

4.3.1.7

Site No. 9 At Ringmahon

A Ringmahon Site would be located on the northern side of the Blackrock end of the proposed downstream crossing. Its selection as a possible site for a wastewater treatment plant results from its possible availability as a disposal site for material excavated during construction of the proposed tunnel. If the area was sufficient and suitable material were available it would offset in part the anticipated higher costs of reclamation of the foreshore. The quality of excavated material would obviously be a vital factor in the viability of the site as a location for the treatment works.

The Site - Advantages and Disadvantages

The site at Ringmahon has the following advantage:

- Linking the site to the proposed road tunnel crossing makes the spoil from the tunnel works available, if suitable, for site filling, thereby reducing the reclamation costs somewhat.

Disadvantages associated with the site are:

- Reclamation costs, while possibly cheaper than those for the other foreshore sites, would still be significant.
- Pumping main from Tramore Valley is relatively long and its route is in a direction away from the ultimate outfall point.
- Pumped outfall required.
- Its proximity to existing residential development
- High pumping costs.

The Collection System

The principal features of the Collection System associated with this site are as follows:

- Twin 1500mm diameter rising mains from the Atlantic Pond Pumping Station, laid along the Old Passage Railway Line as far as Dundanion, and then eastwards across fields and along Ringmahon Road to a header chamber near the Garda Station.
- A 1500mm diameter gravity pressure main from the header chamber to the Treatment Plant Site.
- Wastewater from little Island, including that of industry, to be collected and pumped across the Lee Estuary via the route of the proposed Tunnel Road Crossing, to the Treatment Plant Site.
- The Tramore Valley Scheme would be pumped from the existing pumping station at Ronayne's Court, across the Douglas Estuary and via the route of the proposed South Ring Road to the Treatment Plant Site.
- Wastewater from the Besborough and Mahon areas would be pumped to the Treatment Plant Site also using the route of the

proposed South Ring Road.

The estimated cost of the Collection System for this option is £47.29M

4.3.1.8 **Conclusion**

Table 4.3.1 has been developed to display the engineering and economic cost comparisons of the seven options considered. The table incorporates:

- Capital Costs of the Collection System
- Site Reclamation and Filling Costs
- Outfall Pipeline Costs
- Nett Present Value of Pumping Costs
- Land Acquisition Costs.

It can be seen from the Table that there is no significant overall cost difference between the two most favourable options, i.e. Carrigrenan and Mahon with both being approximately £6M - £10M cheaper than the other two land-based options and £13M - £15M cheaper than the foreshore options. It is therefore considered that low lying land-based sites and sites on reclaimed land are uneconomical and should only be considered if there are significant environmental disadvantages to using land-based sites of suitable elevation to obtain gravity outfall.

4.3.2 **Environmental Appraisal**

This environmental appraisal of the above mentioned options is organised to individually address each of the seven proposed design alternatives. For each proposed scheme, a general description is provided and the proposed Treatment Plant Site, Collection System, and Discharge Main and Outfall are addressed. Each scheme/option, and component thereof, is addressed in the appropriate level of detail to allow consideration of the environmental feasibility of that option. This section evaluates the options and ranks the schemes from an environmental standpoint.

4.3.2.1 **Site No. 1 Little Island (Castleview)**

This site is located in existing farmlands on the north side of Little Island, adjacent to and immediately south of the National Primary Road N25.

The middle section of the site in an east-west direction, is wet and swampy and forms part of an old watercourse, probably that which originally drained Little Island, but is reduced in size and volume of flow

Table 4.3.1
Cork Main Drainage Scheme.
Cost Comparison of Options - Collection System.

Option	1	2	3	4	5	6	7	8	9
Location	Little Island (Castlevary) (£ m)	Little Island (Malah) (£ m)	Little Island (Carrigrahan) (£ m)	Mahon (£ m)	Lakevade Strand (£ m)	Hop Island East (£ m)	Ringmahon (£ m)		
City to Atlantic Pond	23.44	23.44	23.44	23.44	23.44	23.44	23.44	23.44	23.44
Atlantic Pond to Site	8.22	8.22	16.18	4.12	4.47	7.60	3.08		
On-Site Pump Station	4.50	4.50	---	---	4.50	4.50	4.50	4.50	4.50
Outfall Pipe	9.95	7.23	2.20	12.72	7.14	4.08	10.08		
City Laterals	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
Tramore Valley	3.18	2.53	0.61	0.41	0.64	0.55	1.08		
Site Reclamation / Excavation / Filling	2.00	7.65	0.85	0.85	17.00	17.00	14.00		
Land Acquisition	1.70	1.14	2.45 (2)	2.30 (2)	0.45	0.45	0.45	0.45	0.45
Access Roads	0.10	0.50	0.66	0.08	0.10	0.30	0.30	0.30	0.30
Totals	55.98	58.10	49.28	46.81	60.63	60.81	59.82		
Glanmire / Little Island	0.95	0.69	0.90	2.30	2.09	2.06	2.22		
Adjusted Totals	56.93	58.79	50.18	49.11	62.72	62.87	62.04		
NPV Pumping Costs	4.07	3.98	4.64	3.64	3.44	4.65	5.02		
Total Capitalised Costs	61.00	62.77	54.82	52.75	66.16	67.52	67.06		

Note : (1) Costs given are for construction works only and are exclusive of VAT.

(2) Carrigrahan : 32 ha @ £61,775 / ha (£25,000 / ac) ; Mahon : 18.75 ha @ £98,840 / ha (£40,000 / ac).

by the construction of the marine retaining walls at Bury's Bridge and also to the west of Glounthaune Village. The ground to the north and south of this watercourse is boulder clay on carboniferous limestone.

The existing land use is agricultural while the County Development Plan shows the land zoned for industrial use.

It is noted that the natural gas main traverses the site at about its mid point in a south-west/north-east direction with the result that the final site boundaries and/or the layout of a treatment plant would have to be adjusted to take this into account.

The low lying area of the site is dominated by scattered pockets of rush wetland. The dominant vegetative community is active pasture/hayfield with little overall ecological value.

Construction of a treatment plant on this site would have some effect on the flora and fauna of the wetlands area, and would be visually obtrusive from the north side of the National Primary Road.

The main disadvantage of the site is the existence of the stream and gas main. The former would have to be retained in some form providing as it does, a means of draining extensive lands in the surrounding area. The gas main would, as stated above, have limiting effects on the layout of the plant.

Wastewater Collection System

The new Collection System for the City to this site would traverse existing roadways and run adjacent to the National Primary Road from Dunkettle.

The Tramore Valley Scheme would be pumped directly to the site across Lough Mahon which the Glanmire/Little Island Scheme would involve mains in roadways and part fields to bring wastewater to the site for treatment.

Description given below for Site No. 3 regarding work on the foreshore should be noted as should comments on the Douglas Estuary which would be crossed by the mains taking the Tramore Valley wastewater to the site.

The distance of the site from the Tramore Valley Pumping Station means that the Collection System for same would have more

environmental impacts than those on the southern side of Little Island. These impacts would be of a temporary nature.

Discharge Main and Outfall

The treated effluent discharge main from this site would be laid in fields and roads southwards via Flaxport to the foreshore from where it would go eastwards past Carrigrenan Point to discharge in the deep waters off Marino Point.

The construction of this pipeline would have more extensive environmental impacts of a temporary nature than those from sites on the south side of Little Island. This is due to the longer length of main required.

Known cultural heritage resources at Carrigrenan should be avoided in the laying of this or any other mains in the area. Construction of the discharge main in the intertidal zone on the foreshore would impact temporarily on habitats of the area. These impacts would be of short duration and re-colonisation should take place within a reasonable time of completion.

4.3.2.2

Site No. 3 Little Island (Mitsui)

The site is heavily disturbed and consists mainly of fill material. The site supports an early successional vegetation community dominated by gorse shrubs, thistles, nettles, and various grasses. In the vicinity of the site are several large settling ponds used by Mitsui for discharging of by-products slurry. Directly adjacent to the site is a pond that does not seem to have been used for slurry disposal or otherwise recently disturbed. This pond was observed to be heavily utilised by avifauna including numerous swans, cygnets, gulls, and a variety of waterfowl. The pond is fringed by a high quality freshwater emergent marsh that is apparently utilised by waterfowl for nesting.

Due to size constraints of the filled portion of the site (approx. 11 hectares), it is likely that the adjacent pond and associated wetland ecosystem would need to be filled in order to construct the treatment plant at this site. Although the site is heavily disturbed, construction of the treatment plant would have an adverse effect on the local flora and fauna.

Land use in the vicinity of the treatment plant site is industrial. Although the site is currently undeveloped, industrial use of this site would be consistent with existing land use patterns and zoning. Due to the heavily industrial nature of the entire western portion of Little Island, development of the treatment plant at this site would result in no significant impacts regarding noise, odours, and material assets. Potential visual impacts would be moderate due to the visibility of the site from Lough Mahon; however, other industrial facilities in the general vicinity would lessen the overall visual obtrusiveness of the facility.

No other significant impacts would be realised by construction and operation of the treatment plant at the proposed IDA site.

Wastewater Collection System

This new Collection System would be constructed almost exclusively along existing roadways. Two exceptions to this are the extension of the Tramore Valley Sewer directly across Lough Mahon northeasterly to the treatment plant site, and the portion of the main that follows the foreshore of Little Island from the proposed River Lee Tunnel roundabout to the treatment plant site and from the Courtstown Industrial Estate to the treatment plant site.

The majority of the Little Island Sewer would be installed in the foreshore along the south side of the island. The upper intertidal zone is characterised by abundant cobbles, shingle, and gravel with scattered large boulders. This zone supports heavy growth of brown and green seaweed (algae). Abundant populations of periwinkle snails, mussels, barnacles, and limpets occur in the upper intertidal zone. Numerous shorebirds including oyster catchers, plovers, curlews, and sanderlings utilise this area to forage during incoming tides. Construction through the foreshore area would result in direct and indirect impacts to flora and fauna resources. However, studies of the effects of pipeline construction through foreshore areas have shown that such impacts are short in duration and the foreshore area is rapidly recolonised.

Construction activities would also result in short-term minor impacts to water quality in the adjacent estuary due to sediment disturbance.

This scheme would include a crossing of the mouth of the Douglas River south of Mahon at the current location of the Tramore Valley Sewer outfall. The Douglas Estuary is one of the most valuable avifauna habitats in the Cork/Kerry region. Its close proximity to the large Cork City population centre makes it particularly valuable as a local

recreational amenity. Studies of the estuary have identified a total of 41 bird species utilising the area, including wading birds, ducks, grebes, herons, rails, cormorants, gulls, and terns. A large range of land-based birds also utilise the open lands surrounding the estuary. Common species include crows, thrushes, warblers, owls, kestrels, and falcons.

Wastewater from Sewer No. 4 north of the River Lee would be siphoned to the south side of the City across the River Lee at the existing outfalls.

Wastewater from Sewer No. 4 and from the south side of the City would be pumped back across the River Lee from the Atlantic Pond's Pumping Station. The northside collection system would include the new sewer line to be constructed along the Cork-Waterford Road and the Little Island foreshore. The portion of the collection system on Little Island would be constructed within the upper intertidal zone along the foreshore.

Due to the design of the collection system following existing roads, walkways, and the foreshore area, impacts on current land use would be minimal and would primarily be restricted to construction periods. Standard in-road construction procedures would be utilised, and the road surface would be restored following construction.

The proposed collection system would result in relatively minor impacts of temporary duration to the marine environment. This scheme would require three crossings of the River/Harbour. The short distance of the crossings of the River Lee would result in fewer impacts in relation to other schemes; however, the crossing of Lough Mahon would result in construction-related impacts of temporary duration (i.e. increased turbidity and suspended sediment loads).

Although the wastewater collection main serving Little Island is proposed to be located in the foreshore area, it is not anticipated that any long-term impacts would result from construction and operation of the main.

However, if selected as the preferred scheme, a more detailed analysis of this foreshore area would be conducted.

The collection system would not impact any known historic or prehistoric cultural heritage resources, although the extension of the Tramore Valley sewer directly across Lough Mahon may pass a shell midden near Rochestown.

Discharge Main and Outfall

Treated effluent from this option would be conveyed to the outfall site via a main installed in the upper foreshore along the south shore of Little Island. This main would be parallel and adjacent to the Little Island untreated wastewater collection main described above. The discharge main would extend east along the upper foreshore to Carrigrenan Point, where it would then diverge to the south. The main would continue past Carrigrenan Point out to the outfall point in the deep water channel northwest of Marino Point.

Impacts to environmental resources resulting from construction of this discharge are addressed in Option 4.

4.3.2.3 Site No. 4 Little Island (Carrigrenan)

The treatment plant site for this option would be located at Carrigrenan on the southern end of Little Island. The site is currently a portion of a large active farm and is characterized by open rolling pasture, hedgerows, and scattered large open grown oak, beech, cherry laurel, and various other ornamental trees.

Land use in the vicinity of the site includes low density residential to the north, recreational (golf courses) to the north and northwest, Foaty Channel to the east, and Lough Mahon to the west and south. Development of the treatment plant at this site would result in the conversion of 20 hectares of agricultural lands to an industrial/utility use.

Due to the wind patterns and to the relatively sparse residential development in the area, possible odour and noise impacts would be relatively minimal. The site is relatively visible from Lough Mahon. However, its location and the surrounding rolling terrain would minimise the visual impacts.

No known cultural heritage resources exist at this site. However, the remains of a circular tower are located along the western shore of Carrigrenan Point. This structure, dating to the 17th to 19th centuries, consists of a circular tower with a rectangular structure attached. The walls remain in a good state of preservation. A shell midden is also located along the shoreline to the south of this tower.

Wastewater Collection System

The collection system would be constructed almost exclusively in roadways and pathways. The main exception to this is the crossing of Lough Mahon from Mahon to Carrigrenan.

- Wastewater from the north side of the City would be siphoned across the River Lee to the south side of the existing outfalls. The combined north and south flows would then gravitate to the Atlantic Pond Pumping Station along existing roads and pathways, and then would be pumped along the railway line/pathway to a header chamber at Mahon. The Tramore Valley system would be pumped along the old railway/pathway from Ronayne's Court to the header chamber at Mahon. The flows from Mahon and Besborough would also be pumped to this header chamber. The combined flows would be carried from the header chamber to the site at Carrigrenan across Lough Mahon in an easterly direction. The Little Island system would entail the laying of rising mains through fields along roads and along the upper intertidal zone of the foreshore. This intertidal habitat was described previously as part of the collection system for Site No. 3.

Due to the design of the collection system following existing roadways, walkways, and the foreshore area, impacts on current land use would be minimal and would be restricted primarily to construction periods. Standard in-road construction procedures would be utilised, and the road surface would be restored following construction. All pathways and fields would also be restored following construction.

This proposed collection system would result in relatively minor impacts of temporary duration to the marine environment. This scheme would require one crossing of the River Lee near the Custom House and a 3.5km long crossing of Lough Mahon.

Although a major portion of the wastewater collection main servicing Little Island is proposed to be located in the foreshore area, it is not anticipated that any long-term impacts would result from construction and operation of the main. However, if this option selected as the preferred scheme, a more detailed analysis of this foreshore area would be conducted.

The collection system would not impact any known historic or prehistoric cultural heritage resources.

Discharge Main and Outfall

Implementation of this option would include a treatment plant facility very near the proposed outfall location, thereby requiring construction of a relatively short treated effluent discharge main. The proposed discharge main would leave the treatment plant and would continue due south for approximately 1,000 metres to the outfall site in the deep water channel near Marino Point.

Construction of the discharge main and outfall in the foreshore area would not result in land use, odour, noise, or visual impacts.

4.3.2.4 Site No. 7 - Mahon

This site is located in the Mahon area at the far southeastern end of Cork City adjacent to Lakeland Strand and Lough Mahon and north of the mouth of the Douglas River. The site is generally level to slightly rolling and is vegetated with a mosaic of cover types, including active pastureland, wet meadow wetland, emergent marsh, mature woody and brushy hedgerow, and early successional woodland. A portion of the site is managed by Cork Corporation for the production of nursery stock used for planting on public works projects.

The central portion of the site is occupied by the ruins of an old farmstead. Associated with the farmstead are large common oak and European beech shade trees. The cultural resource significance of this ruin is not known. There are no known prehistoric heritage sites of significance (i.e. shell middens) at this parcel. However, a shell midden is located across the Douglas River to the south of the site.

The site has a relatively high ecological value due to the diversity and interspersed cover types and its close proximity to the Douglas River Estuary Bird Sanctuary and to the Lakeland Strand mudflats. The significance of the Douglas River Estuary and nearby mudflats has been discussed previously in connection with Site No. 3. As noted in the South Ring Road EIS, several species of rare plants, animals, and insects are found in the Douglas Estuary system. Although these species have not been specifically identified at the Mahon Site it is likely that such species may be found at the site or in the direct vicinity.

From a land use perspective, a portion of this site is used as a nursery by Cork Corporation, part of the site is used for grazing purposes, and part of the site is undeveloped. Land use in the vicinity of this site consists of a mix of Local Authority housing, scattered private residential units, agriculture, and recreational (i.e. golf course). There is no significant industrial development in the immediate area, however light industries are located in Mahon. The Cork Land Use and Transportation Study indicates that significant lands are available for development in the Mahon area.

A review of the Cork Waterfront Study (Part Two; Mahon) indicates that this site has been identified as a site for future residential development, possibly including some industry and amenity uses. The Mahon peninsula provides one of the few relatively large areas of undeveloped lands close to Cork City that is suitable for housing development. The alignment of the proposed South Ring Road also serves to limit the development potential (i.e. size, desirability) of the site for residential or industrial purposes, although increased traffic flow would likely affect housing development (i.e. public safety) to a greater extent than industrial uses.

The Mahon site is also sensitive from a visual standpoint. The site is highly visible from the pedestrian level along the public walkway, as well as from Lough Mahon and from residential areas on the hillside in Rochestown. Although some screening and landscaping can be used to minimise visual impacts, in particular retaining the trees and existing vegetation along the southern portion of the site, some visual impacts would be unavoidable. In general odour-related impacts would not be significant due to wind patterns in relation to developed areas.

The site does provide suitable qualities for siting a treatment plant such as central location for collection of wastewater, nearly level topography, waterfront location possibly buffered from current residential area due to the proposed South Ring Road, current public ownership, and sufficient height to allow gravity feed to the outfall.

Construction of the treatment plant at this site would have short- and long-term impacts to terrestrial resources, i.e. loss of ecological diversity and habitat viability.

Wastewater Collection System

The untreated wastewater collection system for this Option involves essentially four separate components: the north side system, the south side system, the Tramore Valley system, and the Little Island system.

The north side main would collect wastewater from portion of Cork City

on the north side of the River Lee via Sewers No. 1 and No. 4. This wastewater would be siphoned to the south side system at the existing wastewater outfall point.

The south side system would consist of a number of existing and proposed wastewater mains that collect and convey wastewater from the south and southwestern portions of the City. This entire system would be constructed along existing and proposed roadways and an abandoned railroad corridor, thereby having minimal environmental effects. No component of this system would cross open waters or undisturbed natural habitats.

The Tramore Valley system would consist of a short length of pipeline extending from the existing Tramore Valley pumphouse to the proposed treatment plant. Construction of this proposed wastewater main would require crossing near the mouth of the Douglas River Estuary. The significance of the Douglas River Estuary has been discussed previously for Site No. 3.

The fourth component of the untreated wastewater collection system would be the Little Island system. This wastewater main would collect and transport primarily industrial wastewater from the various industrial estates on Little Island. The main would begin at the Courtstown Industrial Estate and extend primarily along the southern Little Island foreshore to the IDA Industrial Estate near the western end of Little Island. The collection main would then diverge southwesterly across Lough Mahon and Lakeland Strand to the treatment plant site.

Environmental impacts from this component of the collection system would be primarily related to disturbances to the upper intertidal zone along the Little Island foreshore. The resultant impacts to biota and water quality have been discussed previously for Site No. 3. Whether the crossing of Lough Mahon would be directionally drilled, or trenched, no long-term environmental impacts are expected.

Construction of the collection system would result in short-term impacts to land use, traffic i.e. (in-road construction), and visual resources. These impacts would be temporary and would last for the duration of construction and restoration activities. Operation of the collection system would result in no significant environmental impact.

Discharge Main and Outfall

The treated effluent discharge main for this option would extend southeasterly from the treatment plant site across Lakeland Strand and the mouth of the Douglas River to the neck of Hop Island. The main would then extend due east in the upper intertidal zone parallel and adjacent to the base of the old Great Southern Railway line. The main would then extend out into the deep water channel off Marino Point where the treated wastewater would be discharged.

Construction of the wastewater outfall would be almost exclusively across tidal flats of Lough Mahon. The implications of construction across such resources have been discussed for Site No. 3.

The proposed discharge point in the deep water channel would be optimal from the standpoint of wastewater mixing and assimilation, and would minimise impacts to estuarine water quality and biota.

4.3.2.5

Site No. 7A - Lakeland Strand

The proposed treatment plant site for this option would be located on reclaimed land in Lakeland Strand east of the Mahon area.

The site is currently intertidal mudflat composed primarily of silt, sand, and organic matter. The Lakeland Strand mudflat is a healthy ecosystem, supporting a variety of green and brown seaweeds, and benthic organisms including snails, mussels, clams, and a variety of macroinvertebrates. Numerous waterfowl and shorebirds utilise this mudflat area including curlews, oyster catchers, plovers, mallards, herons and gulls.

Utilisation of Site No. 7A would require filling approximately 20 ha. of productive mudflat, thereby having a detrimental affect on the biota of the Lakeland Strand area and reducing the natural assimilative capacity of the estuary.

As with Site No. 7, land use in the vicinity of this site consists of a mix of Local Authority housing, scattered private residential units, agricultural/grazing land, and amenity uses (i.e. public walkway). Although the use of this reclaimed site would not directly result in a change in existing land use patterns, it would affect the desirability of surrounding lands for development, particularly for housing development. As previously noted, the Cork Waterfront Study proposed residential development at a site adjacent to this area proposed for reclamation.

There are no known historic or prehistoric cultural heritage resources located at this site.

