ELECTRICITY SUPPLY BOARD

Aghada Combined Cycle Gas Turbine Power Plant

ENVIRONMENTAL IMPACT STATEMENT

July 2004

Report P378250-R605-0001

ESB INTERNATIONAL

Table of Contents

APPENDICES

LIST OF TABLES

LIST OF FIGURES

NON-TECHNICAL SUMMARY

THE PROJECT

Introduction

Current analysis indicates that there will be a shortfall in electricity generating plant to meet demand in the winter of 2007. The proposed development is designed to assist in meeting this shortfall.

The project is the construction of a combined cycle gas turbine (CCGT) electricity generating station. The electrical output from the station will be approximately 420 MW and it will be located at the existing Aghada Generating Station at Whitegate, Co. Cork.

An examination of the likely significant effects on the environment of the proposed plant has been carried out and the results are presented in this Environmental Impact Statement (EIS). The conclusions of the EIS are contained in this Non-technical Summary.

The existing station has an Integrated Pollution Control Licence issued by the Environmental Protection Agency. The project will require that this licence be reviewed prior to operation of the new plant.

Basis of Operation

The combined cycle power plant process is recognised as being the most environmentally benign method of power generation from fossil fuels. The combined cycle mode utilises the following process:

- Air is drawn into a compressor where it is compressed and fed to a gas turbine.
- The compressed air is mixed with either gas or gasoil in the combustion chamber and ignited.
- The hot gas produced is passed through a gas turbine and, as it expands, causes the turbine to rotate at high speed.
- The rotating turbine is coupled to an electrical generator, which as it spins, produces electricity.
- The hot gases from the gas turbine are directed to a heat recovery steam generator (HRSG) where high-pressure steam is produced.
- The high-pressure steam is passed through a steam turbine and, as it expands, causes the turbine to rotate at high speed.
- The rotating turbine is again coupled to an electrical generator which, as it spins, produces electricity.
- The spent steam is condensed to water in a condenser at the end of the turbine and recycled to the HRSG.
- The waste gases from the HRSG are discharged through a chimney into the air.

The plant may also have the capability of operating in open cycle mode. In this case, exhaust gas from the gas turbine is not passed through the HRSG. Instead, it is sent directly to atmosphere via a bypass stack. This mode of operation, if provided, is inefficient and would only be used in very rare cases.

The electricity generated is fed to electrical transformers where the voltage is adjusted to allow for transmission to the National Grid.

Water from Cork Harbour will be used to condense the exhaust steam from the steam turbine. The steam is condensed to hot water which is then reused in the HRSG. The cooling water will be returned to the harbour in a slightly warmer condition. Water cooling is the most energy efficient method of cooling available.

This type of power station operates successfully in many locations.

The plant will operate continuously, 24 hours per day, 365 days per year (except for downtime for maintenance). The plant will operate on natural gas, but will also be capable of operating on gasoil, in case of interruption in the gas supply.

The contract to supply and construct this plant will be open to international competition. The exact plant output and layout cannot be specified at this stage without prejudice or favour to a particular manufacturer.

The result of the tendering process will be the award of a contract for a particular model of gas turbine. The final size, configuration and layout of the plant will be finalised following the award of contract. However, consideration of environmental impacts is on the basis of the largest size of plant envisaged.

The proposed development will not result in a change in the risk classification of the site.

With regard to alternatives, the CCGT technology chosen is accepted world-wide as being the most suitable technology for a power plant of this size, with significantly higher efficiency and lower relative emissions. The site at Aghada is the most suitable site available for this development as the area is zoned as a strategic industrial area, has a long association with power generation, has direct access to gas supply and national grid, and is located at the centre of the major electricity demand centre of Cork.

SIGNIFICANT IMPACTS OF THE DEVELOPMENT

The possible impacts of the development were examined by considering the environment as having the following components: human beings, water, fisheries, flora and fauna, soil and groundwater, air, noise, landscape, material assets and cultural heritage. In each case, impacts were examined by considering the receiving environment, environmental impacts, mitigation measures (where appropriate) and the conclusion.