This site would be highly visible to pedestrians using the public walkway and from Lough Mahon. There is no natural vegetation buffer to mitigate these visual impacts (as with Site No. 7). The site would also be visible from the residential areas on the hillside in Rochestown. As with Site No. 7, odour may be noticeable during certain weather conditions. Impacts would not be significant due to prevailing winds away from developed areas.

Wastewater Collection System

The untreated wastewater collection system for proposed Site No. 7 is essentially identical to that described for Site No. 7A.

Discharge Main and Outfall

The treated wastewater discharge main would be largely similar to that described for Site No. 7. The primary difference is that the western end of the main leaving the treatment plant would extend across Lakeland Strand north and east of Hop Island, rather than across the neck of the Island. East of Hop Island, the main would run parallel and adjacent to the old Southern Railways corridor, proceeding east to the discharge outfall off Marino Point.

Implementation of this scheme would have slightly less impact to flora and fauna and cultural resources than that described for Site No. 7, since the proposed discharge main would avoid the high quality salt marsh west of Hop Island as well as a shell midden cultural resource near the neck of the Island.

4.3.2.6 Site No. 8 - Hop Island East

The treatment plant site for Option No. 8 would be located on reclaimed land located along the south shore of Lough Mahon just east of Rochestown. The site is currently intertidal mudflat, with ecological characteristics previously described for Site No. 7a.

Utilisation of this site would require filling approximately 16 - 20 ha. of mudflat, resulting in a long-term impact to flora and fauna and the assimilative capacity of Lough Mahon.

Land use in the vicinity of the site consists of scattered residential houses and agriculture (grazing) to the immediate south, with more densely developed areas at Rochestown to the west and Passage to the east. The proposed site is located in the predominantly undeveloped area between these two communities. The site would be somewhat visible from the hillside. Visual impacts would not be as significant as with potential sites in closer proximity to more developed residential areas. The site would be more visible from Lough Mahon.

To the extent that a treatment plant may limit the desirability of surrounding lands for residential development, the siting of the facility in this location may contribute to maintaining the relatively undeveloped buffer between Rochestown and Passage.

Wastewater Collection System

The untreated wastewater collection system for Site No. 8 would consist of essentially four distinct components. The City System (North and South), the Mahon/Besborough System, the Tramore Valley System, and the Little Island System.

The City System would be very similar to the City System described for Alternative Options 7 and 7A. The primary difference is that wastewater would be conveyed past the Mahon area and Hop Island to the treatment plant via a sewer main aligned along the old Passage Railway corridor. The majority of this component of the collection system would be aligned along existing roadways and the old railroad corridor, thereby minimising environmental impacts. An exception is at the far eastern end of the system where the main would be constructed in the upper intertidal zone along the Rochestown foreshore. Environmental effects resulting from construction on intertidal flats have been described previously.

The Mahon/Besborough System would collect and transport wastewater from the far eastern end of the City to a header chamber at Rochestown. Most of this main would be aligned along existing roadways and the proposed South Ring Road. The main would cross the Douglas River estuary at one of two alternative locations near the mouth of the Douglas River. After crossing the river the main would extend eastward and join the City Main at the header chamber at Rochestown.

Impacts resulting from construction of this component of the collection system would be limited to those resulting from construction across the Douglas River Estuary. The significance of such impacts have been discussed previously.

The Tramore Valley System would collect and transport wastewater from the Tramore Valley Sewer and pump to a header chamber at Rochestown. The wastewater would then enter the City Main, running from the header chamber along the foreshore to the treatment plant. Construction of this component would require a pipe line crossing of the Douglas River Estuary. The environmental impacts of such a crossing have been discussed in previous sections.

The fourth component of the untreated wastewater collection system is the Little Island System. This component of the system would be largely similar to that described for Options 3 and 4. The primary difference is that the industrial wastewater would be pumped from Little Island south across Lough Mahon to the treatment works site. This crossing would be located approximately at the widest portion of Lough Mahon. Depending upon the type of crossing proposed, construction of this portion of the scheme could have significant effects on flora/fauna and water quality in the harbour. Impacts would occur if the pipeline is trenched across the bottom of the harbour. Directional drilling of the crossing would result in negligible environmental effects.

Discharge Main and Outfall

The treated wastewater discharge main for this option would extend due east from the treatment plant within the upper intertidal zone along the south Lough Mahon shoreline. The discharge main would continue east, diverging from the mainland and extending out into the deep water channel and discharge point west of Marino Point.

Environmental effects resulting from discharge pipeline construction in the intertidal zone have been previously discussed.

4.3.2.7 Site No. 9 - Ringmahon

The treatment plant site for Option No. 9 is located in the area of Ring Mahon Strand in Lough Mahon. The treatment plant would be constructed on reclaimed mudflat created from dredge material excavated during construction of the proposed River Lee Tunnel. The site would be situated northwest of the tunnel access road and to the southeast of Blackrock Castle.

The existing mud flat is composed primarily of silt and sand, with a low organic matter content. The upper intertidal zone that would naturally support salt marsh has been previously filled and bulkheaded. The existing mudflat supports a prolific growth of brown algae and numerous shellfish including cockles, softshell clams, and mussels. Numerous birds were observed using the mudflat area, including a variety of common gull species, oyster catchers, curlews, and plovers.

The previous filling and bulkheading along the shoreline creates an abrupt ecotone between the uplands and mudflat, thereby lowering its ecological value. Nevertheless, the existing mudflat presents desirable habitat for a variety of biota, thus reclamation of the area for the purpose of treatment plant construction would have a long-term negative impact to flora and fauna in the area.

Current land use of the site is tidal mudflat. Land use in the vicinity of the site consists of undeveloped areas and Local Authority housing to the west, and residential uses extending to Blackrock Castle to the north. Although this area of mudflat is likely to be reclaimed as a result of the construction of the Lough Mahon Tunnel, it is not known how much land would be available, and whether the reclaimed site would be of sufficient acreage to support the treatment plant.

Because of the proximity of the site to established residential areas, odours and noise would be of concern. Depending on weather conditions (i.e. wind, rain, etc), and on the ultimate design of the treatment plant, odours and noise would possibly be perceptible intrusions into these residential areas, thus limiting the overall acceptability of the site.

Development of the treatment plant at this site would also result in visual impacts, due to the conspicuous nature of the site. The treatment plant

would be readily visible from all water-borne traffic and from the Blackrock Castle. Landscaping and screening could, however, lessen the visual impact of the site.

Development of this site would likely not present any significant impacts to automobile and pedestrian traffic. Some minimal impacts may result if sludge is to be removed from the treatment plant by truck.

No prehistoric cultural heritage resources are located in the vicinity of this site. The Blackrock Castle is located in close proximity to the northwestern portion of the site.

Wastewater Collection System

The wastewater collection system for this option would include three distinct components. The Cork City System, the Tramore Valley System, and the Little Island System. These individual sewer systems are described briefly herein.

The Cork City Sewer System is a conglomeration of individual City sewers including Sewers 1, 4 and 6, the Boreenmanagh Road Sewer, and the Beaumont Sewer. Most of this system is already in place. Upon completion, this sewer system would collect and transport wastewater from the City of Cork to the proposed treatment plant at Ring Mahon Strand. Wastewater from the north side of the City would be conveyed via existing Sewers 1 and 4 and would cross the River Lee to the south side of the City at the point of the existing untreated wastewater discharge. A series of seven pump stations would be included in the Cork City System to pump wastewater either directly or indirectly to the treatment plant. Most of this system would be aligned along existing roads, thereby having minimal environmental effect.

The Tramore Valley Sewer would take wastewater from the existing Tramore Valley Pump Station at Douglas River and from the undeveloped Corporation property at Mahon to the proposed treatment plant site.

Construction of this sewer would require trenching or directional drilling of the Douglas River. Depending upon the nature of the crossing technique, some adverse impacts to a particularly sensitive natural area may be realised. After crossing the Douglas River, the sewer would cross undeveloped agricultural/recreational/open lands to the proposed treatment plant. This area supports a variety of vegetation cover types including wet meadow wetland, upland pasture, mature wooded

hedgerow, maintained playing pitch, and open grassland. Impacts to such cover types would be minimal and limited to the period of construction.

The Little Island Sewer would collect and convey wastewater from Little Island to the proposed treatment plant. The majority of this wastewater would be collected from the various industrial estates on Little Island, with some collection of urban wastewater.

This sewer main would extend from the Courtstown Industrial Estate at the far eastern end of Little Island to the proposed River Lee Tunnel at the west end of the island. The sewer main would cross Lough Mahon via the tunnel route to the proposed treatment plant site.

Most of the Little Island Sewer would be installed in the foreshore along the south side of the island. The upper intertidal zone is characterised by abundant cobbles, shingle, and gravel, with scattered large boulders. This zone supports heavy growth of brown and green seaweeds (algae). Abundant populations of periwinkle snails, mussels, barnacles, and limpets occur in the upper intertidal zone. Numerous shorebirds including oyster catchers, plovers, curlews and sanderlings utilise this area to forage during incoming tides. Construction through the foreshore area would result in direct and indirect impacts to flora and fauna resources. However, studies of the effects of pipeline construction through foreshore areas have shown that such impacts are short in duration and the foreshore area is rapidly recolonised. Construction activities would also result in short-term minor impacts to water quality in the adjacent estuary due to sediment disturbance.

To the maximum extent practicable, the collection system has been located to utilise existing public walkways, utility corridors, and roadways. The use of existing corridors/routes would minimise the potentially significant impacts of new corridor creation. Nearly all of the proposed collection system would be located within existing roadways.

Standard in-road construction procedures would be utilised and the road surface would be restored following construction. A portion of the collecting system follows the old railway line across Mahon (currently a public walkway). This area would also be restored to its current condition following construction.

The wastewater collection main servicing Little Island is proposed to be located in the foreshore area. It is not anticipated that any long-term significant impacts would result from construction and operation of this main. If selected as the preferred scheme, a more detailed analysis of

this foreshore area would be conducted.

As currently proposed, the collection main serving the Tramore Valley system may result in impacts to the future use of lands in the Mahon area, as any proposed development would need to avoid the main. In particular, the development of this site for residential housing would need to reflect the existence of the collection main, and allow for sufficient land area for safe maintenance of the main.

The wastewater collection mains would not affect any known cultural heritage resources.

Operation of the collection mains would result in no significant environmental impacts. Maintenance activities may result in minor temporary impacts.

Discharge Main and Outfall

Treated effluent would be pumped from the treatment plant through a 3.0 metre diameter pipe to the proposed outfall site in the deepwater channel off Marino Point. The discharge main would be installed within the intertidal zone across Lakeland Strand, through the Douglas River Channel, to the narrows of Hop Island. The main would then traverse due east through the upper foreshore, parallel and adjacent to the old Great Southern Railways line, to the discharge point.

A major portion of the treated effluent main would cross a relatively high quality mudflat ecosystem. The flat supports abundant green and brown seaweeds as well as a variety of shellfish including cockles, clams, mussels, barnacles, limpets, and snails. Numerous birds including a variety of gulls, curlews, oyster catchers, plovers, and sanderlings make heavy use of these mudflats. Short-term minor impacts to flora/fauna resources and estuarine water quality would occur as a result of construction through the foreshore.

The proposed outfall main would also cross a high quality cordgrass saltmarsh on the west side of Hop Island. This saltmarsh area is one of the last remnants of this type of habitat in the upper Lough Mahon estuary. Abundant shorebirds and waterfowl were observed in the vicinity of this marsh.

There would be no impact on known cultural heritage resources. This discharge main would be located to the west of the remains of a tower at the tip of Hop Island, and east of a shell midden located near Harty's

Quay in Rochestown.

Since the entire route of the proposed outfall main would be within the foreshore area, there would be no impacts to current land use. Operation of the main would not result in any odour, noise, or visual impacts.

4.3.2.8 Environmental Evaluation of Options

In general, the best option for the collection and treatment of urban wastewater for Cork City and the surrounding area would meet the following environmental criteria:

- Provide secondary treatment of wastewater and ensure environmentally sound sludge disposal;
- Minimise impacts to Lough Mahon and the Douglas River Estuary;
- Minimise river/estuary crossings;
- Minimise reclamation of mudflats;
- Make the treatment plant consistent with surrounding land uses and not adversely impact planned developments;
- Utilise existing roads, walkways, and utility corridors for collection and discharge mains;
- Minimise odour/noise-related impacts to nearby residents;
- Ensure no long-term impacts resulting from construction of collection/discharge mains in the foreshore area;
- Ensure timely restoration of ground surface (i.e. roads, shorelines) disturbed by construction activities; and
- Ensure that the treatment plant is operated and maintained in proper working order.

The proposed schemes were evaluated from an engineering and cost feasibility standpoint in Section 4.3.1 and environmental appraisal in Section 4.3.2. It is the purpose of this section to evaluate these options from an environmental standpoint.

In order to provide an evaluation of the proposed Alternative Design schemes, and to select the preferable design scheme(s) from an environmental/ecological perspective, each option was assessed based on critical factors that would be addressed in an EIS. Of particular concern was to determine what effect construction and operation of the schemes as proposed would have on the existing environmental/ecological resources of the sites and of Lough Mahon. Potential impacts were assessed in terms of short-term (i.e. temporary) and long-term (i.e. permanent) impacts, as well as direct vs. indirect effects.

In addition to the potential impacts of the proposed action on environmental/ecological resources, this evaluation also addressed various considerations that are critical from a planning perspective. By addressing each scheme in relation to important planning considerations and potential impacts to environmental resources, each scheme can be evaluated, both individually and comparatively. Potential schemes can then be more realistically ranked.

Table 4.3.2. provides an evaluation of each of the proposed design schemes in relation to EIS resource areas including flora and fauna; land use/landscape; odour; noise; visual impacts; marine environment; human environment; cultural resources; and agriculture. Each scheme is broken down into its basic components (i.e. treatment plant, collection system, and discharge main and outfall). For each component, a number has been assigned representative of potential impact on each of the EIS resource areas. The numbers range from 0 to 5. The following are the relative impacts indicated by number:

0	-	No impact
1	-	Low impact
2	-	Low to Medium impact
3	-	Medium impact
4	-	Medium to High impact
5	-	High impact.

By assigning a numerical value to the potential impact of a specific component on each resource area, a numerical value can be determined for the overall impact of each component and of the entire scheme. The numerical value of each scheme can then be compared and ranked to give a general indication of environmental impact of each option. The higher the number for each component/scheme, the greater likely impacts of that option.

**Table 4.3.2
Cork Main Drainage Scheme
Impact Ranking Matrix**

EIS Resource Areas										
Flora / Fauna	Land Use / Landscape	Odour	Noise	Visual Impact	Marine Environment	Human Environment	Cultural Resources*	Agriculture	Total	
CMD Scheme 1										
Castleview Site										
Treatment Plant	3	2	2	3	0	2	0	1	14	
Collection System	0	0	0	0	2**	0	0	0	4	
Discharge Main	0	0	0	0	2**	0	2**	0	24	
CMD Scheme 3										
Mitsui Site										
Treatment Plant	1	1	1	1	0	1	0	0	7	
Collection System	0	0	0	0	2**	0	0	0	4	
Discharge Main	0	0	0	0	2**	0	2**	0	17	
CMD Scheme 4										
Carrigrenan Point										
Treatment Plant	2	1	1	2	0	2	1	1	11	
Collection System	0	0	0	0	2**	0	0	0	3	
Discharge Main	0	0	0	0	2**	0	2**	0	19	
CMD Scheme 7										
Mahon										
Treatment Plant	3	2	2	3	0	2	1	0	16	
Collection System	1**	0	0	0	1**	0	0	0	4	
Discharge Main	1**	0	0	0	2**	0	0	0	25	
CMD Scheme 7A										
Lakeland Strand										
Treatment Plant	3	2	2	4	3	2	0	0	18	
Collection System	1**	0	0	0	1**	0	0	0	3	
Discharge Main	1**	0	0	0	2**	0	0	0	5	
CMD Scheme 8										
Hop Island East										
Treatment Plant	3	1	1	4	3	2	0	0	16	
Collection System	1**	0	0	0	2**	0	2**	0	7	
Discharge Main	0	0	0	0	2**	0	0	0	3	
CMD Scheme 9										
Ring Mahon Strand										
Treatment Plant	4	2	2	4	3	2	2	0	23	
Collection System	2**	0	0	0	2**	0	0	0	6	
Discharge Main	1**	0	0	0	2**	0	0	0	6	

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Key :
 0 = No Impact
 1 = Low Impact
 2 = Low / Mod. Impact
 3 = Moderate Impact
 4 = Mod. / High Impact
 5 = High Impact

* Known Cultural Resources In The Project Vicinity-Actual Impacts Determined By Project Siting , Design & Construction Practices .
 ** Temporary Impact (During Construction) Only .

Source : Ecology & Environment , Inc. 1992 .

It should be noted, however, that assigning quantitative values to often intangible or relative environmental impacts can be difficult because impacts, and their significance, are often based on individual perceptions and understanding of the potential problem. For example, what one individual would consider an obtrusive visual impact, another may not. One individual may not consider a salt marsh/mudflat area to be important, whereas a marine ecologist may disagree.

The quantitative values presented in Table 4.3.2. represent the professional judgement based on a review of the proposed alternative schemes (Including each subsequent component); site visits to each area potentially impacted; background research; and previous professional experience with similar types of projects.

The following summarises the results as presented in Table 4.3.2.

Site No. 1

This scheme proposed that the treatment plant be sited on lands at Castleview, Little Island, with an outfall main running southwards through fields and roads to the foreshore near Flaxfort and thence eastwards along the foreshore passing Carrigrenan Point to outfall at Marino Point.

The site was worthy of consideration because of its location in an area zoned for industrial development but its proximity to Local Authority Housing on the south side and its low elevation incorporating a small watercourse render it unsuitable for development as a site for a treatment plant. From an environmental standpoint, this site is less attractive than sites on the southern side of Little Island because of its impacts on surface water drainage and on the human environment (proximity of high density residential area and exposure to view from houses in Grounthaune area).

Site No. 3

This scheme proposed that the treatment plant be built at a site adjacent to the Mitsui Corporation facility on Little Island, with an outfall main along the Little Island foreshore to Marino Point. The advantages of this site include consistency with surrounding land uses, significant distance from residential areas, minimal visual impacts, and negligible odour/noise problems. Construction of the collection system and the discharge main would likely result in temporary impacts to the foreshore areas (i.e. marine environment, flora/fauna). However, these

are not expected to be long-term impacts. Depending on the siting of the outfall main, the tower and shell midden located at Carrigrenan Point can likely be avoided. The primary disadvantage of this site is the small parcel size, which may pose design and layout complications. Also of concern is the existence of industrial waste disposal ponds in the near vicinity and the potential that wastes have migrated from these ponds and contaminated the site. From a solely environmental/ecological standpoint, this scheme appears to cause the fewest environmental impacts of the six proposed schemes, assuming that no contamination exists from the Mitsui slurry disposal ponds.

Site No. 4

This scheme includes treatment plant at Carrigrenan Point with an outfall at Marino Point. As with option 3 this scheme would not likely result in significant impacts to flora/fauna, odour, or noise. The treatment plant site would result in the permanent conversion of 20+ hectares of agricultural (grazing) land to an industrial use. This represents a significant change in the land use/landscape of the area. The site is located in the proximity of scattered residential houses. In general this scheme would result in less significant impacts to the human and visual environment than other alternatives due to the distance of the site from densely developed areas. The collection and outfall mains would result in temporary impacts to the foreshore/marine environment, but these will be short-term in duration. As with option 3, the discharge main of option 4 may be sited so as to avoid impact to the tower and shell midden located along the western edge of Carrigrenan Point.

Site No. 7

This scheme involves a treatment plant site at Mahon with an outfall routed past Hop Island and to the east along the foreshore to the outfall at Marino Point. This treatment plant site appears to be a good centrally located site. Potential impacts would include negative effects on planned housing at the site, loss of a diverse mix of flora and fauna currently at the site, visual impacts from the hillside in Rochestown and from the public walkway, potential noise and odour problems due to proximity of people, impacts to the human environment, and loss of agricultural (grazing) land on part of the site.

Site No. 7A

This scheme is very similar to option 7. The treatment plant site would be located on reclaimed land on Lakeland Strand. Many of the impacts

resulting from the use of this site are similar to those discussed for site no. 7. However, rather than direct impacts to planned housing development at the Mahon site, the Lakeland Strand site would indirectly affect this resource by negatively impacting the desirability of the site for residential development. The Lakeland Strand site would not affect the ecological diversity on the terrestrial portion of Mahon, but land reclamation would result in significant impacts to the local marine environment and to the landscape of the area in the vicinity of the public walkway. This treatment plant site would result in visual impacts from both the walkway and Lough Mahon. Visual impacts would be particularly noticeable due to the pedestrian use of the area and the unprotected views to/from the hillside in Rochestown and from Hop Island. The collection system and discharge main would result in temporary impacts to the foreshore and marine environment. These would be short term in duration.

Site No. 8

This proposed scheme consists of a treatment plant site located on 20+ ha. of reclaimed land east of Hop Island. Although a specific site has not been identified, it would be located in the vicinity of the sparsely developed area between Rochestown and Passage. The primary impacts of concern regarding the use of this site would be on the marine environment and on flora/fauna. These resources would be impacted by reclamation of the site and the construction of the collection system and outfall main in the foreshore. However, due to the exposed nature of this portion of Lough Mahon and the absence of a natural buffer to water/wind action, the mudflat is of a lesser quality than one in a more protected area (i.e. west of Hop Island, Douglas River Estuary). The site would also result in visual impacts due to the unprotected nature of the area, although the primary area of visual impact would be from Lough Mahon due to the predominantly undeveloped area south of the site between Passage and Rochestown. Due to the exposed nature of the site and the prevailing wind patterns, odour - and noise-related impacts would be minimal. The proposed collection system would possibly impact a known shell midden located near Rochestown and the mouth of the Douglas River. These can likely be avoided as a result of the siting, design, and construction practices regarding main installation.