The most significant potential impacts on the environment from the proposed plant have been identified as follows:

- Heat transfer to the harbour by cooling water
- Emission of combustion gases to the atmosphere
- Noise arising from operation of the plant
- Visual impact from construction of buildings and chimneys

Other potential impacts on the environment are related to discharge of minor effluent streams to the harbour, hazards, material assets, cultural heritage and interaction between impacts.

Human Beings

The proposed development will lead to employment during the construction stage.

Positive impacts are expected as regards input to the local economy and the project will ensure that national economic development is not constrained by shortfalls in the availability of electric power.

The use of the site for electricity generation is well established. Continued use for electricity generation will not adversely impact on other land uses in the area and is compatible with the Cork County Development Plan.

The basic technology to be employed in the project is well understood and has been used successfully in many equivalent projects both nationally and internationally. There are no implications for health and safety.

Water

Water will be abstracted from Cork Harbour to condense the steam used to spin the steam turbine. Heated cooling water will be returned to the harbour via a submerged pipeline to a submerged outfall 440 m offshore from the station. Cooling water will be treated to prevent deterioration in plant performance that could result from fouling by marine organisms.

Computer modelling was used to predict the extent of the plume of heated water in the harbour, taking into account the discharges from the existing power station. This showed that the impact region from the combined discharge will be confined principally to Whitegate Bay, its approaches and a strip running parallel to the shoreline. The effect of both discharges on Whitegate Bay shows a minimal increase in temperature over the existing discharge scenario.

The incremental concentration of residual chlorine in Whitegate Bay, arising from treatment of cooling water in the additional discharge, is of no consequence. The additional concentration is equivalent to only about 5% of the existing outfall.

Fisheries, Flora & Fauna

The most significant potential impact of the heated cooling water is on fisheries. Independent advice has confirmed that the existing discharges do not impact negatively on movements of fish in the harbour and that the proposed development will not lead to a negative impact either.

Dredging associated with marine works will be similar to existing activities throughout the harbour. Any impacts are most likely to affect non-commercial species and, in any case, a full recovery can be expected to occur in most cases over a short period.

Impacts of the proposed new CW discharge will not be detectable in the wider harbour and will be minor or insignificant in the area within or around Whitegate Bay itself. Any thermal effects on marine organisms will be restricted to the immediate vicinity of the outfall, beyond which changes in sub-tidal benthic community composition are unlikely.

An intertidal habitat within Cork Harbour is currently designated as a Special Protection Area (SPA) under the EU Birds Directive and its extent has been under review by National Parks and Wildlife. The development will not impact physically on the existing SPA or its proposed extension, either during the construction or operational phases. No impacts on waterfowl use of Whitegate Bay are expected as a result of the development.

Soil & Groundwater

The development does not involve any discharges to soil or groundwater.

Having been reclaimed during development of the existing station in the late-1970s, the soils at the site have no significant resource value and the CCGT development will have no impacts on their status.

Similarly, the groundwater resource beneath the site is not of suitable quality to represent an abstractable resource for consumption and as such the development is unlikely to have any discernible impact on the value of the groundwater resource. The quality of groundwater beneath the site has been degraded by the intrusion of saline harbour waters and is not attributable to any present or past practices associated with the existing station.

Air

Natural gas is the most environmentally benign fossil fuel available for power stations. When it is burned it produces carbon dioxide (CO_2), water vapour and traces of oxides of nitrogen (NOx). Special designs are available to minimise the latter emissions and they will be incorporated in the design of the development. Operation using gas oil as stand-by fuel will lead to similar emission characteristics but with the addition of some sulphur dioxide (SO_2) and higher levels of NOx.

An air dispersion study of the emissions from the proposed development was carried out, taking into account the emissions at the existing power station. This indicated that effects of emissions on air quality in the area will be insignificant and that air quality will comply with all present and future regulations.