Site No. 9

This scheme utilises a treatment plant site located on reclaimed land north of the proposed Lough Mahon Tunnel and south of the Blackrock

Castle. Despite uncertain parcel size, as the site would be reclaimed from an unknown amount of tunnel dredge material, construction and operation of the treatment plant at this site would result in significant negative impacts. These impacts would result from the close proximity to residential (i.e. Authority) housing, proximity to the historic Blackrock Castle, a highly visible site (from both Blackrock and from Lough Mahon), inconsistency with the surrounding land use/landscape, the loss of a relatively productive salt marsh/mudflat ecosystem and flora/fauna habitat, and marine impacts due to reclamation activities. Construction of the collection system and the discharge mains would result in temporary impacts to the marine environment and flora/fauna. Impacts should last for the duration of construction only.

Table 4.3.3 presents an evaluation of each proposed design scheme in relation to critical planning factors. These factors need to be considered along with the EIS resource matrix to determine the overall environmental/ecological effects of each proposed scheme. Factors that are particularly important from an environmental perspective include whether land reclamation is required, potential impacts on planned developments, proximity of the treatment plant to existing housing, consistency of the treatment plant with surrounding land uses, the number of river/marine pipeline crossings, and whether the mains will cross the Douglas River Estuary.

4.3.2.9

Conclusions

Based on the above analysis, and evaluation of the alternative options from an environmental standpoint, the following general conclusions can be drawn:-

- That irrespective of which design scheme is selected, the environmental condition of Lough Mahon and Cork Harbour will improve due to the cessation of discharging untreated wastewater in favour of secondarily treated effluent.
- That some adverse environmental impacts due to the construction and operation of the treatment plant will be unavoidable (mitigative measures can be employed to reduce these impacts).
- That a discharge outfall at the deep water channel at Marino Point will provide greater mixing and dilution of effluent, greater use of natural current flow to remove effluent from Lough Mahon, and will avoid potential problems with channel dredging activities interfering with the outfall (i.e. diffuser).

Table 4.3.3
Cork Main Drainage Scheme
Impact Ranking Matrix - Planning Considerations

Scheme	Sufficient Parcel Size	Land Reclamation Required	Impact On Planned Developments	Proximity Of Housing	Compatible With Surrounding Land Use	Number Of River / Lough Mahon Crossings
1 Little Island (Castleview)	Yes	No	No	W / I 100m	No **	4
3 Little Island (Mitsui)	Unknown	No *	No	W / I 1000m	Yes	4
4 Little Island (Carrigrenan)	Yes	No	No	W / I 200m	No **	3
7 Mahon	Yes	No	Yes	W / I 500m	No	3
7A Lakelands Strand	Yes	Yes	Potential	W / I 500m	No	3
78 Hop Island East	Yes	Yes	No	W / I 300m	No	3
9 Ringmahon	Unknown	Yes	No	W / I 100m	No	3

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Key : W / I = Within .
 * Landfill Required .
 ** Compatible With Proposed Land Use .

- That construction and operation of a treatment plant site will affect the development potential of surrounding lands, although specific impacts, and their significance, will depend on demand for that land, the use(s) proposed, the location in proximity to Cork City, availability of public services, and the cost of land. For example, while treatment plants would likely inhibit adjacent residential development, it may not prohibit future development if the location, cost, and other amenities are desirable. In addition, a treatment plant may inhibit the development potential of the surrounding area for some uses (i.e. residential) but not for others (i.e. industrial).
- That no particular scheme evaluated in this document can be absolutely disregarded based on environmental reasons alone. However, it is clear that certain proposed schemes would result in fewer and less significant environmental impacts.
- Based on the evaluation matrix presented in Table 4.3.2 Sites No. 3, 4 and 7 (Mitsui, Carrigrenan & Mahon) are seen as presenting the most favourable environmental conditions for the construction of the scheme. When taken in conjunction with the engineering and economic evaluation as presented in Table 4.3.1, the site at Mitsui becomes less attractive and from a cost standpoint could only be considered if sites 4 and 7 were deemed to be not viable on environmental grounds.
- It therefore follows that Site No. 4 (Carrigrenan) and Site No. 7 (Mahon) are those which are most attractive for the location of the treatment plant, and the next section of this EIS deals with the selection of a preferred site from these.

4.4 Alternative Outfall Locations

4.4.1 Engineering Appraisal

Two possible locations for an Outfall Point have been considered:

- Lough Mahon
- Marino Point

The fact that an outfall at Lough Mahon would be to the dredged channel of the estuary has raised questions as to its feasibility for the following reasons:

1. The channel has to be dredged to 8m below OD Malin Head. In fact overdredging to 9m is carried out to allow for resilting to the minimum 8m before re-dredging becomes necessary.
2. The bottom of the dredged channel is approximately 5.5m below low water level. This means that the channel is only deep enough to accommodate the type of shipping which is expected to use the Tivoli and City Quays for berthing. Consequently, an outfall pipe would be vulnerable to damage from such shipping.
3. Due to the overdredging, the outfall would have to be kept sufficiently high above the lower dredged level to ensure its freedom of operation when resilting takes place. This increases the vulnerability of the outfall to damage during dredging operations.
4. The large flow through the outfall (present dry weather flow 67,000m³/day) would seriously affect smaller boats using the channel, and a diffuser type outfall would be necessary to reduce the impact of this outflow. In fact a diffuser type outfall is desirable for dispersion of the treated effluent in any case. This long over-bed length of pipework would further increase the likelihood of damage from shipping and dredging operations.

It is therefore considered that the option of an outfall at Lough Mahon is not acceptable.

An outfall at Marino Point has the following distinct advantages:

- 1 It is downstream of the dredged section of the channel.
- 2 It has an approximate 8m depth of water at low tide thus providing an extra safety factor to damage by shipping.
- 3 The depth available will provide excellent dispersion of the effluent thus rendering it unobtrusive on the surface.
- 4 Its location is still within a reasonable distance of the City and is, in fact, the nearest point in the channel where an adequate depth of water is available to ensure a safe and efficient outfall.

- 5 The greater tidal exchange factor indicates a significant increase in volume of dilution water, resulting in an improved standard of recipient waters.
- 6 The location is downstream of all potentially viable sites for a treatment plant.

It is recommended therefore that the Outfall Point be located in the deep water section of the estuary off Marino Point, unless subsequent results from water quality studies (Section 4.4.3) of the Harbour show that the outfall should be moved further downstream.

4.4.2 Economic Appraisal

The cost of the outfall pipe and diffuser depends mainly on the length and size of same.

The actual length of pipe from the Treatment Plant Site to the Outfall Point depends on the location of the former. If the site is located downstream of Lough Mahon (as in the case of Hop Island East and Carrigrenan sites) the extra distance to Marino Point would be reduced or eliminated.

Consequently the real cost implications of the selection of Marino Point cannot be quantified until the preferred Treatment Plant Site is selected.

It is considered therefore that while the engineering assessment comes down in favour of an outfall discharge at Marino Point, it is advisable to establish the preferred location of the Treatment Plant Site before commenting further on the cost implications.

4.4.3 Environmental Appraisal

The determination of the optimum location for the proposed outfall, from an environmental viewpoint, has been based on comparing the likely impacts on water quality resulting from two alternative discharge locations. The mathematical models prepared for Cork Harbour have been used to simulate the discharge of a treated effluent, first to a location in Lough Mahon and then to a location in the vicinity of Marino Point. The dispersion and decay of the bacteriological and chemical constituents of the treated effluent have been modelled at both locations over a full range of tidal conditions and for present and future loadings.

Maximum BOD levels at 7 key locations between the Custom House and Roches Point were evaluated for both cases to aid in determining localised impacts associated with the two options. Corresponding comparison of the maximum predicted total coliform levels at five locations between Blackrock and Cobh was also carried out. In each case the maximum levels were quantified on a neap tide at low water.

The following is a summary of the main conclusions which can be drawn regarding the likely impacts on water quality associated with the two outfall options.

- (a) The maximum estimated increase in BOD is 0.5 mg/l which occurs at the point of discharge from the Lough Mahon outfall. The corresponding maximum increase for the Marino Point option is 0.3 mg/l. Ref. Fig. No.s 4.4.1 and 4.4.2.
- (b) In Upper Lough Mahon predicted BOD levels resulting from a discharge to Lough Mahon are three times the levels predicted for an equivalent discharge at Marino Point.
- (c) The maximum predicted BOD concentration at Marino Point caused by a treated effluent discharge to Marino Point is, in fact, only equivalent to the maximum concentration resulting at Marino Point due to a discharge at Lough Mahon.
- (d) BOD levels at Monkstown will be slightly higher due to a release at Marino Point compared with a Lough Mahon discharge.
- (e) Beyond Monkstown and into the Outer Harbour BOD levels reduce to trace values for both discharge alternatives.
- (f) The maximum estimated increase in total coliform levels is 5,920 counts/100 ml which occurs at the point of discharge from the Lough Mahon outfall. The corresponding maximum increase for the Marino Point option is exactly half this figure at 2,960 counts/100ml. Ref. Fig. No.s 4.4.3 and 4.4.4
- (g) During the Harbour Water Quality Survey carried out in September 1991, mean total coliform levels of about 4,100 counts/100 ml were recorded at low water neap tide in Lough Mahon. The corresponding mean level at Low Water Spring Tide was 5,530 counts/100ml. It can therefore be concluded that a discharge to Lough Mahon will result in total coliform levels which, when combined with existing background levels, may exceed mandatory EC bathing water quality levels within Lough Mahon. The results of the models further indicated that a Marino

There is evidence of rock outcrop along the south-western edge of the site at the foreshore, while the remainder of the site is expected to be of boulder clay resting on rock.

The existing entrance to the site is at the northwestern corner from where an avenue leads to Carrigrenan House.

A considerable number of trees exist on the site as indicated on the aerial photograph (Plate No. 4.5.1).

Photomontage (Plate No. 4.5.2) gives an impression of the finished site following construction of the treatment plant.

This site is now considered from a number of standpoints in relation to its potential use as a site for the treatment of wastewater from the Main Drainage Scheme.

4.5.2.2

Access

Access to the site at present is via the existing County Road running southwards to Clashavodig and Carrigrenan from its junction with the Industrial Estate Road to Courtstown.

A number of dwellings exist along this road which would suffer from the impact of construction traffic. The road would not have a greatly increased traffic flow following construction, however, the narrow width of the road and the residential development along the road poses a safety problem.

The County Development Plan provides for the existing Courtstown Industrial Estate Road to be extended for future industry into the north-east corner of the site. This road would service lands remaining to be developed in the Courtstown Industrial Estate as well as providing access to the site. This road would be designed specifically to accommodate vehicular traffic associated with industrial uses.

4.5.2.3

Proximity to Development

Carrigrenan House and Tower View Cottage are located within the site. Twelve further dwellings are located on and adjacent to the roadway running west to east at the northern boundary of the Carrigrenan lands. Ref. To Fig. 4.5.2.

If the northern boundary of the plant layout is fixed along the southern edge of the lands affected by Spring Tides the treatment plant would be more than 100m from the latter dwellings.

Tower View Cottage would have to be purchased as part of the site.

The Tower at the western edge of the site would be preserved.

It is noted that Planning Permission for the construction of a dwelling house on the north-west corner of the site has been granted on appeal.

If this building is proceeded with, steps would have to be taken to include for its purchase in any procedures for acquiring land for a treatment plant.

Other developments in the general area consist of Cork Golf Club and Harbour Point Club, both of which command views of the site from particular locations.

4.5.2.4 Development Plan

Cork Co. Council's Development Plan for the area shows the townland of Carrigrenan as "land reserved for industry".

It is understood that a port dependent industry making use of the adjacent deep water is considered the most desirable type of industry for the site. Although the treatment plant is not technically considered an industrial use, its impacts and general nature are consistent with industrial usage. The treatment plant will make use of the deep water channel as noted in the County Development Plan.

Use of the site for a treatment plant would cut across this objective and consideration would have to be given to the positive and negative effects this would have on the potential for development in the area.

Any such consideration must take account of:

- The general zoning objectives of Little Island which are for industrial development mainly, with interspersed residential and open space areas.
- The realistic prospects of a port dependent industry locating at Carrigrenan given that considerable investment has been made to develop Ringaskiddy for such industry.
- The enhanced prospects for attracting other types of industry to Little Island as a result of locating a treatment plant in this area.
- The objective set out in the LUTS Review of establishing one large scale industry on Little Island as one of the elements in promoting employment in the Greater Cork Area.

- Consideration of the site in the context of providing for the treatment of wastewater originating in Carrigwohill and west of same.

4.5.2.5 Environmental Action Programme

The final selection of a site for a treatment plant must take into account the three principles outlined in the Environmental Action Programme issued by the Department of the Environment. These are:

- The concept of sustainable development as advocated in the Report of the World Commission on Environment and Development (The Brundtland Report). This concept envisages a reasonable balance in man's interest between development and nature.
- The principle of precautionary action even where there is no definite scientific evidence to link emissions or discharges with detrimental environmental effects.
- The integration of environmental considerations in all policy areas.

In the context of the Cork Harbour Area, sustainable development must have its basis on the Development Plans of the Local Authorities and on the LUTS Review as these documents contain the most pertinent information on existing conditions and strategies for future development.

The effects on sustainable development of siting a treatment plant in this townland are seen as:

- Allowing the strategy and objectives of the City Development Plan to be fulfilled without an imposed restriction.
- Allowing the strategy and objectives of the County Development Plan to be achieved without restriction. This is true despite allocation of a site reserved for industry to be used for the proposed plant.

Location of the treatment plant at Carrigrenan is also seen as contributing to the potential for development in Little Island and Carrigwohill as encouraged in the LUTS Review under the heading "East Harbour Area".

4.5.3 Site at Mahon

The site at Mahon is located south of the proposed South Ring Road between Ballinure Road and Lakelands Strand.

This site presents itself for consideration because of its location at the south-eastern limit of the County Borough, its elevation and its area which is adequate to accommodate the treatment plant.

4.5.3.1 Topography

The layout of the proposed wastewater treatment plant on this site is shown on Fig. 4.5.5. Sectional Elevations and a 3D perspective of the treatment plant on this site are shown in Fig. No.s 4.5.6 and 4.5.7 respectively.




Map No. 4.5.2 shows the site in colour contour and it will be seen that it has an elevation varying from 2m to 12m OD Malin Head, the highest point on the site being at the proposed new South Ring Road. The site slopes generally in a south-easterly direction with a slightly elevated area at 8m OD Malin Head in the western half of same. Part of the site is used as a Corporation landscaping nursery and a number of trees screen the site from the Douglas Estuary. See aerial photograph Plate No. 4.5.3. Photo montage, Plate No. 4.5.4 gives an impression of the finished site following construction of the treatment plant.

The entire area lying to the south of the proposed ring road consists of 18 ha. which is the minimum required for a satisfactory layout of a treatment plant given the necessity for adequate landscaping and screening facilities.

The site is traversed by 1,200mm dia. and 600mm dia. water mains as shown on the map and there is also a gas main located along the eastern edge of the area adjacent to Lakelands Strand. These mains would have an effect on the layout of the plant and would either have to be diverted or incorporated into non-productive areas of the site such as roadways, paths or margins.

The site is now considered from a number of standpoints in relation to its potential use as the site for a major wastewater treatment facility.

LEGEND

1. Stormwater Settlement Tank
 2. Screen House
 3. Grit And Grease Chamber
 4. Primary Settlement Tank
 5. Anaerobic Tank
 6. Aerobic Tank
 7. Final Settlement Tank
 8. Return Sludge Pumping Station
 9. Primary Sludge Thickener
 10. Sludge De-watering
 11. Heat And Gas Generators
 12. Digester
 13. Gas Holding Tank
 14. Control Room And Transformer
 15. Garage And Workshop
 16. Administration Building
 17. Chemical Storage And Dosage Tank
 18. Advanced Sludge Treatment/Storage
 19. Odour Treatment
-  Works Required Under Present Loading
 Additional Works Required Under Future Design Loading
 Possible Extension For Nutrient Removal

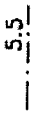



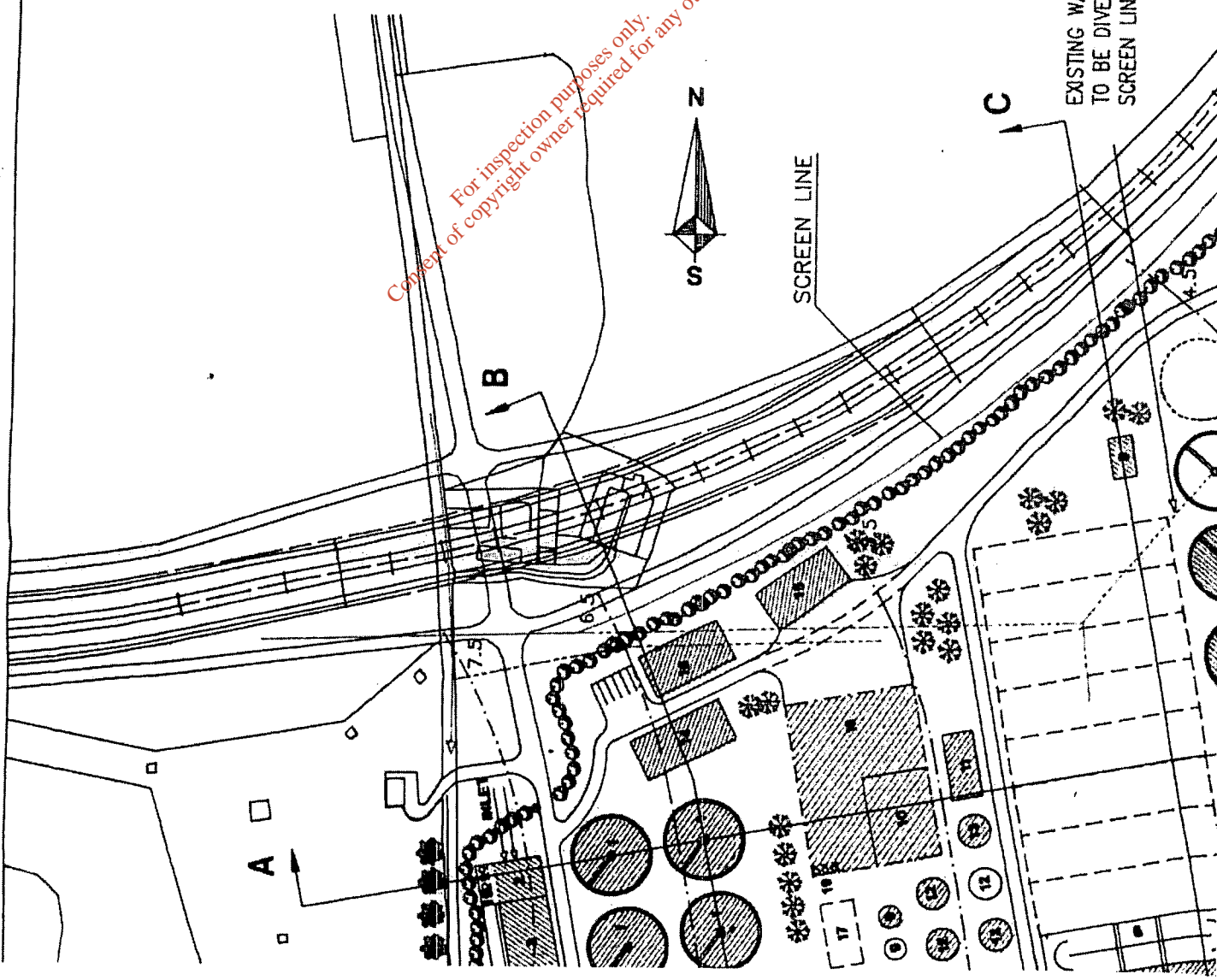
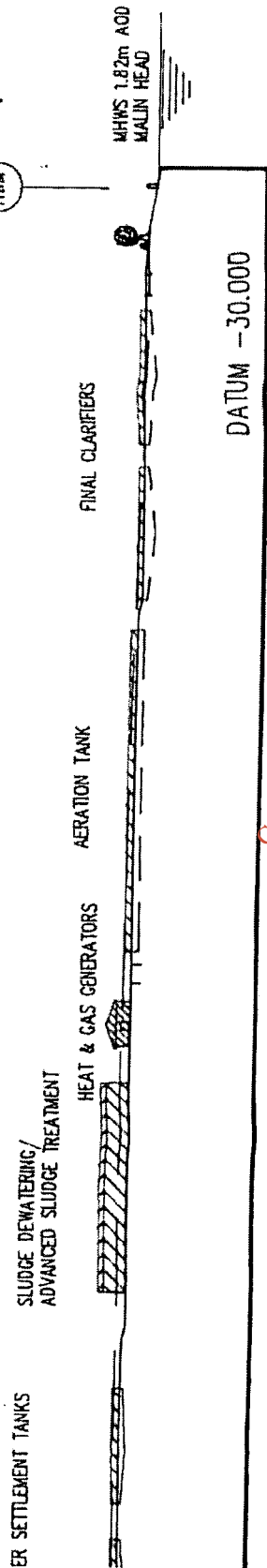
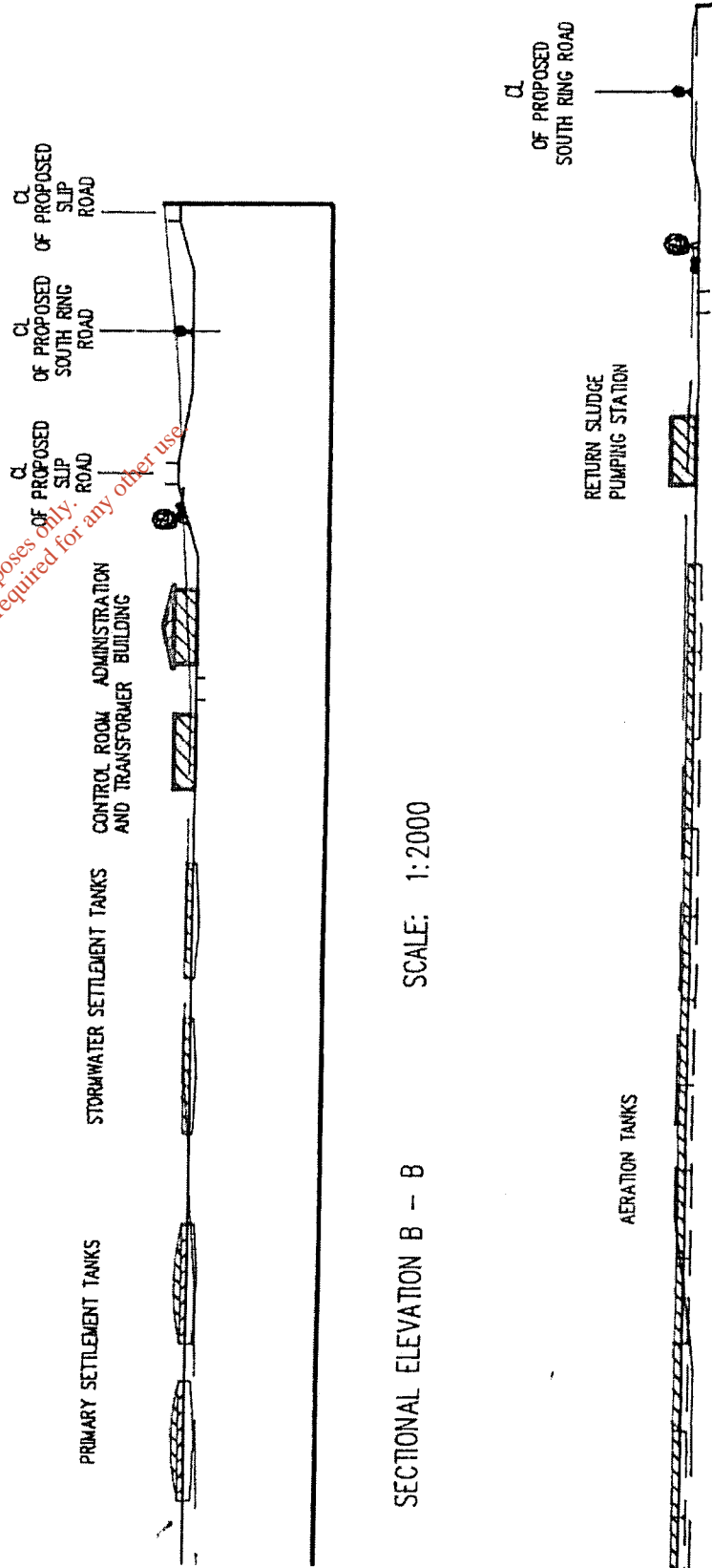
-  5.5 — PROPOSED CONTOURS
 SCREEN LINE
 SHRUBS
 SITE BOUNDARY

FIG. 4.5.5
LAYOUT PLAN OF PREFERRED TREATMENT PLANT
ON MAHON SITE
 Scale 1:3000





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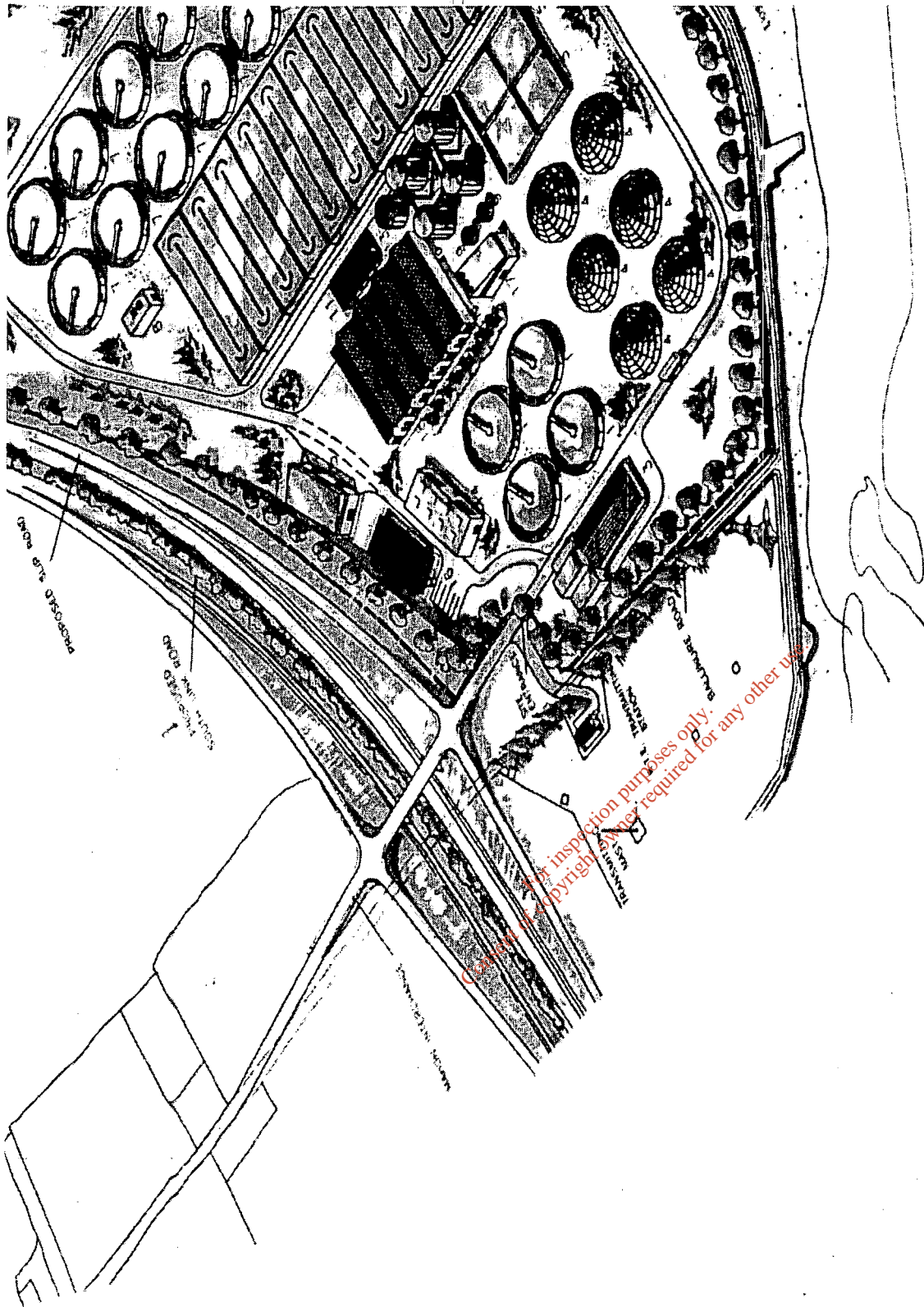


FIGURE NO. 4.5.7 CORK MAIN DRAINAGE SCHEME
 WASTEWATER TREATMENT PLANT
 LOCATED AT MAHON



4.5.3.2 Access

Existing access to the site is from the minor roadway running due south at its western boundary. However, this road will be upgraded and altered in alignment as part of the future South Ring Road construction.

The proposed South Ring Road which would form the northern boundary of the site would facilitate site access, particularly for traffic generated by operation and maintenance requirements of the plant. Construction access from this Road would depend on the time of construction of same.

4.5.3.3 Proximity to Development

This aspect is considered from two standpoints:

- Existing development
- Future development.

Existing Development

Existing structures on the lands themselves are not of significance in relation to the development of the site for the proposed wastewater treatment plant.

Developments in the vicinity of the site are those within the Mahon Area generally and those on the Douglas/Rochestown Road area in the County.

With regard to existing development in the Mahon Area what has been achieved to date is a mixture of Local Authority housing and amenity areas together with light industrial development.

Housing development occurs approximately 500m from the site at present while industrial development is approximately 1.2km distant. Thus, in terms of existing development in Mahon, the site is a satisfactory distance from dwellings when considered from any direct adverse effects such as possible air pollution and noise.

Similar comments can be made in relation to developments in the Douglas/Rochestown area.

Future Development

The City Development Plan envisaged residential development taking place both in the site area itself and in lands immediately north of the proposed Ring Road. Light industrial development is envisaged also north of the Ring Road.

Portion of the proposed site is designated as "land on which development may be restricted or prevented for amenity reasons".

If this proposed site is developed for a treatment plant and the objectives of the Development Plan were achieved outside the site, there would be a considerable number of habitable buildings approximately 150m from the northern boundary of the site.

Future development in the county area, would obviously not encroach too close to the boundaries of the site but it would have to be considered from environmental aspects as discussed later.

The strategy proposed in the City Development Plan for the area does not take into account any possible development of a site at Mahon for a proposed wastewater treatment plant.

However, paragraph 4.41 of the Plan draws attention to the possible requirement to change the zoning objectives if a wastewater treatment facility is located within the City.

4.5.3.4 Environmental Action Programme

Refer to Section 4.5.2.5

Location of the treatment plant at Mahon is seen as having the following effects on sustainable development.

The strategy and objectives of the City Development Plan would be compromised in the Mahon area by impeding residential development.

The strategy and objectives of the County Development Plan would be compromised by discouraging the type of development envisaged for the Maryborough/Rochestown Road area.

The following paragraph taken from the LUTS Review 1991 is relevant:

"The largest tract of undeveloped land within the City is located in the southern part of the Mahon Peninsula. Originally allocated for housing, this and the developed lands at Rochestown on the south side of the Douglas Estuary have the potential to avail of the scenic and recreational amenity value of the area".

These comments highlight the mix of housing, industry and amenity which should be provided for in the area. A location for industry has been designated to the north of the proposed ring road.

It is concluded that, when the concept of sustainable development is taken into account, the treatment plant should be located where it contributes rather than hinders the prospect of achieving development objectives.

The site at Mahon is particularly disadvantageous in this regard.

4.5.4

Conclusions

Table 4.5.1 shows in summary form the detailed examination of the two remaining possible locations for a Wastewater Treatment Plant.

The headings listed in the table are those dealt with in the preceding analysis. The site which is most compatible with the heading is identified under "preferred site" and where the two sites are considered to be equally compatible this is stated.

It will be seen from the Table that, of the 14 headings listed, nine indicate that the Carrigrenan site is the more favourable, four indicate that both sites are of approximately equal value and in one case under the heading "Access", Mahon is indicated as the preferred site.

The Site at Carrigrenan therefore emerges as the preferred site for a Treatment Plant and it is recommended that the preferred scheme be based on this site as the location for same.

With regard to the desirability for improved access to the site it is recommended that this be provided by extending the industrial estate road at Courtstown. The length of road involved is approx. 1km and the estimated cost of this is £0.66m. This road would open up for development, further lands, zoned for industry, at Courtstown.

It is clear that the site at Carrigrenan has the greatest potential for satisfying the concept of sustainable development commanding as it does an extensive area in the county. It provides a focal point for

Table 4.5.1
Comparison of Sites at Carrigrenan & Mahon

Heading	Carrigrenan	Mahon	Preference	Reasons for Preference
Topography	Suitable for Treatment Plant. Site development required.	Suitable for Treatment Plant. Site development & diversion of watermain required.	Equal	The topography of both sites is amenable to development as proposed. Overall site development costs are equal.
Access	Improved access to be provided from Courstown Industrial Estate extension.	Access from proposed South Ring Road.	Mahon	Mahon is adjacent to proposed main traffic route.
Proximity to Outfall Discharge Point.	1 km distant.	4 km distant.	Carrigrenan	Avoids necessity of long outfall sewer.
Existing Development	Scattered housing over 200m from developed portion of the site. Industrial development 1 km distant.	High density residential development within 500m of site. Industrial development 1 km distant.	Carrigrenan	The site should be remote from high density development.
Future Development	Zoned for industry.	Zoned for residential & amenity use.	Carrigrenan	More compatible with zoning objectives.
Land Use / Landscape	Grazing / pasture & hedgerows.	Cooperation Nursery / pasture, wet meadow & woodland.	Carrigrenan	Limited areas of similar characteristics available in Mahon. Extensive similar areas available near Carrigrenan.
Flora / Fauna	No major ecological significance.	High ecological value due to proximity to Douglas Estuary Bird Sanctuary.	Carrigrenan	Site at Carrigrenan will affect Flora & Fauna less significantly.
Odour / Noise	Air quality dispersion model indicates that proposed plant design minimises these effects.	Air quality dispersion model indicates that proposed plant design minimises these effects.	Equal	Plant design caters equally for both sites.
Marine Environment	Exposed foreshore will be affected to a minor degree. Short term effects during pipeline construction.	Sheltered Douglas Estuary will be affected to a medium degree. Short term effects during pipeline construction.	Carrigrenan	It is preferable to avoid siting the plant near the breeding grounds of the Douglas Estuary.
Human Environment	Not an amenity area, foreshore used by locals at low tide.	Amenity walkway nearby, pedestrian traffic in the area generated by this walkway.	Carrigrenan	Less impact on the Human Environment in the immediate & general areas.
Traffic	Through proposed industrial estate road.	Through proposed South Ring Road.	Equal	Proposed developments will be facilitated by future road works at both locations.
Visual Impact	Local scattered residential development. 2 golf courses. Shipping traffic.	High density residential development. 1 golf course. Shipping traffic.	Carrigrenan	Site is remote from high density residential developments.
Disposal of Residual Waste	As for traffic.	As for traffic.	Equal	As for traffic.
Sustainable Development	Development of the site will support this concept.	Development of the site is in conflict with this concept.	Carrigrenan	The Carrigrenan Site meets the criteria required by the 3 Principles outlined in the Environmental Action Programme.

drainage of further developments, bearing in mind that the area of the townland itself is on the order of 32 hectares. In addition, it will not influence ongoing or proposed projects in the Cork City/Mahon area, it will allow for continued residential and light industrial development of this area of the City and county, it will encourage further industrial development on Little Island, it can be easily expanded to provide increased wastewater treatment capability, and it could provide for continued industrial growth and development in the Carrigtwohill area.

4.5.5 Environmental Evaluation

Certain criteria are effective in terms of evaluating, and ultimately selecting, the preferred option. The following are directly relevant to the evaluation of the alternative options at Mahon and Carrigrenan:

Minimise Impacts to Lough Mahon and Douglas River Estuary

The results of the mathematical modelling of water quality in Cork Harbour have clearly shown that the treatment of urban wastewater from the Cork Main Drainage Scheme will result in improved water quality within Lough Mahon and Cork Harbour, Ref. Appendix I. However, the siting of the treatment plant and associated collection/outfall mains can potentially result in direct and indirect adverse impacts to these important resources.

While siting the treatment plant at the Mahon Site would minimise direct impacts to Lough Mahon, it would result in impacts to the Douglas River estuary system. Impacts would include loss of diverse habitat adjacent to the estuary, impacts to potential cultural heritage resources and loss of bird-roosting areas, and would result in a significant change in the land use in close proximity to the Douglas River. The diverse habitat at the site provides protection and food for a wide array of flora and fauna, including birds. Development of an industrial use at this site would also adversely affect the aesthetic nature of the estuary and impair the natural landscape along the public amenity walkway.

Siting the treatment plant at the Carrigrenan site would minimise long-term impacts to Lough Mahon (as no reclamation would be required) and would completely avoid impacts to the ecologically sensitive Douglas River Estuary.

Avoid or Minimise Reclamation of Mudflats

Siting the treatment plant at either the Carrigrenan or Mahon site would avoid reclamation of mudflats.

Impact on Land Use and Planned Developments

When siting a facility such as a wastewater treatment plant, it is critical to strive for consistency with surrounding land uses and to avoid adversely impacting planned developments. Siting the treatment plant at Mahon will result in a facility which is not consistent with existing land use patterns, land use planning objectives, or planned developments. While the treatment plant is not entirely inconsistent with the proposed South Ring Road, it is inconsistent with the objectives of the LUTS plan to provide a good-quality residential development at the site. Although the LUTS plan proposes a mix of residential and office/light industrial uses in the Mahon area, the proposed treatment plant is not considered consistent with these uses.

The current use of the Mahon site includes open space, agricultural (limited grazing), and a city nursery. Land use in the vicinity of this site includes a mix of low-to-medium density residential uses, open space/agricultural uses, recreational/amenity uses (i.e. walkway, golf course), and public facilities and infrastructure. Development of a treatment plant at the site would result in a significant change of the land to industrial use and may limit the favourability of developing nearby lands for various uses such as housing and recreational use (i.e. the walkway).

Development at the Mahon site would not adversely affect the construction of the proposed South Ring Road. Access to the site would need to be incorporated into the design of the roadway. The current route of the proposed roadway does, however, provide for an irregular parcel shape that may pose some difficulties in the design and layout.

Development of the treatment plant at the Carrigrenan site will result in a change in existing land use, but the parcel in question has been designated for industrial development by the County Development Plan. The existing land use is open space/agricultural, with some scattered residential dwellings in the vicinity. The Little Island and Harbour Point Golf Courses are also located in the vicinity. While conversion of the site to industrial usage is a change from existing conditions, the change

is not considered significant because the distance from the plant to the nearest residential dwelling will be over 100m and the area has been designated for industrial use by the County Development Plan, the LUTS Study, and the Harbour Commissioners.

Development of the treatment plant at the Carrigrenan site is not expected to adversely impact planned development at the site. It will likely limit the development of additional residential dwellings in the area, but this is not considered adverse in that this area is not envisaged for residential use. On the contrary, development of the treatment plant at this site may actually promote the industrial development of other parts of Little Island (i.e. Courtstown and Sitecast Industrial Estates, IDA Lands) in that availability of connection to wastewater treatment facilities could be used as an incentive for encouraging industry.

Minimise Odour/Noise-Related Impacts

Due to the inherent nature of wastewater treatment, the emission of odours is unavoidable. Odour emissions can be significantly reduced by proper facility design, operation, and maintenance, and by covering or enclosing treatment tanks and sludge handling facilities. Odour-related impacts can also be ameliorated through siting a treatment plant facility away from heavily populated areas and where predominant wind patterns disperse odours prior to their reaching sensitive receptors. These measures are accomplished through awareness and sensitivity during the selection of a suitable site.

The proposed wastewater treatment plant design is one that ensures that odorous emissions are controlled and have the potential for nuisance complaints in the neighbourhood kept to a minimum. The inlet works, primary sedimentation tanks and sludge handling facilities will be housed/covered. The positively extracted air will be conveyed to biological scrubbers for treatment prior to discharge to the atmosphere.

Air quality dispersion modelling studies were carried out for both sites (Appendix 4). On the basis of the results of these studies, both sites are similar from an odour dispersion viewpoint and therefore it is not possible to make a recommendation on which site should be adopted based on odour dispersion alone.

The Mahon site is located adjacent to heavily developed areas (i.e. Mahon, Rochestown and Douglas) and the greater use of the immediate vicinity by people (i.e. public walkway, playing pitches). Although wind patterns are predominantly eastward away from populated areas, the

greater human use of the area will result in more people being exposed to possible odours at a closer distance than at Carrigrenan site.

As with odours, noise can result in noticeable impacts in close proximity to a site. Noise dissipates rather quickly over distance. As such, it is important to identify a site with the greatest feasible distance from heavily populated areas in order to mitigate unavoidable operation-related noise.

Due to the proximity of the Mahon site to populated areas and to the heavily used public amenity walkway and playing pitches, noise-related impacts in the vicinity of this site would be of greater concern than at Carrigrenan. Although it is not anticipated that the noise generated by the operation of the facility will be significant, the closer the noise sensitive receptor is to the treatment plant, the more noticeable it will be.

Noise generated during the construction of the treatment plant will be similar regardless of which site is selected, but proximity of sensitive receptors again determines the significance of this noise. Construction-related noise (i.e. trucks, excavation equipment, etc.) will be temporary in duration, occur only during the daytime hours when noise-sensitivity is the lowest, and cease at the end of construction.

Construction of the treatment plant at the Mahon site will result in greater perceived noise levels during construction than at the Carrigrenan site due to the closer proximity of high density residential areas.

Avoid Impacts to Cultural Heritage Sites

Known cultural heritage resources are present in the vicinity of both the Mahon and Carrigrenan sites. Records show that the ruins of Lakelands House are located near the route of the South Ring Road, adjacent to this site. Ruins of a 19th. century boathouse, a 19th. century bathing house, and the remains of the stone farmyard buildings (c. 1831) from Lakelands Farm. The 1991 Draft Development Plan indicates that these farm outbuildings are worthy of protection. Depending on the design and layout of the treatment plant at this site, each of these sites would be lost or seriously compromised.

At the Carrigrenan site, the remains of a stone tower and a prehistoric shell midden are located along the western shoreline. Site visits and field reconnaissance have located another potential shell midden of unknown age or significance at the extreme southern point of the site, but this site requires additional evaluation. Each of these three sites is located around the extreme perimeter of the site. Due to the size of the parcel available, the design and layout of the treatment plant can be accomplished without any permanent facilities and disturbances within 50m of the cultural heritage sites so as not to compromise the integrity and potential significance of these features. The ruins of Carrigrenan House and associated outbuildings located at the interior of the site will, however, need to be demolished. These ruins are not listed in the Sites and Monuments Record (Cork Archaeological Survey) of the Office of Public Works, "Cork Harbour Archaeology" by the Department of Archaeology UCC, or in "Cork and County Cork in the 20th. Century" by Hodges and Pike, and are thus not considered unique or highly significant. As such, location of the treatment plant at the Carrigrenan site will result in the removal of the ruins of an old house but will not impact the known existence of two sites of cultural significance and one potential shell midden of undetermined significance.

4.5.6

Selection of a Preferred Scheme

Based on the results and conclusions of the environmental, engineering, and economic evaluation of alternatives, the following preferred scheme was selected from options previously discussed.

- Locating the wastewater treatment plant site at Little Island - Carrigrenan
- Installing a collection system to transport wastewater for Cork City, Tramore Valley, and Glanmire/Little Island to the treatment plant site.
- Constructing a treatment system consisting of primary and secondary treatment capabilities, including storm water management and advanced sludge treatment, but not including nutrient removal at this time (although the system will be designed to accommodate this capability should it be required in the future).

- Discharge of treated effluent at the deep water channel at Marino Point.

Each of these elements is addressed in more detail in Section 2.2 (Project Facilities, Design, and Layout) of this EIS.

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Chapter 5

RECEIVING ENVIRONMENT

CHAPTER 5

Receiving Environment

This section identifies and describes the relevant aspects of the existing environment in and around the Cork area that could potentially be affected by construction and operation of the proposed Cork Main Drainage Scheme.