The plant will not give rise to significant transboundary environmental impact. It will assist in the achievement of national obligations regarding limiting transboundary air pollution and sectoral targets that will be established in this regard in the future.

The proposal will utilise high efficiency state-of-the-art technology and participate in the forthcoming EU emissions trading scheme. Emissions arising from the proposed plant will not be significant in the context of global climate.

Noise

Noise levels from various construction activities were calculated at various distances from the site. At locations that are 500 m or more in distance from the site boundary noise levels will remain below the existing ambient daytime noise levels.

It is not envisaged that foundations for the main buildings and structures will require piling, although this may be necessary for the new cooling water pumphouse and the cooling water outfall access/maintenance platform. This piling will lead to some noise for a short period only, but any possibility of local disturbance will be limited by restricting piling work to daytime hours

Power stations are inherently noisy places internally due to the use of equipment rotating at high speeds. The gas turbine will be the major source of noise but it will be supplied with its own individual noise enclosure and noise will not have significant tonal or impulsive character. The enclosure will in turn be housed within a building. Silencers will be used on the air intake to suppress associated noise and the measures taken to control noise will ensure that there is no disturbance at the nearest residence.

Proprietary noise calculation software was used to assess the impact of the development. The predicted noise levels at noise sensitive locations are within the noise limits applicable to the existing station.

Landscape

The proposed plant will be located within the boundary of the existing power station at Aghada and will be physically much more compact than the existing station. The main plant buildings will be of lower height than existing structures at the site and the tallest component is unlikely to exceed **39 m** in height.

The development will inevitably lead to alteration in the visual appearance of the site. Views will nonetheless be of equivalent character to those prevailing at present and the overall character of the site will not be altered. The site is openly visible from the north and west and the development will have a degree of impact on the landscape setting of the eastern shore of Cork Harbour, with the loss of a large open space, albeit an area of reclaimed land.

With the exception of the stacks, the station will not obviously intrude on the skyline. The impact on landscape character is moderated by it taking up only a small part of the wider landscape from many viewpoints and the site's proximity to existing large-scale industrial developments.

Material Assets

The site is already serviced by the public road network, telecommunications, drainage, gas pipelines, electricity and water supply. No new public infrastructure requirements, other than those already provided for or planned, will be necessary, either for construction or operation.

An increase in traffic will occur during the construction phase but the effects thereafter will be minimal. Additional traffic volumes will be well within the capacity of the existing road network.

The proposed development will not result in significant adverse impacts on tourism.

The proposal will contribute to ensuring that adequate electricity supplies are available to support economic activity and growth in a manner fully compatible with Government energy and environmental policies.

The platform at the point of cooling water discharge will form a new permanent structure in the eastern part of Cork Harbour. It will be outside the main navigation channel in an area that is less utilised than elsewhere in the harbour. The platform will benefit navigation by providing a new marker and navigation aid.

There are no implications for air navigation and there will be no impact on the safety of air traffic.

Cultural Heritage

On the basis of a paper survey, one recorded potential archaeological site was identified to the immediate west of a former pond on Long Point. However, the location is in an area where land reclamation works occurred during the 1970s and nothing of archaeological or historical interest was noted during visual investigation. Precautionary archaeological examination will be undertaken during construction.

The development will have no impact on architectural heritage.

It is not anticipated that material of marine archaeological significance will be uncovered during construction and there will be no impact associated with operation of the plant.

General Issues & Interaction of Impacts

Interaction of impacts has been considered and they are not considered as significant.

MITIGATION MEASURES

All necessary measures will be put in place to minimise the impact of the proposed development on the environment.

In particular, these comprise the following principal measures:

- Specification of low-NOx burners in the design of the gas turbines will have the effect of reducing these emissions.
- Minimising the temperature increase in cooling water discharges.
- Incorporating noise control measures in the housing of items of plant considered to be sources of noise.
- Incorporating active and passive hazard protection measures in the design of the plant.
- Minimising visual impact by making building heights as low as possible and providing attractive finishes to building exteriors.