5.1 Human Environment

Impacts to human beings and the human environment from this type of project may typically involve effects on land use and land use patterns, population and housing, recreation, and transportation.

5.1.1 Land Use

Land use patterns throughout the Cork Area are diverse and include a densely developed urban commercial centre, varying densities of residential development, industrial developments, and recreational, agricultural, and open space areas. The Atlantic Pond Pumping Station site is disused low lying grassland. Land use patterns on Little Island are predominantly a mix of undeveloped lands and industrial uses with scattered residential and agricultural areas and recreational facilities. In general, the land use of Little Island is greatly influenced by industrial uses such as chemical, pharmaceutical, and manufacturing industries. Significant industrial land holdings on Little Island include the Mitsui-Denman Lands, IDA Industrial Estate, Courtstown Industrial Estate, and the Sitecast Industrial Estate.

The townland of Carrigrenan covers an area of approximately 32 hectares at the southern tip of Little Island. The land use is currently farmland but also includes two dwellings, Carrigrenan House and Tower View Cottage. Carrigrenan House and its outbuildings are derelict and in an advanced state of disrepair. They are located in the approximate middle of the site. Tower View Cottage, located near the northeast corner of the townland, is occupied.

A majority of the proposed Carrigrenan site is in active agricultural use, consisting of cattle grazing. The vacant Carrigrenan House is addressed in greater detail in the cultural heritage section of this EIS.

The site is bounded on the north side by a local service road serving several private houses. Immediately to the south of the road is a low-

lying area that is partially covered by spring tides. This area covers approximately 7 ha. and would provide a buffer zone between the proposed site and nearby houses along the existing service road.

The derelict Carrigrenan House and Tower View Cottage are located within the site. Approximately 12 dwellings are located on the opposite side of the roadway at the northern boundary of the site near Clashavodig (Fig. 4.5.2). The northernmost unit of the treatment plant is located more than 200m from these habitable dwellings.

Other land uses in the general vicinity of the proposed site include:- Harbour Point Golf Course, located at its nearest point approx. 150m north of the site boundary, Little Island Golf Course nearest point approx. 500m to the northwest. Clashavodig, located approx. 300m northwest of the site. The Courtstown Industrial Estate, located approx. 750m to the northeast. Fota Castle, located approx. 1km to the northeast, and IFI Fertiliser Plant, approx. 1km to the south. The distance from Carrigrenan to Passage across Lough Mahon is approx. 1km, and Carrigrenan is approx. 2.8km from Mahon.

The Cork County Development Plan indicates that the townland of Carrigrenan is land reserved for industry. The original intention of the development plan was that the site be designated as most suitable for port-dependent industry making use of the adjacent deep-water channel. While the proposed wastewater treatment plant is considered an infrastructural use, its nature and resultant impacts are consistent with an industrial use and it also will make use of the adjacent deep-water channel, it is not considered a "port dependent" industry.

The largely industrial use of Little Island is also a primary objective of the **Cork LUTS in 1978**. As reconfirmed in the **LUTS Review of 1991**.

"Little Island has potential to benefit from the new road through the creation of a wholesaling/industrial support services park. Housing development should be carefully controlled to avoid compromising privately owned land which may be suitable for industry in the longer term. Little Island has potential for accommodating a major industry requiring 100 acres or so." (LUTS Review, 1991 pg.99).

The LUTS Review also states that wholesaling/industrial support services are:

"sensitive to the availability or otherwise of good access to the region centered on Cork. Current road improvements are

"creating locations providing this good access at..Little Island. Planning policies should ensure that the advantages created in this way are exploited" (LUTS Review, 1991, pg. 94).

Based on a review of the policies as established in the County Development Plan and the LUTS study, it is clear that Little Island is seen as instrumental in locating industrial and manufacturing uses and thus promoting regional job creation.

5.1.2 Population and Housing

The total 1990 population (LUTS Review) of Cork City and nearby portions of Cork County was approximately 234,600, including 129,500 residing in the City and 104,600 residing in the County.

The LUTS Review projected the population trend to the Year 2001 AD, and, for the areas given above established the following figures, taking into account measures to be taken to promote population increase and slow down the rate of decline in certain areas.

	<u>2001 Plan</u>
Cork City	117,400
Tramore Valley	22,000
Glanmire/Riverstown	6,700
Little Island/Glounthaune	<u>2,600</u>
Total	148,700

For the purpose of the present studies it is considered that the following population projections are realistic, having regard to the necessity to provide design capacity well beyond the horizon year of 2001 AD adopted in the LUTS Review.

Cork City	129,600
Tramore Valley	55,000
Glanmire/Riverstown	15,000
Little Island/Glounthaune	<u>6,000</u>
Total	205,600

The present Population Equivalent (PE) of the proposed drainage area is 321,566. Of this total, Cork City and Tramore Valley account for 278,533 PE and Glanmire/Little Island accounts for 43,033 PE. To

account for current population, projected population increases, and industrial effluent loadings, the design loadings of the treatment plant will accommodate a total of 448,350 PE, with 381,366 PE attributable to Cork City and Tramore Valley, and 66,983 PE to Glanmire/Little Island.

Although housing is scattered throughout Little Island, of particular concern are those houses located in close proximity to the proposed site. Based on field reconnaissance and a review of recent aerial photography, approximately 12 residential housing units are located within 250m of the site. These units are all single-family residential units. Based on the results of a survey of estate agents conducted pursuant to the LUTS Review (1991), residential property values at Little Island range between £35,000 and £40,000. This survey was based on an average 130m² semi-detached dwelling and does not necessarily reflect the actual values of residential dwellings in the vicinity of Carrigrenan.

Tower View Cottage is located within the proposed site and will be purchased prior to construction.

5.1.3

Recreation

A wide variety of active and passive recreational activities and opportunities are available throughout the Cork area and on Little Island in particular. Many of these opportunities are directly related to the presence of Lough Mahon, such as the public amenity walk from Mahon to Passage, boating, rowing, recreational fishing, and sightseeing. Other activities include golf, jogging/walking, playing pitches, and nature-watching (i.e. birdwatching). Water-contact activities such as swimming and bathing are uncommon in the upper harbour due to water quality and the lack of suitable beaches.

Recreational activities on Little Island are less varied and not as extensively utilised as those in Cork City or Mahon. The two most significant formal recreational facilities available on Little Island are the Harbour Point Golf Course and the Little Island Golf Course. Use of these 18-hole golf courses is, however restricted to members and guests. The Harbour Point Golf Course is located at its nearest point approximately 150m to the north of the site, and the Little Island Golf Course is located, at its nearest point, approximately 500m to the northwest. Portions of the Harbour Point Golf Course are, at times, within direct visual contact of the proposed treatment plant site.

Recreational activities are also available at Fota Castle and Fota Wildlife

Park located on Fota Island approximately 1km to the northeast across Foaty Channel. A resort development is planned for this island to include a hotel, golf course, and other tourism-related activities.

Access to the shoreline around the perimeter of the Carrigrenan site offers informal recreational opportunities. Due to its distance from more densely developed areas and its lack of maintained public walkway the public use of this area is limited. Currently, no formal recreational activities are located within the boundaries of the proposed treatment plant site at Carrigrenan.

5.1.4 Transportation

This section addresses automobile traffic, public transportation, and Cork Harbour and shipping services.

Automobile Traffic

Automobile access to Little Island is predominantly via National Primary Route N25. The primary road serving industries and residential areas is the Industrial Estate Road, which originates at the traffic roundabout located at N25 in the extreme northwest portion of Little Island, proceeding primarily east-west, and terminating at the Courtstown Industrial Estate located at the extreme eastern end of Little Island.

Currently, access to the Carrigrenan site would be via the existing county road extending southward from its junction with the Industrial Estate Road at Ballytrasna, approximately 1.5km to Clashavodig and to Carrigrenan. The width of this road varies from approx. 10-12 metres at the Industrial Estate Road to approx. 6 metres near Clashavodig. This road currently provides access to a mixture of land uses, including recreational, residential, agricultural, industrial, and manufacturing.

Based on an informal traffic count conducted along this road at the entrance to the proposed Carrigrenan site, the traffic volume in the direct vicinity of the site is low. Traffic flow during the time typically considered the morning peak (8am to 9am) was less than 15 vehicles per hour. Traffic flow was five to eight vehicles per hour during the afternoon, and approx. 15 vehicles per hour in the late afternoon peak (5pm to 6pm). These totals are approximate and are considered representative of the typical existing traffic flow in the vicinity of the site.

In order to facilitate the industrial use of the Carrigrenan site, the county development plan provides for the existing Courtstown Industrial Estate

Road to be extended to the northeast corner of the site near Tower View Cottage. This proposed road would be of appropriate width and design to serve the industrial and manufacturing land uses remaining to be developed in the Courtstown Industrial Estate, as well as provide access to the Carrigrenan site. The road is intended to provide suitable access for industrial vehicles, thereby eliminating their need to use a relatively narrow road through residential areas.

Public Transportation

Currently, public transportation modes serving Little Island include regular bus and train service. However, the Carrigrenan site is not served by either of these forms of public transport.

Cork Harbour and Shipping Services

Cork Harbour is the premier deepwater industrial port in Ireland and the premier port for the handling of bulk cargoes (LUTS 1991). The harbour currently provides a total berthage of over 3 miles in both private and public control. A full range of handling and storage facilities is available, including roll-on/roll-off containers, lift-on/lift-off containers, conveyor and bulk loading, as well as offshore servicing and a 24 hour work schedule. Port facilities exist at three locations-the City Berths area, Tivoli Industrial and Dock Estate, and the new Deepwater and Car Ferry Terminals in Ringaskiddy, where vessels of up to 60,000 DWT can be accommodated (LUTS 1991).

It is expected that the Deepwater Basin, Ringaskiddy will attract further substantial private investment in bulk storage facilities, and the ferry passenger services are also expected to grow. The Port's container terminal at Tivoli is being doubled in capacity and will be of considerable benefit in attracting new industry to the region. Further development works are proposed from 1992 through 1996 involving additional berthage at both Tivoli and Ringaskiddy (LUTS 1991).

The County Development Plan proposes that a port-dependent industry making use of the adjacent deep water is considered the most desirable type of industry for the Carrigrenan site. The use of this site for a treatment plant, will utilise the deepwater channel for the disposal of treated effluent and as such facilitates the use of the site and the adjacent deepwater channel.

5.2 Flora and Fauna

This section describes the existing flora and fauna in the project area, concentrating on those habitats and their characteristic biota that will most likely be affected by construction and operation of the proposed wastewater collection and treatment facilities. These habitats are primarily the estuarine habitats of Cork Harbour and, to some extent, the terrestrial habitats of Carrigrenan and areas to be traversed by the proposed sewer mains and construction of the main Pumping Station.

To provide a recent account of existing conditions in the harbour, a survey of the littoral, sublittoral, and planktonic communities was carried out in September 1991. Other ecological surveys of the project vicinity were also conducted in the Autumn of 1991 in support of the Environmental Impact Study for the South Ring Road Stage VI and River Lee Tunnel (Resource and Environmental Management Unit [REMU] 1991b; REMU 1991b; and Goodwillie 1991). This section is based largely on these recent surveys and supplemented with historical information.

5.2.1 Terrestrial Environment

Construction and operation of the proposed wastewater treatment plant, Pumping Station and wastewater transmission mains will alter the native terrestrial flora and fauna. The site of the proposed treatment facility is a large, active farm located on a promontory at the southeastern end of Little Island. The site is currently predominantly open rolling pasture with some hedgerows and large open-growth oak, beech, cherry laurel, and various ornamental trees, most of which are concentrated toward the southern portion of the property.

Where the new collection system traverses terrestrial environs, it will be constructed along existing roadways and the public walkway along the route of the old railway line. The areas adjacent to the public walkway mainly consist of early successional field, hedgerows, and brushy communities characterised by hawthorn, nettles, gorse, brambles, and dog rose. Few trees are located within the proposed wayleave of the sewer line. Table 5.1 lists the common flora occurring in the project vicinity (Appendix 5).

Numerous bird species occur in the fields, trees, and hedgerows of Carrigrenan, Mahon, and other upland areas surrounding Cork Harbour (See Table 5.1). The most common families include crows, thrushes,

warblers, finches, and pipits. Skylarks and meadow pipits may frequently be found feeding on grasslands and fields, including the golf courses at Mahon and Little Island. The hedgerows and trees provide foraging, roosting, and nesting sites for songbirds, including spotted flycatchers, treecreepers, long-tailed tit, warblers, and finches. Four species of predatory birds (peregrine falcons, sparrowhawks, kestrels, and short-eared owls) are also known to occur in the area, preying up on small terrestrial birds, waders, or small rodents (O'Halloran 1987, REMU 1991b).

Little information on mammal populations in the Cork Harbour area is available. However, a mammal survey was conducted in September 1991 in the vicinity of Mahon and the Douglas Estuary as part of the South Ring Road Stage VI Ecological Impact Study (REMU 1991b). Seven mammals were found in this area: house mouse, woodmouse, pygmy shrew, brown rat, rabbit, fox, and otter. The hedgehog was also considered likely to occur. Seven other species (bank vole, hare, stoat, badger, and three species of bat) are possible permanent or temporary residents of this area, but were not confirmed. The population size of each of these mammals is unknown. However, six of the fifteen species are protected under the Wildlife Act 1976, including the woodmouse, pygmy shrew, and otter. The pygmy shrew is the only projected species likely to occur in habitats affected by the proposed project.

The areas adjacent to the public walkway along the shoreline of Mahon and Blackrock (where the South Ring Road collection main would be installed) are of little habitat value to larger mammals because of the lack of cover and the level of human encroachment (REMU 1991b). However, the early successional areas provide ample food supplies for grazers, such as the rabbit and hare, and insectivores such as the hedgehog, pipistrelle, and pygmy shrew. They also provide cover for small rodents, such as the housemouse and brown rat, as well as amphibians, such as the common newt. Other corridors proposed for collection sewers follow existing roads and generally are within urban or industrial areas where only mammals accustomed to human disturbance (e.g. small rodents) are likely to occur.

The proposed treatment plant site at Carrigrenan provides limited habitat for mammals. The site is mainly exposed pasture, except for large trees near the point and surrounding Carrigrenan House. The trees as well as the abandoned house may provide roosts for bats, and the hedgerows may provide den sites, forage areas, and travel corridors for mammals such as the hedgehog, hare, rabbit and rodents. However, the highly exposed shoreline of Carrigrenan is unlikely to provide

suitable habitat for otters, and little shelter or food resources are available on site to support sustainable populations of fox, badgers, or stoats. In addition, because the site is located on a point of land, it does not serve as a migration corridor for transient mammals.

5.2.2 Estuarine Environment

Cork Harbour is the largest estuaries in the country and consists of two main sections: the upper harbour, which is composed of the outer Lee Estuary and Lough Mahon, and the lower harbour. The two sections are connected by an east and west channel. The waters of the lower harbour are well mixed and have salinities characteristic of coastal marine waters, whereas salinities in the upper harbour are more typical of an estuary.

The harbour is subject to semidiurnal tides with an average range of 4 metres and is characterised by extensive intertidal mudflats. The shores are typically covered with boulders, cobbles, and/or shingles, especially in the upper intertidal areas. The rocks provide substrate for a diversity of attached and encrusting seaweeds, the most dominant of which are the brown wracks (e.g. *Fucus spp.*, *Ascophyllum nodosum*, *Pelvetica canaliculata*). Green algae, predominantly *Enteromorpha sp.* and *Ulva lactuca*, may also be locally abundant, especially in areas subject to nutrient enrichment.

The dominant fauna of the rocky intertidal zone are barnacles (*Balarus Balanoides*, *B. crenatus*, and *Elminius modestus*), mussels (*Mytilus edulis*), and periwinkle snails (*Littorina spp.*). Other fauna common in the rocky intertidal area include limpets, beadlet anemones, amphipods, springtails, sedentary polychaetes, and bryozoans, and shore crabs.

The harbour survey carried out as part of the preparatory work for this scheme identified spatial and temporal variability in the flora and fauna of the harbour's intertidal zone. Several species, including limpets (*Patella vulgata*), (*Pelvetia canaliculata*) that were present at Carrigrenan Point, Marino Point, and Monkstown in 1975 were absent in 1991. The distribution and abundance of other species, including egg wrack (*Ascophyllum nodosum*) and the flat periwinkle (*Littorina littoralis*), were substantially reduced from 1975 to 1991 at Marino Point. Those *Ascophyllum nodosum* plants found at Marino Point were apparently unhealthy: this finding, in conjunction with the predominance of green algae and absence of newly settled limpet spat and juveniles, possibly indicates deteriorated water quality in the Marino Point area.

The soft bottom animal communities of Cork Harbour consists of 123 species of benthic macroinvertebrates, based on 35 grab samples analysed by Aqua-Fact International Services in 1991. The species represented 52 polychaetes, 38 crustaceans, 23 mollusks, seven echinoderms, two anemones, and one oligochaete. The Lower Harbour generally supports diverse species assemblages, such as the *Amphiura filiformis* subcommunity (*sensu* O'Connor *et al.* 1986), which are indicative of natural undisturbed environmental conditions. Conversely, faunal samples from the Upper Harbour were typically depressed in species numbers and numbers of individuals. Characteristic species included the polychaetes *Nereis diversicolor* and *Nephtys hombergi* and the mollusks *Cardium edule* and *Abra alba*.

The low species diversity, poor recruitment, and apparent ongoing reduction in abundance and distribution of certain floral and faunal species documented in the Upper Harbour are typical effects of organic overenrichment, which is apparently caused by the discharge of untreated urban wastewater into the River Lee and Lough Mahon. In contrast, areas of the Lower Harbour support more diverse animal and plant assemblages, indicating that the nutrient-enriched waters of the Upper Harbour are sufficiently diluted by the time they reach the Lower Harbour to inhibit significant adverse impacts to the floral and faunal communities.

Cork Harbour is a Controlled Area for shellfish harvesting. In the latter 1800s Cork Harbour supported a prolific oyster fishery (Partridge *et al.* 1982). However, widespread bacterial contamination and disease curtailed the industry in the early 1900s and resulted in the Controlled Area designation. A commercial mariculture venture began restocking oyster (*Ostrea edulis*) beds in North Channel (approx. 6 to 7km east of Carrigrenan) in the mid 1970s (McManus 1987). The extent of current harvests is unknown. A 1987 study indicated that no natural recruitment of oysters occurred (McManus 1987).

Cork Harbour and the River Lee support a number of estuarine and anadromous fish species that are the target of limited fisheries. The River Lee is an important spawning habitat for two salmonid species, Atlantic salmon and sea trout, both of which are fished recreationally. Individuals of these species must migrate through the estuary twice in their lifetimes: as adults returning to spawn and as smolts migrating to the sea. Peak upstream migration usually occurs between May and September corresponding with high freshwater discharge. Smolts generally migrate through the estuary between April and June, and typically spend more time in the estuary than do adults.

Hydroelectric dams on the River Lee prevent significant natural recruitment of salmon; however, hatchery-reared smolts are released annually downstream of the dams (REMU 1991a, Twomey 1991). Consequently, the timing of a substantial proportion of the smolt run is known. Operation of the dams may also affect the timing of upstream migration, as withholding of river flow, which often occurs during the summer months, may forestall movement of adult salmon into the river because of the low freshwater discharge. Sea trout tend to migrate into rivers under lower flow conditions than salmon, although poor water quality (which may arise from reduced mixing and dilution during low flow) may impede their migration (REMU 1991a).

Twenty-two species of estuarine fish were caught in a 1985 trawl survey of Lower Cork Harbour (May 1986). The more abundant species, such as mullet, flounder, and plaice, are of limited commercial importance. These species are most common in the estuary during summer and early autumn (REMU 1991a, Maye 1986). Table 5.1 (Appendix 5), lists the most abundant fish species found in the Cork Harbour.

High levels of fish disease (fin rot, ulcers, pigment abnormalities, petechial, skeletal anomalies) have been documented in Cork Harbour. These abnormally high levels of disease have been attributed to stress effects of excessive nutrient enrichment of harbour waters and/or the possible presence of unknown, toxic chemicals (Maye 1986).

As the largest estuary on the south coast of Ireland, Cork Harbour is well recognised as a significant habitat for waterfowl. Twenty-seven species of wading birds and wildfowl regularly occur in the harbour (see Table 5.1) including more than 1,250 shelduck, more than 10,000 golden plover, more than 400 black-tailed godwits, and more than 20,000 waders (Hutchinson and O'Halloran (1984). These numbers qualify Cork Harbour as a wetland of international importance using widely accepted criteria developed by the International Waterfowl Research Bureau. In addition, Cork Harbour is considered of national importance for oyster catcher, lapwing, dunlin, and redshank (Goodwillie 1991, REMU 1991b).

During counts of Cork Harbour waterfowl conducted between Nov. 1978 and December 1981 the largest number of birds inhabited the inner harbour, composed of the Douglas Estuary, the western side of Lough Mahon, and the mud flats of Tivoli and Dunkettle. (No organised counts have been conducted between January 1982 and July 1991: Hutchinson and O'Halloran 1984, REMU 1991b).

The primary importance of the Douglas Estuary is as a high-tide roosting area and as a feeding area just before and after high tide. The major roosting areas in the Douglas Estuary are on the south shore to the east of Bloomfield House and the Goat Island vicinity near the head of the estuary. As the tide retreats, some of the birds leave the estuary to feed on the extensive mudflats of Lough Mahon, primarily on Lakeland Strand and around Hop Island. Golden Plover, lapwing, dunlin, redshank, and black-tailed godwits feed mainly within the Douglas Estuary, while other species utilise feeding habitats more evenly distributed between Lough Mahon and the Douglas Estuary (Goodwillie 1991, REMU 1991b). Oystercatchers and hooded crows commonly feed on mussels from a bed located at the public walkway crossing of the Douglas River (O'Halloran 1992).

Important winter roosting sites also occur on the south shore of Little Island and on the Martello Tower peninsula across Foaty Channel from Carrigrenan. The extensive mudflats between Marino Point and Fota Island are a primary feeding area for wintering wildfowl. Over 800 shelduck have been counted in this area in late winter (Hutchinson and O'Halloran 1984). The extent to which intertidal mudflats in the central portion of Lough Mahon (i.e. Meelough Bank and mudflats south of Little Island) are used as feeding habitat is largely unknown (O'Halloran 1992).

Peak number of wintering waterfowl are present in Cork Harbour from October through February, although certain species (such as oystercatchers and redshank) may have spring and autumn peaks that correspond with the passage of migrating birds (Hutchinson and O'Halloran 1984).

5.3

Geology and Soils

The bedrock of the Cork region is composed of Devonian and Carboniferous sedimentary deposits and is overlain by unconsolidated Quaternary soils. The bedrock consists of four major rock formations: 1, red or purple sandstones and mudstones; 2, grey/green sandstones and red/purple mudstones; 3, brown/grey sandstones and mudstones; and 4, pale grey limestones. Rock formations 1 and 2 are Devonian in age and collectively are referred to as Old Red Sandstone; formation 3 and 4 are of Carboniferous origin (MacCarthy 1988).

The Cork area is characterised by a ridge and valley topography. The ridges, including those north of the River Lee and Little Island and south of the Douglas River and Lough Mahon, coincide with anticlines where the bedrock is composed of erosion-resistant Old Red Sandstone. In

contrast, the valleys, such as that containing Cork City, Lough Mahon, and Little Island, coincide with synclines composed of Pale Grey Limestone, which is susceptible to weathering. The brown/grey sandstones and mudstones are exposed on the flanks of the anticlines.

All of these rock formations have extensive faults. None is active (MacCarthy 1988). Many minor faults are visible where bedrocks are exposed, such as outcrops along the southwestern shoreline of Carrigrenan.

According to the National Soil Survey Ireland, Soil Association 13 occurs in the Cork synclinal valley, including the Mahon area and Little Island.

The principal soil of this association is a well-drained acid brown earth (70%), which has a sandy loam texture. Clay and silt contents are 15% and 25%, respectively. Associated soils include grey brown podzolic (15%) soil, which originates from parent material with a greater limestone content, and gley soil (15%), which occurs in low-lying areas and may have a high degree of impedance. This soil association has a wide use range and is very suitable for tillage and pasture, as well as for large-scale developments. Due to its sandy loam texture, the soils have free drainage and good structure, although inclusions of gley soil may have limited suitability due to impedance. Gley soils can be successfully drained if an outfall is available (Gardiner and Radford 1980).

Soil Association 15, which is composed of brown podzolics (60%), acid brown earths (20%), and gleys (20%), occurs along the anticlinal ridges north of the River Lee and south of the Douglas River and Lough Mahon. Long rock outcrops may extrude through these soils in some places. The principal soil, brown podzolic, is a well-drained sandy loam to loam with a gravelly loam parent material occurring below about 86cm. Gley soils occur mainly in depressions and are usually loam to sandy loam in texture.

Brown podzolic and acid brown earth soils have structure, texture, drainage, and depth features that make them suitable for a broad range of potential uses, including cropping and grassland. The associated gley soils are mainly suitable for grass production but can be reclaimed by providing an outfall for drainage.

5.4 Hydrology and Water Quality

The land-based components of the Cork Main Drainage Scheme will not traverse or otherwise affect any perennial freshwater water bodies or affect groundwater resources in the area. Therefore, this discussion

focuses on the existing hydrology and water quality of Cork Harbour, specifically Lough Mahon and the estuarine reaches of the River Lee and the Douglas River.

In 1989, the Environmental Research Unit of the Department of the Environment prepared a status report on the water quality of Cork Harbour, based on existing information (ERU 1989). A water quality and hydrographic survey of the harbour and River Lee was carried out to provide recent baseline data for the Cork Main Drainage Scheme. The result of these surveys provide much of the information used in this discussion of existing water quality and hydrology in Cork Harbour.

The harbour is subject to semidiurnal tides with an average range of 3.5 metres and is characterised by extensive intertidal mudflats. The shores are typically covered with boulders, cobbles, and/or shingles, especially in the lower intertidal areas.

Various studies have concluded that the upper reaches of Cork Harbour suffer from deteriorated water quality, primarily due to the discharge of untreated wastewater from Cork City. Prolonged discharge of raw urban wastewater from outfalls located in the River Lee has caused excessive organic loading and nutrient enrichment, resulting in high levels of BOD and hypoxic or anoxic sediments in the lower Lee Estuary and portions of Lough Mahon. Daily discharges of city wastewater to the upper Lee Estuary have been estimated at 12,000kg of BOD of which domestic wastewater accounts for 7,000kg/day (ERU 1991). The total daily wastewater input to the harbour, including industrial wastewater has a BOD load of approx. 46,000kg (ERU 1991).

Industrial development around the harbour has been concentrated at Little Island in the upper harbour and Ringaskiddy in the lower harbour. Wastewaters from these industries, which consist predominantly of chemical and pharmaceutical manufacturing plants, are generally discharged to waters with better circulation and dilution characteristics than those in the upper Lee estuary, where city wastewater is discharged. Thus, the degree of localised contamination is anticipated to be less severe in the vicinity of the industrial outfalls as compared to the area downstream of the municipal outfalls.

Despite eutrophic conditions in the harbour resulting from organic and nutrient enrichment, there has been little evidence of major phytoplankton blooms or increases in attached algal standing crop. Various investigators have speculated that light limitations caused by high turbidity may counteract the eutrophic conditions associated with

enhanced nutrient concentrations (ERU 1989). However, as discussed in Section 5.2.2 benthic communities in the upper harbour have experienced adverse impacts from habitat alteration associated with organic loading (e.g. lowered dissolved oxygen [DO] and increased silt load).

The waters of the upper harbour are also characterised by bacteriological contamination, which is mainly attributable to the discharge of untreated urban wastewater from Cork City into the upper Lee Estuary. Excessive levels of coliform bacteria occur at Blackrock and further up the estuary. Bacterial contamination declines markedly seaward of Blackrock, although localised increases have been reported in the Marino Point and West Passage area and are apparently associated with other localised sources. Peak seasonal coliform counts usually occur in late summer and early autumn, probably in association with periods of high storm water runoff (ERU 1989). Areas of concern with respect to bacteriological conditions are shellfish-harvesting areas in North Channel and bathing areas in the lower harbour. The Lough Mahon-West Passage area generally satisfy mandatory water quality criteria but not guideline limits for total faecal coliform bacterial established by the EC Bathing Water Directives.

Water column levels of heavy metals and synthetic organic compounds (e.g. organochlorine pesticides) in Cork Harbour generally do not constitute significant contamination. Only zinc has been shown to occur at concentrations significantly above background. However the most recent results compare favourably with those from previous studies indicating that the source of local contamination postulated as being the old Irish Steel Dumpsite off Haulbowline Island (O'Sullivan 1977), is declining. Enhanced levels of zinc have also been documented in other urbanised estuaries.

The sediments of Cork Harbour reflect typical estuarine conditions with the principal heavy metal contamination occurring at the mouths of the rivers entering the harbour and in the Lough Mahon area. Thus indicating the significant effect of the freshwater inflows with their loads substantially derived from urban wastewater inputs.

The majority of synthetic organic compounds were not detected in the sediments of Cork Harbour during the survey carried out as part of the main drainage scheme.

Some spatial trends in water quality of Cork Harbour are apparent from the existing data e.g. the survey carried out as part of the Cork Main

Drainage Scheme. Water quality parameters generally exhibit a gradient, with concentrations of BOD, nutrients, bacteria, and various contaminants decreasing in water, sediment, and biota from the upper harbour to the mouth (ERU 1989). This pattern is a further indication that the major sources of nutrients and contaminants are located in the upper harbour and that dilution and dispersion act to decrease concentrations with increasing distance from Cork City.

The waters of the lower harbour are generally well mixed as is evidenced by the similarity in water quality between the surface, mid and bottom waters. However, during the autumn survey carried out as part of the Cork Main Drainage Scheme, a freshwater wedge was noted overlaying a saltwater ridge from the Waterworks Weir as far as Blackrock Castle, with the wedge giving way to well mixed water at Marino Point. The effects of the freshwater was seen to extend as far as Marino Point during the corresponding spring survey with good mixing occurring at Black Point. This is attributed to the higher river flows in the spring time and consequently the zone of influence of the freshwater can be expected to extend further downstream.

The effects of the freshwater/saline water wedges can be seen clearly when parameters such as BOD, DO, etc. are studied. It is clearly seen at any given location where the wedge occurs that the freshwater is more heavily polluted with higher BOD levels being recorded in the upper layers corresponding to lower salinity levels, while BOD levels decrease with depth as the salinity increases. This indicates a definite distinction between the freshwater inputs polluted by agricultural run-off and wastewater discharges, etc. and the cleaner coastal saline waters.

Seasonal variation in water quality in Cork Harbour occurs primarily as a result of changes in river flow. During periods of low flow, dilution and dispersion of waste inputs are diminished, particularly in the upper estuary where the current urban wastewater outfalls are located.

While long-term trends in the water quality of Cork Harbour are difficult to establish (based on available data) a comparison of survey results from the early 1970's to the present appears to indicate that the levels of nitrate and ammonia have increased throughout the harbour, with the most significant increases being in the Upper Harbour Area. Levels of organic matter (as indicated by BOD measurements) and the degree of deoxygenation also appear to have increased in the same period, particularly in the Lough Mahon area (Appendix I).

5.5 Climate and Air Quality

5.5.1 Climate

Maximum daily average air temperatures in the vicinity of Cork Harbour are approximately 10.5°C. Sea breezes created by differential heating of air over land and water during these conditions would tend to prevent air stagnation in Cork Harbour (Bailey 1992 - Appendix 4).

The prevailing wind direction in the harbour is from the northwest (occurring approx. 32% of the time). Southwesterly winds occur during 30.5% of the year, generally during the summer when coastal breezes develop during warm, calm weather conditions. This air flow would normally reverse during the cooler night-time conditions (Bailey 1992).

Periods of calm or low wind speeds (<2m/s) occur about 10% of the time in Cork Harbour.

Poor air dispersion due to calm or light winds is also indicated by the presence of mist or fog, which was recorded in Cork Harbour 9.8% of the time between 1960 and 1984. The highest incidence of mist or fog occurred during the early morning and the lowest during the afternoon (Bailey 1992).

5.5.2 Air Quality

Ambient air quality in upper Cork Harbour generally is good. Chemical and pharmaceutical manufacturing facilities located in the industrial estates on Little Island have relatively small industrial emissions. However, the Irish Fertiliser Industries plant at Marino Point, located approximately 1km southeast of the Carrigrenan site, is a significant emission source of ammonia, which may be detected in the vicinity of Passage West and Lower Lough Mahon (Bailey 1992).

Background levels of five common air pollutants (carbon monoxide, nitrogen oxides, hydrocarbons, sulphur dioxide, lead) measured at Mahon during August 1991 were well below health protection criteria established by the European Community and the World Health Organisation. However, smoke levels measured at Ringmahon House monitoring station from 1988 to 1990 occasionally approached the EC Directive limit (Cork Corporation 1991).

5.5.3

Noise

Noise is generally defined as sound with an intensity greater than the ambient or background sound pressure level (SPL). SPL is determined by measuring the noise emissions in terms of sound pressure in a relationship defined as a decibel (dB). The type of decibel unit commonly used in sound level measurements is the A-weighted decibel dB(A). This scale is almost universally used to describe environmental noise because it simulates the variation with frequency through the audible range of the sensitivity to sound of the typically healthy human ear (Cunniff 1977, Kryter 1970, May 1978).

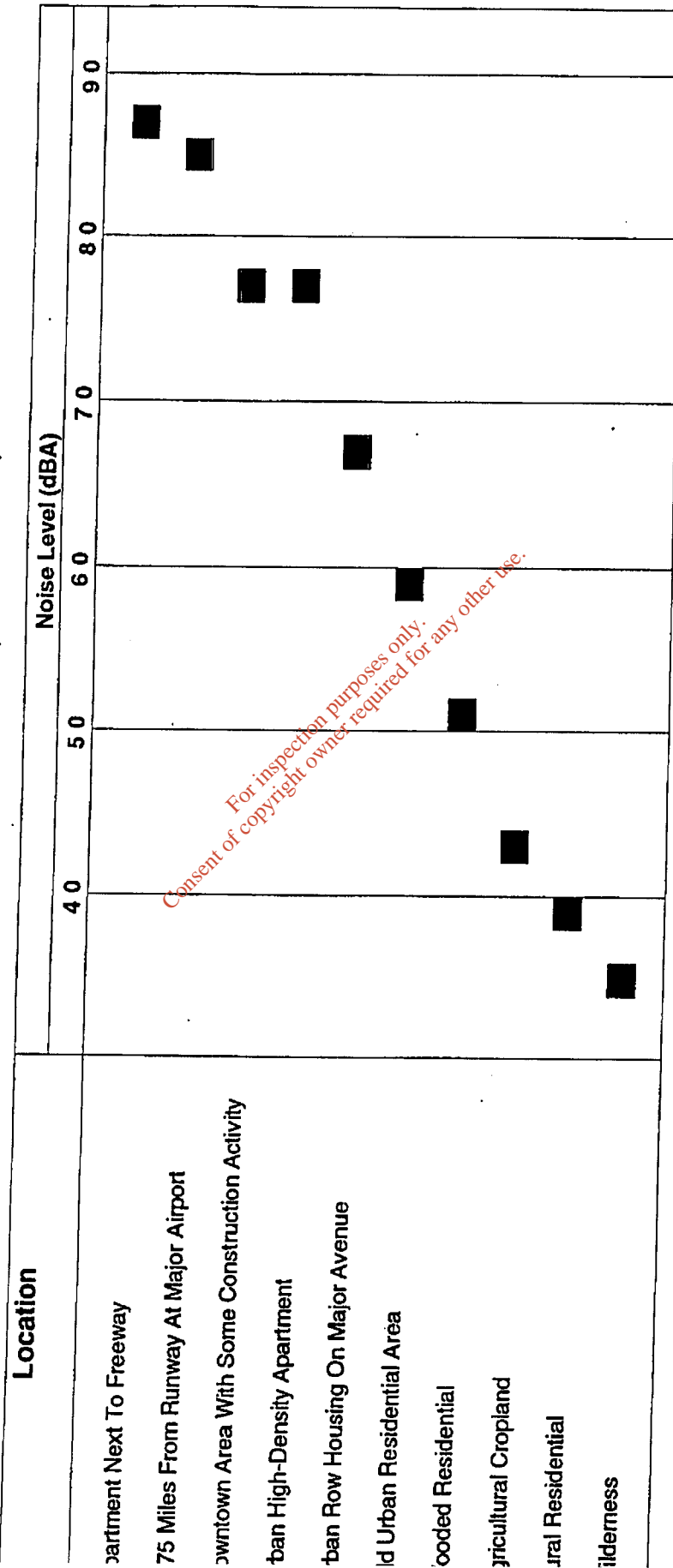
Outdoor noise levels change continually because of the temporal and spatial variations of noise sources. The temporal variation in the resulting sound levels is described by statistical levels in the form L_x , where L_x designates a sound that exceeds the level L for x percent of the sampling duration, or by equivalent sound levels in the form L_{eq} , defined as the stationary (constant) level with the same acoustic energy as the actual time-varying sound level over the given sampling period.

Areas that will be traversed by the proposed collection sewers include urban, commercial, industrial, and rural residential lands. Typical outdoor sound levels for these areas are shown in Fig. 5.5.1. As the figure indicates, ambient sound levels in the land uses that will be affected by construction of the sewers range from 38 dBA in rural residential areas to 79 dBA in heavily urbanised areas.

The proposed treatment plant site is located on pastureland; adjacent and nearby land uses include rural residential, light industrial, and recreational golf courses. The nearest noise-sensitive areas to the proposed treatment plant site are residences located approximately 200m from the nearest treatment plant unit. In addition, golfers on the golf course to the north of the site would be considered temporary noise-sensitive receptors as they would only be present during daylight hours.

Noise measurements were conducted at the nearest residence to the proposed treatment plant site at Carrigrenan on 17th.-18th. December 1992 and 21st.-22nd. December 1992. The wind speed was stronger than that acceptable for noise measurements during most of the first 11 or 12 measurement hours on Thursday 17th December. The recorded values were therefore not taken into consideration. The measurement microphone was approx. 1.5m above ground level at 12m from the front of the residence. An integrating sound level meter, Cirrus model type

Figure 5.5.1
Outdoor Day-Night Average Sound Levels at Various Locations



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Source : USEPA 1978

E.G. Pettit & Co.

CRL 702 (serial No. 16487), an outdoor microphone, type MK425, and sound level calibrator, type SIID, were used for the measurements. Values of the Leq for the day (07h-20h), intermediate period (6-7h, 20-22h) and night 22h-06h) are shown on Table 5.5.1 for the 24 hour period starting at 10h on 21.12.'92. These time-averaged measurements indicate background noise levels (leq) of 45.0 dBA during the day and 39.3 dBA during the night. Fig No.s 5.5.2 and 5.5.3 present the calculated hourly values of the Leq, L1, L10, and L95 for the period of measurement. Plots of the Leq are shown on Fig. No.s 5.5.2 and 5.5.3 for the period of measurement on the 17-18 December '92 and 21-22 December 92 respectively.

Table 5.5.1

Noise Measurements (Leq) at the nearest noise sensitive receptor to the Treatment Plant Site at Carrigrenan

<u>Period</u>	<u>Leq (dBA)</u>
Day (0700-2000)	45.0
Intermediate (0600 - 0700 2000 - 2200)	40.2
Night (2200-0600)	39.3

Source: Department of Civil and Environmental Engineering, University College, Cork, 1992.

TABLE 5.5.2**Calculated Hourly Noise Values (dBA) from Baseline Noise Measurements
(17/18 December '92)**

Period	Leq	s	L1	L10	L95
1h 00mn	48.8	2.9	56.0	51.1	44.0
2h 00mn	48.4	3.2	56.5	50.4	43.7
3h 00mn	48.6	2.9	56.5	50.7	44.0
4h 00mn	51.6	3.5	61.5	53.1	46.5
5h 00mn	52.1	3.7	60.8	54.1	46.1
6h 0mn	49.9	3.7	59.8	51.7	44.3
7h 00mn	50.4	2.9	57.6	52.6	45.1
8h 00mn	52.0	3.2	60.3	54.5	46.8
9h 00mn	52.5	3.6	60.9	54.7	46.4
10h 00mn	49.1	3.9	57.7	51.4	42.2
11h 00mn	43.0	5.7	52.9	44.3	35.6
12h 00mn	56.9	20.5	71.9	39.4	35.6
13h 00mn	39.3	4.1	51.3	35.6	35.6
14h 00mn	36.9	1.6	35.8	35.6	35.6
15h 00mn	35.9	0.8	36.2	35.6	35.6
16h 00mn	38.5	3.0	35.7	35.6	35.6
17h 00mn	35.7	0.5	37.1	35.6	35.6
18h 00mn	38.4	2.9	37.4	35.6	35.6
19h 00mn	35.6	0.2	35.6	35.6	35.6
Overall	49.5 dBA				

Source: Department of Civil and Environmental Engineering, University College, Cork 1992

Table 5.5.3**Calculated Hourly Noise Values (dBA) from Baseline Noise Measurements - (21/22 December '92)**

Period	Leq	s	L1	L10	L95
11h 04mn	39.3	3.7	46.6	38.3	35.6
12h 04mn	36.5	1.2	39.1	35.7	35.6
13h 04mn	41.5	6.0	52.7	36.5	35.6
14h 04mn	44.1	8.5	52.2	35.7	35.6
15h 04mn	44.7	8.8	59.6	38.2	35.6
16h 05mn	43.7	8.0	58.6	37.2	35.6
17h 04mn	43.4	7.7	55.4	35.7	35.6
18h 04mn	49.7	13.5	64.4	38.2	35.6
19h 04mn	44.1	8.4	56.4	36.4	35.6
20h 04mn	42.7	7.0	54.9	38.6	35.6
21h 04mn	40.9	5.4	53.0	36.0	35.6
22h 04mn	41.4	5.8	51.6	35.8	35.6
23h 04mn	38.5	3.1	39.7	35.6	35.6
0h 04mn	36.6	1.5	41.3	35.6	35.6
1h 04mn	38.6	3.2	35.8	35.6	35.6
2h 04mn	35.6	0.1	35.7	35.6	35.6
3h 04mn	40.5	5.0	43.0	35.6	35.6
4h 04mn	38.2	2.9	40.1	35.6	35.6
5h 04mn	40.0	4.5	44.8	35.6	35.6
6h 04mn	36.7	1.7	41.5	35.6	35.6
7h 04mn	43.8	8.0	55.7	38.2	35.6
8h 04mn	46.4	10.0	59.4	44.1	35.6
Overall;	42.8	dBA			

Source Department of Civil and Environmental Engineering, University College Cork 1992.