CONCLUSION

The equipment used will be of the most advanced technological design available. The most significant environmental impacts from the project have been examined and the best available control technologies have been applied in an integrated approach.

With the application of various mitigation measures, there are no impacts that are considered unacceptable within the context of the planning policy framework for assessing such developments.

1. INTRODUCTION

1. 1 SCOPE

This Environmental Impact Statement (EIS) has been prepared to accompany an application by the Electricity Supply Board (ESB) to develop a natural gas fired combined cycle gas turbine (CCGT) power station of approximately 400 MW capacity within the existing ESB Aghada generating station site near Whitegate, Co. Cork.

1. 2 APPLICABLE LEGISLATION & REGULATIONS

The EIS has been prepared in accordance with the provisions of the European Communities (Environmental Impact Assessment) Regulations, 1989 to 1999. These gave effect to Council Directive 85/337/EEC and Council Directive 97/11/EC amending Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment.

The provisions of the above Regulations stipulate those projects that must be subject to an Environmental Impact Assessment (EIA). The proposed project falls within the scope of Article 24, First Schedule, Part I, Clause 2, being a thermal power station with a heat output of more than 300 MW.

The project will require an Integrated Pollution Control licence from the Environmental Protection Agency and a Foreshore Licence from the Department of Communications, Marine and Natural Resources.

1. 3 FORMAT OF EIS AND METHODOLOGY

The EIS is presented in the grouped-format structure with each category (Human Beings, Noise, etc.) being considered under the separate headings: Description of Receiving Environment; Impact of the Development; Mitigation (where appropriate); and Conclusions (where appropriate). It reflects the Advice Note on Current Practice (in the preparation of Environmental Impact Statements) and the Draft Guidelines on the Information to be Contained in Environmental Impact Statements issued by the Environmental Protection Agency (EPA). The order of presentation has been adjusted to aid comprehension.

Plant size will be in the range 380-450 MW. The range of plant size arises from the nature of gas turbines. Sizes are particular to the design of individual manufacturers and it is not possible in an open international competition to specify the exact output without prejudice or favour to one manufacturer. The particular model of gas turbine selected for the proposed plant will determine the size of the various components and their configuration and layout. The choice of equipment will be determined by tender evaluation using technical and economic criteria.

Throughout this EIS, consideration of significant environmental impacts of the proposed development is based on the largest size of plant foreseen.

A Glossary of Terms used inn the EIS is presented in Appendix A and a Bibliography is presented in Appendix B.

1. 4 PREPARATION & CONSULTATION

This EIS was prepared by ESB International Limited, Stephen Court, 18-21 St. Stephen's Green, Dublin 2, Ireland.

The following persons/companies contributed to the preparation of the EIS:

- Air: Envirocon Limited
- Underwater Archaeology: ADCO
- Cultural Heritage: Byrne, Mullins Associates
- Mathematical Modelling: Hydro Environmental Ltd.
- Noise: AWN Consulting
- Birds and Terrestrial Ecology: Ms. E. Mayes
- Landscape: Ferguson McIlveen
- Marine Ecology: Aquatic Services Unit (ASU)
- Fisheries: Aztec Management Consultants
- Marine surveys: Irish Hydrodata
- Traffic: Count-on-Us

No difficulties such as technical deficiencies, lack of information or knowledge were encountered in compiling any specified information for the EIS.

Consultations took place with the Environmental Protection Agency (EPA), Cork County Council and the Department of Communications, Marine and Natural Resources during the preparation of the EIS. It was discussed with Port of Cork and the cooling water discharge was the subject of a presentation to the Marine Licence Vetting Committee of the Department of the Marine.

The scope of the EIS was the subject of a written report (Report No. P04M024A-R1) submitted to the Environmental Protection Agency in March 2004 and to those listed in Appendix C.

An Information Open-Day was held in Midleton on 19th April 2004 to provide information and answer queries related to the project.