No. of channels: 1
 No. of Leqs: 43229
 Elementary duration: 2 s
 start: 10h 04mn01s 21/12/1992
 end: 10h 04mn59s 22/12/1992
 Channel 1: Civ. Eng.Dept,UCC dBA min: 35 max: 95.
 Code 3: Pause

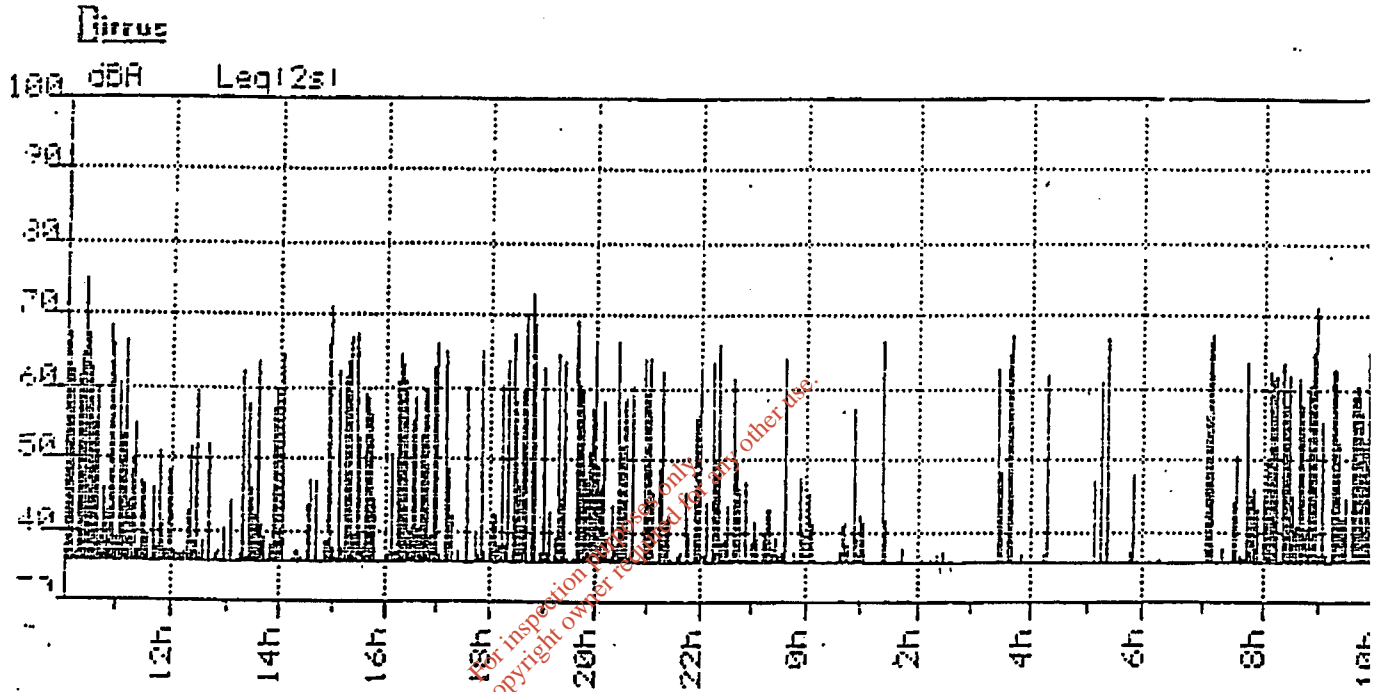
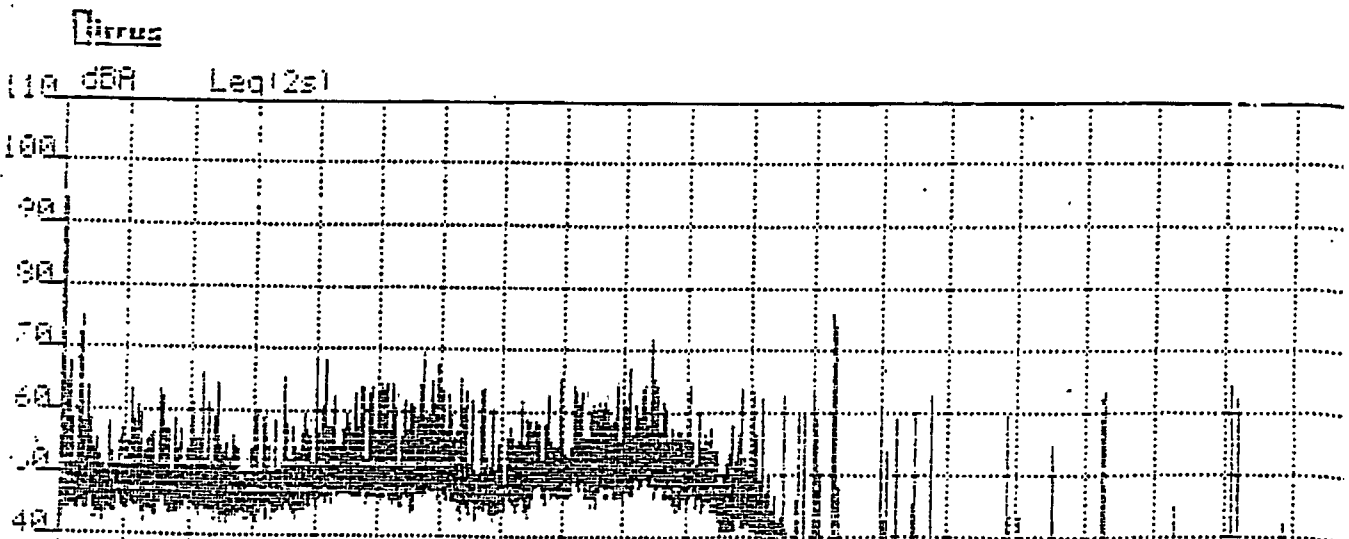


Fig 5.5.2 Plot of Leq 21/22 - 12 - 1992

No. of channels: 1
 No. of Leqs: 36403
 Elementary duration: 2 s
 start: 11.00 Thursday 17/12/1992
 end: 07.00 Friday 18/12/1992
 Channel 1: Civ.Eng.Dept,UCC. dBA min: 35 max: 110



5.5.4 Odours

Ambient odours in the project vicinity include hydrocarbon emissions from internal combustion engines (particularly from diesel-driven vehicles), which are most noticeable in Cork City and along major roads.

Burning of coal in fireplaces and furnaces also produces widespread sulphurous odours, most noticeable during cold periods. Emissions of organic compounds from chemical and pharmaceutical manufacturing plants on Little Island and Marino Point also generate detectable odours in the Lough Mahon vicinity. In addition, naturally occurring sulphurous odours emanate from the expansive mud flats throughout Lough Mahon when exposed during low tides, especially during warm conditions (Bailey 1992). The proposed treatment site at Carrigrenan is surrounded on three sides by extensive mud flats.

A detailed odours study, including air quality dispersion modelling, for the proposed treatment plant was carried out. This report is included as Appendix 4.

5.6 Landscape

The purpose of this section of the EIS is to describe the context and character of the project area, its significance, and its vulnerability to visual impacts. This section focuses primarily on the treatment plant site at Carrigrenan in that this is the primary part of the proposed scheme with any significant aboveground structures that may influence existing aesthetic resources. Reference is also made to the Atlantic Pond Pumping Station.

The Atlantic Pond site, near the Marina, has a low situation and is suitably located between the City and the Upper Estuary of the Harbour. The site is bounded by the Old Passage Railway line on the northern perimeter and by private residential property on the southern perimeter. The site is low lying and is disused. The area of disuse extends eastwards parallel to the Old Railway Line beyond the extent of the proposed site, amounting to 1.5 hectares. The envisaged site for the proposed pumping station is 1.2 ha. in area.

The Carrigrenan site is located at the south eastern tip of Little Island and is surrounded on the west, south, and east by Lough Mahon. Little Island is flat to gently rolling in nature and characterised by a predominance of industrial uses and open space with scattered residential development. Much of the open space consists of grazing lands and two golf courses. The land area throughout Little Island is, however, not used as extensively for agricultural and grazing purposes as other areas within the Cork region.

Given the location of the site, both the context of the area and the character of the site are heavily influenced by Lough Mahon and the upper Cork Harbour. In this area, Lough Mahon dominates the

landscape and tends to diminish the visual and aesthetic conspicuousness of specific terrestrial resources.

The character of the Carrigrenan site itself is defined by a rolling topography and a mixture of vegetation types and habitats, and provides aesthetically pleasing views to the west and southwest. Within the boundaries of the site are the remains of Carrigrenan House, which are surrounded and sheltered by mature vegetation. The predominant topographic feature of the site is a hillock approx. 22m in elevation that allows views of Cork Harbour in all directions.

The following provides a more detailed discussion of the prominent components of the landscape.

5.6.1 Topography

The topography of the Carrigrenan site is as previously illustrated in Map 4.5.1. As shown, the site is rolling in nature, with elevations ranging from less than 2m to approx. 22m. Topographic relief of the site is dominated by two hillocks: one of approximately 16m in elevation located in the centre portion of the site, and the second, more dominant feature, being approx. 22m high located in the southern portion of the site. Due to its proximity to the edge of the site along Lough Mahon, the shoreline in this area is composed of cliffs approx. 12m in elevation.

5.6.2 Natural Feature

The predominant natural features of the site are:

- Topographic relief that provides an area of high ground at the southern end of the site.
- The extensive waterfront boundary on three sides of the site.
- A low area (less than 2m) at the northern portion of the site that is covered by spring tides.
- The range of natural habitats ranging from open fields to mature trees and intertidal zones.

It should be noted, however, that the range of habitats is due, in part, to the development and use of the site for agricultural and grazing purposes. This diversity of habitat is reflective of the sites use, which is common throughout the Cork region, and as such is not considered unusual or highly significant.

5.6.3 Man-Made Features

The site is bordered on the north side by a local service road serving several private houses. Tower View Cottage, located near the southeastern corner of the area covered by spring tides, is occupied. Other significant man-made features within the site vicinity are dwellings and industrial/commercial uses along the road from Ballytrasna to Clashavodig, golf courses to the north and northwest of the site, and the IFI plant located south of the site on Marino Point.

Man-made features on the proposed site include Carrigrenan House and associated outbuildings located in the centre of the site. Carrigrenan House is in an advanced state of disrepair and is not inhabited. A stone tower is also located along the rocky shoreline at the extreme westernmost point of the site. These man-made structures are addressed in further detail in Section 5.7 (Cultural Heritage) of this EIS.

5.6.4 Aesthetic Resources

The aesthetic resources of the site, as with any area, are a subjective component of the landscape. As opposed to the more objective nature of the topography, or natural and man-made features of the site, the aesthetic or visual resources are somewhat dependent upon individual perceptions and responses. Aesthetic resources can be discussed in terms of internal (i.e. within the site) and external (i.e. off-site) views. External views include views from the site to other areas, and from other areas toward the site.

Aesthetic resources within the confines of the site are somewhat limited and unremarkable given the context of the site in relation to the remainder of Little Island and the Cork area. Due to the topographic relief, views from any particular point within the site are limited in scope. The entire Carrigrenan site is not completely visible from any one point. The aesthetic resources present within the site include rolling open fields with scattered trees and hedgerows. The aesthetic quality of the site itself is common to the semi-rural landscape of much of the Cork area and as such is not considered significant.

Existing views from the Carrigrenan site to areas off site are more aesthetically pleasing, particularly given the presence of Lough Mahon which adds the water element to the rolling residential/agricultural patchwork that comprises the countryside within the existing viewshed.

Views from the site to the south include the IFI Fertiliser plant at Marino Point, a view past Passage toward the lower harbour, and the gently rolling countryside above Marino Point and Passage. In this latter direction, the IFI plant dominates the view.

Views from the site to the west are across Lough Mahon toward Hop Island and Mahon. Due to the relatively large distance between the sites and these land forms (nearly 3km), they are not dominant features of the visual landscape (in fact, Hop Island is barely distinguishable from the background relief of Rochestown). The mouth of the Douglas River is also barely visible. Cork City is located over 5km to the west and is not readily visible from the Carrigrenan site.

Views to the north of the Carrigrenan site, towards the remainder of Little Island, are dependent on where the viewer is situated on the site (i.e. his or her elevation). From much of the site, views to the north are limited and extend only to the hedgerow along the northern part of the site. From the highest point of the site, other parts of Little Island are visible, but the view of this area is dominated by scattered industrial facilities. As such, the aesthetic value of this portion of the viewshed is limited.

Views to the east of the Carrigrenan site are obtainable only from the eastern portion of the site. Notable features in this direction are the railroad lines across the mouth of the Belvelly River, a Martello Tower, storage yards for the IFI Fertiliser plant, and portions of Fota Island. Fota Castle is barely visible from the extreme northeastern corner of the site.

Views of the Carrigrenan site are available from areas around Lough Mahon. In general, the scale of these views is highly influenced by distance across an expanse of water, which tends to focus aesthetic perceptions on larger features such as hills, large open fields, and wooded areas rather than on specific features such as individual houses or structures. The Carrigrenan site is most visibly apparent, at a distance where the scale allows recognition of specific features, from points along the amenity walkway between Hop Island and Passage (1 to 2km) and from the railway line between the Belvelly River and Marino Point (900m). While views of the site from these areas are notable, there is no existing feature at the site that significantly contributes to or dominates the visual or aesthetic nature of the Little Island shoreline. The site appears as an open area with some trees. The topographic

relief provided by the promontory at the southern part of the site is distinguishable from many points within Lough Mahon.

Much of the Carrigrenan site is visible from the adjacent area to the north of the site. This area includes several residential houses and a portion of the Harbour Point Golf Course. In particular, views of the site from these areas extend from the sloped area between the ruins of Carrigrenan House outbuildings to the east to the 22-metre-high promontory to the west. It should be noted, however, that due to the heights of the existing hedgerow in this area, the density of the existing natural vegetation and maintaining an embankment along the northern side of the developed site, grade-level views from the road into the site are severely limited and restricted to only a few isolated locations - (Ref. Sectional Elevation A-A - Fig. 4.5.3).

In general, the aesthetic resources and scenic views both toward the site and from the site are considered attractive due to the interrelationship of water (Lough Mahon) and land (Little Island, Mahon, Rochestown). However, the distance between viewpoints, particularly across Lough Mahon, tends to influence the scale of visual resources so that the visual landscape is dominated by large land forms and features and specific sites or areas appear less noticeable. While aesthetic resources of Lough Mahon/Carrigrenan are considered valuable assets to local landscape, they are not of an unusual, unique, or highly significant nature.

5.7

Cultural Heritage

Despite its accessibility and extent, Cork Harbour has never been the site of any significant military or naval exploit; consequently, its historical associations are of less national interest and importance than other protected harbours of County Cork, such as Bantry Bay and Kinsale Harbour. Nonetheless, Cork Harbour has been an important centre for trade and commerce for more than 800 years (Coleman 1914).

A 1975 inventory of existing archaeological monuments lists 96 sites within 176 square miles of land surrounding Cork Harbour (O'Kelly and Shea 1976). These sites range in date from the Late Neolithic (c. 2000 B.C.) to the 19th. Century, and include ringforts, churches, castles, shell middens, and 17th to 19th. century fortifications and towers. The *County Cork Sites and Monuments Record* (Cork Archaeological Survey) of the Office of Public Works, 1988 is more comprehensive, including less significant sites such as walls, gates, piers, and wells.

Historical references to the townlands were checked in the Journal of Cork Historical and Archaeological Society, "*Cork Harbour Archaeology*"

by the Department of Archaeology U.C.C., and in "*Cork and County Cork in the 20th. Century*" by Hodges and Pike. Based on these sources, 19 sites are located within 1km of the proposed facilities.

Notable cultural resources within close proximity of the proposed collection mains include Blackrock Castle (1829) and Ringmahon Castle (age unknown), both located in the Townland of Mahon; a shell midden at Harty's Quay near the Tramore Valley Pumping Station; and a circular tower (17th to 19th century) on Hop Island (Coleman 1914; O; Kelly and Shea 1976; Office of Public Works 1988).

Several well-preserved towers from the 17th to 19th century are located in the vicinity of the proposed treatment plant at Carrigrenan, due to the site's strategic location within the upper harbour. A circular tower with an attached rectangular structure is located on the northwestern shore of Carrigrenan at the cove near the access road. In the vicinity, a well-preserved Martello Tower and Foaty Castle are both located across Foaty Channel to the east of Carrigrenan, approx. 800m and 1km from the site, respectively.

The proposed treatment plant will include the site currently occupied by Carrigrenan House, an abandoned 19th century farmhouse and associated outbuilding. This site is not included in the *County Cork Sites and Monuments Record* or in "*Cork and County Cork in the 20th Century*" due to its relatively recent age. Cultural resources of this sort are common in the region and generally not considered of major cultural importance.

As defined by the 1987 National Monuments (Amendment) Act, a "historic monument" is defined as "a prehistoric monument and any monument associated with the commercial, cultural, economic, industrial, military, religious, or social history of the place where it is situated or of the country and also includes all monuments in existence before 1700 AD or such later date as the Minister may appoint by regulations". In terms of this Act, there are no known archaeological monuments at the site of the treatment plant.

The occurrence of shell midden all around Cork Harbour dating from prehistoric times to the 19th Century was recorded by McCarthy (1987 unpublished M.A. thesis UCC), and by the Department of Archaeology UCC Cork Harbour Study (1976). A known prehistoric shell midden is located along the western shore of the Carrigrenan site, south of the stone tower. The date of this midden is not known, but the site does merit protection. Field reconnaissance identified another area of shell

(predominantly clam and scallop) deposition at the extreme southern tip of Carrigrenan Point to the west of the quay. The origins of this shell deposition are not known, as it is not identified as a shell midden in work conducted by McCarthy (1987) or the Department of Archaeology UCC. The determination of this area as a shell midden should be made by a qualified archaeologist. Due to its location at the Carrigrenan site, this area will not be affected by construction or operation of the facility.

No known archaeological sites, monuments or historic structures will be directly impacted (i.e. removed) by the collection mains or outfall main.

5.8 Material Assets

In general, the identification of specific material assets is open to interpretation, and there is little consensus on components of the environment that may be regarded by society as being of value for production, development, maintenance, recreation, and well-being (Bradley, Walsh, and Skehan 1991). For the purpose of the proposed Cork Main Drainage Scheme, significant material assets include sustainable development and severance.

5.8.1 Sustainable Development

The concept of sustainable development is advocated in the report of the World Commission on Environment and Development (The Brundtland Report). These principles are:

- Concept of Sustainable Development as advocated in the Report of the World Commission on Environment and Development (the Brundtland Report). This concept envisages a reasonable balance in man's interest between development and nature.
- The principle of precautionary action even where there is no definite scientific evidence of both emissions or discharges with detrimental environmental effects.
- The integration of environmental considerations in all policy areas.

In the context of the Cork Harbour area, sustainable development must have its basis on the development plans of the local authorities and on the LUTS Review, as these documents contain the most solid information on existing conditions and strategies for future development.

If the Cork Main Drainage Scheme is to contribute positively to sustainable development in the greater Cork area, the treatment plant should be located as far downstream as is economically feasible. The reasons for this are:

- The area likely to benefit most from a development viewpoint is that in the Little Island/Glounthaune/Carrigtwohill corridor
- Location of the site in the limited available land bank in the city area would interfere with projected development proposals initiated in the City Development Plan (i.e. Mahon) and in the County Development Plan (i.e. Douglas/Rochestown area).

The following paragraphs from the LUTS Review 1991 are relevant:

East Harbour Area

The main employment potential lies in the corridor extending from Tivoli and Little Island to Midleton. Careful management of this area will be required to ensure that its potential is not destroyed through commercial strip development along the existing road. (The need for such control also arises in relation to new roads on the study area, particularly near junctions). Little Island has potential to benefit from the new road through the creation of a wholesaling/industrial support services park. Housing development should be carefully controlled to avoid compromising privately owned land which may be suitable for industry in the longer term. Little Island has potential for accommodating a major industry requiring 100 acres or so, and a reservation for this purpose is proposed.

Carrigtwohill may also have potential for a major stand-alone industry and land should be reserved for this, using agricultural/possible (longer term) industry zoning to keep the options open. Carrigtwohill also has some 80 acres of publicly owned industrial land, capable of accommodating several significant industries. An extension of the City and Harbour Water Scheme is likely to be required in the short to medium term to allow for water-using industry. There may be savings in coordinating the extension of the scheme from Little Island to Carrigtwohill with the construction of the corresponding section of the N.25 road improvement.

5.8.2 Severance

Severance deals with the possibility that a development may disrupt activities, linkage between activities, such as journeys to work or shopping trips, or divide land to the detriment of the whole. Particularly for pedestrians, severance may be a psychological feeling and thus difficult to define (Cork Corporation 1991).

Regarding the proposed Cork Main Drainage Scheme, the issue of severance is potentially relevant regarding the treatment plant site and the collection mains. Severance impacts of the proposed scheme are addressed in detail in Section 6.8.2 of this EIS.

5.8.2.1 Treatment Plant Site

The preferred treatment plant site is located at the southernmost tip of Little Island. The site is surrounded on the east, south, and west by Lough Mahon, and on the north by terrestrial portions of Little Island. Although the foreshore area around Carrigrenan Point is accessible to the general public, it is not heavily used due to its distance from more developed areas, the lack of a public walkway (as found around the Mahon site), and the rocky nature of the shoreline to the southwest portion of the site (which makes access more difficult).

Other resources potentially susceptible to severance-related impacts in the vicinity of the treatment plant site include the residential dwellings located along the access road and other developed and undeveloped lands in the vicinity, in particular future roadway access/connection to the Courtstown Industrial Estate located on the eastern side of Little Island.

Severance impacts of large development can be both short-and long-term in duration and can be mitigated in most instances.

5.8.2.2 Collection Mains

Due to the location of collection mains on the Lough Mahon shoreline, a potential exists that pedestrian activities and linkages to the waterfront may be disrupted. This could be particularly pronounced where a collection main follows the route of an existing walkway or path utilised by pedestrians (i.e. Blackrock/Mahon area).

Clearly, construction of the collection mains would also disrupt road surfaces and traffic flows in some areas and thus temporarily restrict or

block access to such places as work, shopping, etc. It is in these areas where construction will be overtly apparent to pedestrians and motorists that severance-related impacts may be perceived to be the greatest.

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Chapter 6

ENVIRONMENTAL IMPACT

CHAPTER 6

Environmental Impacts

This section describes the impacts that could result from the construction and operation of the Cork Main Drainage Scheme. Ameliorative measures are identified and discussed in Chapter 7.

6.1 Human Environment

6.1.1 Land Use

Construction and operation of the wastewater treatment plant will result in a change in the existing use of the Carrigrenan townland site. The entire 32 ha will not be directly affected because the northern portion of the site affected by spring tides (approx. 7 ha) and the 22m hillock at the extreme southern tip of the site will remain undeveloped. However, approximately 20 ha. of the site will be permanently converted to use as an urban wastewater treatment plant facility.

The planning objectives for the site as expressed in the County Development Plan and the LUTS Review of 1991 call for industrial usage, particularly harbour or waterfront-related industry that will utilise the deepwater channel at Marino Point. The wastewater treatment plant will utilise the deepwater channel at Marino Point. In addition, the plant will facilitate the industrial development of Little Island. As such, the treatment plant is compatible with land use policies and objectives regarding industrial land use at Little Island.