1. 5 AVAILABILITY

Copies of this document may be viewed by contacting ESB International at the following location during office hours:

ESB International Limited,

Stephen Court,

18-21 St. Stephen's Green,

Dublin 2.

Telephone: (01)-7038000

Fax: (01)-6616600

Alternatively, this document may be viewed and/or purchased at the Planning Office of Cork County Council, Model Business Park, Model Farm Road, Cork.

2. DESCRIPTION OF PROJECT

2. 1 THE DEVELOPER

ESB is a vertically integrated electricity utility engaged in the generation, transmission distribution and supply of electricity in Ireland and abroad. It has wide experience in the design, engineering, construction and operation of large scale generating capacity. It currently operates more than 4,400 MW of plant in Ireland.

2. 2 DESCRIPTION OF THE SITE

2.2.1 Location

The location of the proposed plant is within the existing ESB Aghada Generating Station site, situated near the village of Whitegate on the eastern shorelines of lower Cork Harbour. The low lying western portion of the site is reclaimed ground. The Midleton -Whitegate public road (R 630) bisects the site, separating the Long Point area from its hinterland. The two areas are joined by a private bridge over the public roadway.

The site is located on the northern boundary of Whitegate Bay opposite Corkbeg Island, which is located on the south side of Whitegate Bay. Corkbeg Island, which is the site of the Conoco Philips, Whitegate Refining Ltd. tank farm for oil storage has a long jetty at which oil tankers load and unload. Whitegate Oil Refinery is situated on the ridge of high ground to the south, which overlooks the bay.

The Ordnance Survey (OS) Discovery Series (1:50,000) map on which the site appears is Sheet No 81.

2.2.2 Association with Power Generation

The existing Aghada generating station has been in operation since 1981. The station was first commissioned in 1981 and has four permanent generating units, giving a nominal electricity generating capacity of 525 MWe. Unit 1 is a 270 MWe conventional steam generation unit, while CT11, CT12 and CT14 are three open cycle gas turbines, each with a nominal generating capacity of 85 MWe. In addition, peaking generation capacity (comprising two 26 MWe capacity open cycle gas turbines which are coupled to the one generator) is currently provided on site.

2.2.3 Site Description

The proposed development site is wholly within the perimeter of the existing Aghada Generating Station and is accessed from the Midleton -Whitegate public road (R 630).

The existing 270 MW unit is located to the east of the low-lying western portion of the site. The three gas turbines and the two emergency generating units are located on the upper eastern portion of the site. Unit 1 is fired on natural gas supplied from the national gas network. The three gas turbines (CTs) are dual fired (natural gas and distillate oil). The peaking generation capacity is fired on distillate only.

There is a gas connection to the site through the Bórd Gáis above ground installation (AGI) located east of the upper portion of the site, from which there is a direct connection to the CTs and a connection via an isolating station at the lower part of the site for Unit 1. Existing oil storage facilities are located in the upper portion of the site.

There is a cooling water intake and pumphouse at the shoreline to the northwest of the site. The existing generating plant discharges cooling water to Whitegate Bay. There are two lagoons on site which were formed by embankments constructed to direct the tidal flow in the area during the first development at the site. The drainage system of the lagoons and adjoining areas of the site is controlled by culverts leading to and from the lagoons.

The site is connected at present to the national transmission system by Aghada – Whitegate 110 kV and Aghada - Knockraha 220 kV power lines. These connections will be supplemented by the new Aghada-Raffeen 220 kV line. There is also a connection to the distribution network by a 38 kV power line.

Land use in the immediate area of the Aghada site is industrial and residential, with agricultural land to the east and the open water and intertidal habitats of Cork Harbour to the west.

The proposed development is located entirely within the lower, reclaimed part of the Aghada site. The planned location for the CCGT plant is to the west of the existing 270 MW boiler and turbine building.