The proposed treatment plant is consistent with the predominantly industrial and manufacturing uses on Little Island. However, the location of approximately 12 residential dwellings at over 100m from the site does provide a generally noncompatible land-use mix. In selecting a site for the treatment plant, a concerted effort was made to avoid residential areas to the maximum extent practical, and in particular to avoid densely developed residential areas. Although these 12 dwellings in their current context are not considered a high-density residential area, their existence is a concern that will be addressed and ameliorated to the extent practical.

These residential houses are all located along the north side of the access road from Clashavodig to Tower View Cottage. At the closest point, the nearest treatment plant unit will be more than 200m from the

nearest residence. Tower View Cottage, which is located on the 32 ha. Carrigrenan site, will need to be purchased.

From a land-use perspective, the construction and operation of the treatment plant will not impact the future use of either the Harbour Point Golf Course or the Little Island Golf Course. In addition, it will not adversely affect the operation of industrial or manufacturing uses in Little Island.

The construction of the proposed collection mains will result in temporary disturbances to land uses directly traversed (i.e. roads, amenity walkways, mudflats), but these disturbances will cease with the termination of construction and subsequent restoration activities. Operation of the collection mains will not affect land use or land use patterns except that future permanent structures (i.e. houses, buildings) will not be permitted directly above the mains for obvious safety and maintenance reasons.

Construction and operation of the proposed outfall main from the Carrigrenan site to the outfall at Marino Point will not affect land use given the current route of the main east of the man-made quay along the southern boundary of the site.

Construction and operation of the Atlantic Pond Pump Station will result in the conversion of 1.2 ha. of undeveloped land to an urban use comprising pumphouse service building and administration building. This use is consistent with the existing fabric of this part of Cork City. Although the access road to this facility will traverse the public amenity walkway (i.e. old railway line), operation of the pump station will not adversely affect the use of the walkway by the public.

In addition to the Atlantic Pond Pump Station, ten other pump stations will be required as part of the Cork City Main Drainage Scheme. Of these, five are existing wastewater pump stations or septic tank facilities that will only be upgraded. The remaining five will require new construction encompassing 0.1 hectares - 0.2 hectares. These pump stations are located throughout Cork City, Blackrock, Mahon, Tivoli and Little Island, and each is located in an area of urban or industrial development. Additional information regarding these pump stations, including specific locations and sizes, is provided in Section 2.2.2.2 (Associated Developments) of this EIS.

6.1.2 Population and Housing

The construction and operation of the proposed Cork City Main Drainage Scheme will not result in any significant impacts to current population or projected population growth patterns for Cork City, Cork County, or Little Island. The treatment plant has been designed to accommodate a population equivalent of 448,350 which will account for population growth for the next 30 years.

Construction and operation of the proposed treatment plant will result in adverse impacts to the approximately 12 residential dwellings located at over 100m from the proposed plant and to new residential construction in the area. These impacts would likely include a reduction of new home construction in the immediate vicinity due to a reduced desirability to live in close proximity to a wastewater treatment plant. It should be noted, however, that residential land use in general on Little Island is currently affected by the predominance of significant industry and manufacturing uses there. In addition, it should be noted that new residential construction on Little Island is not entirely consistent with the County Development Plan and the LUTS Study, which call for encouraging industrial use and developments on Little Island.

Construction of the treatment plant will require that Tower View Cottage be purchased from its current owner and demolished. As such, the proposed action will result in the direct loss of one active residence.

Construction and operation of pumping stations will not impact on population and housing resources.

Construction and operation of the collection mains and treated effluent outfall will not impact population or housing resources.

Measures to ameliorate potential impacts to these housing units are addressed in Section 7 of this EIS.

6.1.3 Recreation

Construction and operation of the Main Drainage Scheme is not anticipated to result in any significant adverse impacts to recreational activities or opportunities in the Cork area.

Construction will result in the temporary disturbance of foreshore areas and part of the public amenity walkway (Old Railway Line), which will result in the temporary loss of access and/or visual impacts and thereby affect the recreational (i.e. aesthetic) value of the area. However, these

impacts would be temporary and would last for the duration of construction only, and the amenities would be fully restored following construction.

6.1.4 Transportation

Construction of the treatment plant at the Carrigrenan site will result in an increase in traffic in the vicinity of the site as a result of construction workers and construction vehicles (i.e. trucks, graders, etc.) accessing the site. Access to the site will be via an extension of the existing Industrial Estate Road from Courtstown Industrial Estate to Carrigrenan. As existing traffic levels are low, this increase in traffic will likely be significant. Traffic flow will be particularly heavy in the morning (8am to 9am) from the Industrial Estate Road south to Carrigrenan and in the late afternoon (5pm to 6pm) from Carrigrenan north to the Industrial Estate Road. This new road will be designed to accommodate the types of heavy vehicles associated with industrial development.

Actual traffic flows resulting from construction of the wastewater treatment plant are dependent on the specifics of the construction plan (i.e. phasing, timing of activities, methods of construction etc), and as such are difficult to accurately predict at this time. It should be noted that actual traffic flow increases will vary over the period of construction depending on ongoing construction activities. Any increases in traffic associated with construction workers and vehicles will be short term, temporary, and occur only for the duration of construction.

Space will be adequate for construction workers to park automobiles on the Carrigrenan site so as not to block the road or restrict access to the existing houses. The parking area should accommodate one vehicle per worker.

Actual traffic flow per day to and from the wastewater treatment plant after construction is estimated to be 11 automobiles for workers and an estimated 2 heavy vehicles for sludge/grit/screening transportation off site, and sufficient parking area to accommodate these vehicles on the Carrigrenan site is provided.

Construction of the collection mains will result in traffic-related impacts to existing roadways that will severely limit vehicle access. In some instances, a road may be closed to allow for safe and efficient

construction. In all cases where vehicle access will be restricted or prohibited, detour routes will be clearly marked.

Construction in roadways will be temporary, and following surface reinstatement, vehicle movement will be restored. Specific roads to be impacted, appropriate detour routes, and a projected timeframe for construction in these areas will be developed during the final design phase.

Operation of the wastewater treatment plant will result in a minimal traffic increase. Due to the extensive automation of the plant a maximum of 11 employees will be required. As such, access to the site by these employees should not be significant. Actual projections as outlined above, are one vehicle per employee.

Operation of the plant will also produce sludge residue (from the thermal drying process and also screenings and grit which will need to be removed. It is estimated that approximately 18m^3 per day of sludge product (16.7 t/d at 93% TS), $4/5\text{m}^3$ screenings and $4/5\text{m}^3$ of grit would need to be disposed of off site. This volume would be removed every one to two days by 2 no. trucks. As such, operation of the plant will result in the long-term increase in large truck traffic on Little Island. This increased volume is not significant given the other industries and associated truck traffic on Little Island.

Many of these traffic-related impacts along the access road from Carrigrenan to Ballytrasna (i.e. traffic congestion, large vehicles, noise, etc) will be avoided due to the extension of the Industrial Estate Road from its current terminus at the Courtstown Industrial Estate to the Carrigrenan site as proposed in the Cork County Development Plan (Cork Co. Council 1989). The extension of this widened and improved roadway would provide excellent site access for employees and truck traffic, avoid the residential areas near Clashavodig, and promote industrial development in the area between Courtstown Industrial Estate and Carrigrenan.

Public Transportation

Construction and operation of the proposed wastewater treatment plant will not affect the availability of public transportation modes. Bus traffic may be affected by construction of collection mains in roadways, but this would be neither long term nor significant. Buses would merely follow

established detour routes.

Cork Harbour and Shipping

Construction of the collection main across Lough Mahon from Mahon to Carrigrenan and across the River Lee at Kennedy's Quay may result in temporary inconveniences to shipping traffic due to the presence of construction barges and trenching equipment. However, this construction can be conducted so as to avoid times when ship traffic to Cork City is anticipated. Inconveniences would only result in the crossing of the dredged channel at high tide when shipping traffic is more likely to occur. Following completion of these river/harbour crossings, operation of the collection mains will not affect shipping activities.

Construction and operation of pumping stations will not affect shipping or harbour activities.

Construction and operation of the treatment plant will not affect shipping or harbour activities.

6.2 Flora and Fauna

This section discusses the potential effects on flora and fauna caused by the construction and operation of the proposed Cork Main Drainage Scheme. The discussion addresses the effects on both terrestrial and marine resources.

6.2.1 Terrestrial Environment

Construction and operation of the proposed facilities will result in both long- and short-term minor impacts to terrestrial flora and fauna. Construction of the proposed treatment plant will require the permanent removal of approx. 20 ha. of native vegetation at the proposed treatment plant site. This impact will be relatively minor due to the previously altered nature of the existing plant communities (Active pastureland, hedgerows, and ornamental trees) and the relative abundance of similar habitat in the general vicinity of the treatment plant site. The proposed facility will be configured and sited so as to minimise clearing of large trees near the southern end of the site. In addition, woody hedgerows bordering the site will be retained to the best degree possible to minimise ecological and aesthetic impacts. Following construction of the treatment plant, open spaces remaining within the site will be revegetated with grass, consequently, a significant portion of the present grassland will be functionally replaced.

Construction of the proposed wastewater transmission mains and pumping stations will have

minor temporary effects on terrestrial vegetation. Most of the mains will follow existing roads and wayleaves and will not require clearing of vegetation. Where mains traverse early successional fields and hedgerows on Little Island and Mahon, approximately 3.0 ha. of vegetation will be removed. Because of the local predominance of these types of vegetational communities, impacts to flora will be minor. In addition, the vegetation will be allowed to revert to its original condition following construction.

Construction of the proposed facilities will have minor short-and long-term impacts of fauna habitat, causing localised impacts to fauna populations. During construction, the clearing and grading of the treatment plant site, pumping stations' sites and transmission main wayleaves will result in a loss of vegetative cover that could cause limited mortality to less mobile forms of wildlife, such as small rodents, which are unable to escape the construction area. In addition, physical disturbance of the site and noise from construction activities will likely cause the temporary displacement of most fauna from the immediate vicinity of the construction zone and adjacent areas. Following construction, displaced species are expected to resume their normal habits consistent with the availability of post-construction habitats.

Construction of the treatment plant on the 20-hectare site will result in the long-term conversion of native vegetation to maintained industrial use. This will preclude the use of this area for some fauna. Small rodents, rabbits, and songbirds may continue to derive benefit from the maintained grassy areas and early-successional hedges retained around the perimeter of the site. Demolition of Carrigrenan House and clearing of adjacent trees at the treatment plant site will remove potential roosting sites for bats. However, the stand of large trees near Carrigrenan Point will be retained as a visual buffer and may provide suitable roosting locations for bat populations. Other mammal species currently occupying the site will be able to find suitable undeveloped habitat generally found in abundance adjacent to the disturbance area.

Of the protected species that may occur in the project vicinity, only the pygmy shrew is likely to be affected by construction and operation of the proposed facilities. Some mortality may occur during construction of the wastewater mains and treatment plant. Loss of habitat will be temporary, and post-construction revegetation of construction areas will provide prime habitat for recolonisation.

6.2.2 Marine Environment

Implementation of the proposed Cork Main Drainage Scheme will have short-term minor adverse effects and long-term beneficial effects on marine flora and fauna.

The new wastewater transmission main that will convey wastewater from the proposed head chamber at Mahon to the treatment plant at Carrigrenan will cause short-term impacts to littoral and pelagic marine resources and the waterfowl that utilise these resources. This transmission main will traverse approx. 3.5km of the floor of Lough Mahon, including the dredged navigation channel.

Operation of heavy equipment for trenching and pipe installation during construction will result in direct and indirect impacts to benthic fauna such as polychaetes, molluscs, and crustaceans. Sedentary organisms such as mussels, oysters, clams, snails, limpets and various algae will experience direct mortality and disruption-of-substrate impacts.

Nearby benthic and pelagic communities may be affected by sedimentation resulting from disturbance and suspension of marine sediments in the water column. Increased sedimentation may smother fauna and sedentary epifauna located adjacent to the dredging area.

Suspended sediment particles may clog the tentacles, fine filters, and gills of suspension feeders and may lead to localised reductions in population of these species (Gay et al 1991). In addition, increased turbidity can cause attenuation of light, thus lowering the rate of photosynthesis by macroalgae and phytoplankton.

However, such effects of suspended solids on benthos are generally restricted to areas that experience extremely high turbidity for a prolonged period of time. Most marine benthic organisms can withstand exposure to high concentrations of suspended solids for short time periods (Saila et al 1972).

Sediment plumes resulting from construction will have a minor effect on demersal and pelagic finfish. High concentrations of very fine sediment particles can coat the respiratory epithelium of fishes, thereby interfering with respiration (Sherk et al 1974).

In addition, suspended solids can affect juvenile and larval fish and cause siltation of spawning beds. However, unlike most benthic fauna,

finfish are highly mobile and can avoid areas they find unsuitable. In general, potential suspended solids impacts are expected to be minimal.

Depending upon the degree of wind and wave energy, intertidal foreshore areas are subject to frequent natural physical disturbance. For this reason, many of the benthic faunal species occupying the littoral zone have developed adaptations to withstand frequent disturbance. Due to this inherent resiliency, marine benthos are expected to recolonise the foreshore area shortly after cessation of construction activities. Recolonisation by benthos after dredging operations has been shown to be very rapid, on a scale of weeks to about two years, depending upon the magnitude and season of dredging (Wildfish and Thomas 1985; Jones 1986). Studies of the rocky intertidal zone of Bantry Bay, County Cork, were conducted to provide information regarding the sequence and duration of ecological recovery following human disturbance of the intertidal zone. Shores cleared of flora and fauna during the summer of 1978 were found to have nearly full recolonisation by August 1979 (Cross and Southgate 1982). Similar recolonisation can be expected to occur in Lough Mahon.

The treated effluent discharge main will convey treated effluent to a discharge point downstream of Lough Mahon. The discharge main will traverse approx. 1km across the floor of Lough Mahon to an effluent outfall point at the deepwater channel near Marino Point at the head of West Passage. This portion of the effluent transmission main will be entrenched into the sediments, thus causing localised direct physical impacts to marine benthos and plumes of suspended sediments. Impacts to benthic organisms resulting from disruption of substrate and sediment plumes are expected to be similar to those described above for the intertidal construction-related disturbance. No commercial shellfish beds or maricultural operations are located in Lough Mahon or Upper West Passage. Consequently, no impacts will occur to commercial shellfishing interests. Impacts to benthic populations will be limited as far as is practicable by minimising the extent and duration of bottom disturbances. In addition, construction of transmission and discharge mains will be scheduled to avoid periods of peak salmonid migrations (April through September) to minimise adverse impacts to recreationally important fish species from degraded water quality.

Construction activities associated with installation of the wastewater transmission and discharge mains in the foreshore will have insignificant effects on waterfowl populations. Operation of heavy equipment will cause temporary avoidance of the construction area. Birds quickly adapt to noise and movement at construction sites. Consequently,

construction operations are not expected to significantly alter feeding behaviour. In addition, construction will move sequentially across the foreshore, affecting local areas only for a short period of the total duration of construction.

Temporary, localised reductions in prey populations due to construction in the foreshore will have an inconsequential impact on the waterfowl carrying capacity of the area because only a small proportion of Cork Harbour's mudflats will be affected, and high-tide roosting habitat (non feeding habitat) - is the limiting factor in waterfowl abundance and distribution in Cork Harbour (O'Halloran 1992). The proposed project will not result in any loss or disturbance to known high-tide roosting habitats.

The construction and operation of the main pumping station at Atlantic Pond will not impact on the marine environment. This also applies to the minor pumping stations.

Night-lighting at the proposed wastewater treatment plant will not adversely affect bird behaviour. Some waterfowl species are known to use night-lighting to their benefit to aid in night-time feeding (Goodwillie 1991).

Although the wastewater will be subjected to secondary treatment to remove the majority of BOD/COD, suspended solids, to effect some reduction in nutrient and bacteriological loadings, some localised impact to marine flora and fauna may occur. Increased nutrient concentrations in the vicinity of the outfall may result in a shift in normal phytoplankton populations or community structure, which may include minor algal blooms. Such effects are expected to be minimal due to the degree of bed-water flushing in the passage and the expected lowering of the overall ambient nutrient levels in the estuary caused by the proposed action.

Suspended solids and organic matter contained in the treated effluent will tend to flocculate and precipitate in the effluent/seawater mixing zones. This precipitation may cause localised smothering of sediments and increases in benthic BOD, thereby reducing dissolved oxygen (Gay and Lee et al 1991). This effect is expected to be minor due to the proposed diffuser structures that will facilitate dispersion and mixing of the treated effluent. Furthermore, the treated effluent will be generally warmer than the receiving waters, thus forming a buoyant plume carrying the effluent to the surface where wind-driven agitation will occur (Tchobanoglous and Schroeder 1985).

Although a significant amount of bacteria and viruses in the waste-water will be removed by treatment, all microorganisms cannot be removed economically and, thus, some will be discharged with the effluent.

Although commercial shellfish and bathing/swimming areas are susceptible to adverse impacts from degraded bacteriological quality, these areas are limited in Cork Harbour. The nearest commercial shellfish beds are located more than 6km from the proposed outfall in the eastern part of North Channel. The closest bathing beach is located in Lough Beg, more than 7.5km from the proposed outfall. Mathematical modelling of bacteria concentrations in Lough Mahon, including the vicinity of the outfall, was conducted based on the expected quality of the effluent and the mixing and circulation patterns of the estuary determined through a recent hydrographic survey.

The cessation of untreated wastewater discharge from the outfalls at Penrose and Kennedy Quays and Tramore Valley will have long-term beneficial impacts on the marine flora and fauna of lower River Lee and Lough Mahon. Improvements to water quality resulting from the cessation of untreated effluent discharge (see Section 6.4) will promote a more diversified and productive benthic community, which in turn will increase the carrying capacity of the upper harbour for benthic feeding fauna, including waterfowl, and fish. In addition to improving water quality in upper Cork Harbour, the proposed discharge of secondarily treated effluent will not significantly degrade the quality of water in West Passage or lower Cork Harbour.

6.3

Geology and Soils

Grading, trenching, excavation, blasting, and backfilling during construction of the proposed facilities will disturb soil horizons. However, many of the areas traversed by the proposed sewer lines consist of fill material that has covered the original soil horizons. No soil-dependent land uses, such as croplands and pastureland, will be traversed by the sewer lines. Consequently, trenching and backfilling during the installation of pipelines will not have any significant impact on soils.

Construction of the proposed wastewater treatment plant will require extensive grading of the Carrigrenan site to achieve necessary elevations and even contours. This disturbance to previously undisturbed soils will adversely impact soil productivity. However, since the proposed action will permanently convert the present agricultural grazing land use to an industrial use, this impact to soils is inconsequential.

Clearing of vegetation, excavation of existing soils, and site grading may result in erosion and sedimentation in the vicinity of the construction

area, including the Carrigrenan site and the collection mains. Without proper mitigation, erosion of topsoil and resultant sedimentation in either Lough Mahon or in the 7-ha. area covered by spring tides could be significant. Sedimentation will be controlled by implementing mitigative practices, such as the installation of sediment fences. Impacts resulting from construction activities will also be minimised by revegetating all disturbed areas as quickly as possible.

Operation of the proposed wastewater treatment plant and associated facilities will result in no significant soil erosion and sedimentation.

The construction of the pumping stations will have no impact on the geology or soils of the locations concerned.

The geology of the area is suitable for supporting large structures and facilities and will not be adversely affected by their construction and operation.

6.4

Hydrology and Water Quality

Construction of the land-based components of the scheme may result in some temporary degradation to Cork Harbour water quality in the immediate vicinity of the construction activities. This impact would be caused primarily by overland storm water flow transporting disturbed soil particles into adjacent receiving waters. This impact would be minimised by implementation of sedimentation and erosion-control measures and limited to the period of construction. Groundwater resources are not expected to be affected by the proposed action.

Construction of the submarine portions of the wastewater transmission main and the treated effluent outfall main will require dredging of approx. 3.5km of the foreshore and harbour bottom within Lough Mahon. Dredging operations will cause temporary minor impacts to water quality, primarily from the suspension of disturbed sediments into the water column.

Disturbance and suspension of sediments will cause temporary localised increases in turbidity and BOD, and may also release nutrients from interstitial water of organically-enriched sediments. Suspension of sediments also has the potential to release sediment-sorbed contaminants, such as heavy metals and synthetic organic compounds, into the water column. However, sediments which could be disturbed by installation of the submarine sewer mains in Lough Mahon do not appear to be significantly contaminated by such metals or compounds.

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5.5 Climate and Air Quality

5.5.1 Climate

Maximum daily average air temperatures in the vicinity of Cork Harbour are approximately 10.5°C. Sea breezes created by differential heating of air over land and water during these conditions would tend to prevent air stagnation in Cork Harbour (Bailey 1992 - Appendix 4).

The prevailing wind direction in the harbour is from the northwest (occurring approx. 32% of the time). Southwesterly winds occur during 30.5% of the year, generally during the summer when coastal breezes develop during warm, calm weather conditions. This air flow would normally reverse during the cooler night-time conditions (Bailey 1992).

Periods of calm or low wind speeds (<2m/s) occur about 10% of the time in Cork Harbour.

Poor air dispersion due to calm or light winds is also indicated by the presence of mist or fog, which was recorded in Cork Harbour 9.8% of the time between 1960 and 1984. The highest incidence of mist or fog occurred during the early morning and the lowest during the afternoon (Bailey 1992).

5.5.2 Air Quality

Ambient air quality in upper Cork Harbour generally is good. Chemical and pharmaceutical manufacturing facilities located in the industrial estates on Little Island have relatively small industrial emissions. However, the Irish Fertiliser Industries plant at Marino Point, located approximately 1km southeast of the Carrigrenan site, is a significant emission source of ammonia, which may be detected in the vicinity of Passage West and Lower Lough Mahon (Bailey 1992).

Background levels of five common air pollutants (carbon monoxide, nitrogen oxides, hydrocarbons, sulphur dioxide, lead) measured at Mahon during August 1991 were well below health protection criteria established by the European Community and the World Health Organisation. However, smoke levels measured at Ringmahon House monitoring station from 1988 to 1990 occasionally approached the EC Directive limit (Cork Corporation 1991).