2.2.4 Other Developments

EirGrid, the transmission network transmission system operator has obtained planning permission for the construction of a 220 kV transmission line from Aghada to the 220 kV transmission station at Raffeen. Construction of this line has not commenced yet.

The Port of Cork Strategic Development Plan set out the framework for the development of the port to 2020 which identified possible sites for development within the Harbour. Four of these sites are in the lower Harbour in the Greater Ringaskiddy Area.

2. 3 PLANT DESIGN AND LAYOUT

2.3.1 CCGT Design

Plant Layout

The proposed development will comprise a combined cycle gas turbine power plant of approximately 420 MW capacity located at the existing ESB Aghada site at Whitegate, Co. Cork, as shown in Figure 2.1. Natural gas will be the main fuel for the plant. There will be associated connections to the electricity and gas Grids. There will be a discharge of cooling water to Cork harbour (from which it has been abstracted)

The area of the total ESB site at Aghada is 62.75 ha approximately and it is expected that the plan area occupied by the station buildings will be 9,500 m^2 .

Two configurations for the plant are possible. The “single shaft” arrangement consists of gas turbine, steam turbine and generator arranged on a single shaft or power train. The alternative “multi-shaft” option would have a gas turbine and steam turbine each with its own dedicated generator. The final choice between single shaft and multi-shaft designs will be made on technical and economic grounds, following a competitive tender process.

The general layout of the possible plant configurations on the site is shown in Figures 2.2 and 2.3.

Plant Design

The plant will be fired on natural gas from the existing BGE network with a back-up facility for firing gasoil.

The plant will be fired on natural gas from the existing Bórd Gáis network with a back-up facility for firing gasoil (distillate).

The combined cycle gas turbine power plant will utilise the following process:

- A gas turbine burning either gas or liquid fuels will drive a generator for electricity production.
- Exhaust gases from the gas turbine will pass through a heat recovery steam generator (HRSG) to generate steam.
- The steam generated in the HRSG will drive a steam turbine which in turn will drive the generator to produce further electrical energy.
- The proposed plant will employ the most recently developed CCGT technology. A schematic of the process is shown in Figure 2.4.

Plant Components

The principal components will include the fo9llowing:

- Gas turbine
- HRSG with HRSG exhaust stack
- Steam turbine and condenser
- Gasoil storage facilities comprising bulk tanks
- Water treatment plant and water storage facilities comprising bulk storage tanks
- Cooling water (CW) system comprising pumphouse, chlorination plant, culverts and outfall
- Above ground Gas Installation/piping to supply the new plant.
- Transformers
- High voltage electrical switchgear
- Fire protection system
- Administration/control building

Depending on the choice of equipment, the following may also be provided:

- Gas compressor
- A by-pass stack for the gas turbine to allow it to operate in isolation from the steam turbine
- Auxiliary boiler and stack for plant start-up purposes

Power Generation Process

The gas turbine itself consists of an air compressor, a combustion chamber, a turbine and an electricity generator coupled together. The air compressor, combustion turbine and electricity generator are all attached to one main shaft which rotates at high speed.

The air compressor takes in large quantities of air from the atmosphere and compresses it into the combustion chamber from where it flows through the turbine. Fuel is then injected into the combustion chamber and ignited. This addition of heat energy and combustion gases raises the temperature of the combined gases to over 1,300 °C and greatly increases the velocity of these gases through the turbine. The effect of this high velocity gas flow through the turbine drives both the air compressor to supply air and the electricity generator to produce the rated electrical power output. The expansion of the hot gases through the turbine, and the extraction of mechanical work from them via the turbine, reduces the temperature of the gases to approximately 600 °C.

Operation of a gas turbine as described above is referred to as open or simple cycle mode. However, it is possible to generate approximately 50% more electricity from the hot exhaust gases by diverting them through an HRSG (boiler) which extracts heat to make steam, which in turn drives a steam turbine. The temperature of the hot gases is reduced in this process to approximately 100 °C, but the heat recovery system does not, in other respects, alter the composition of the gases. They are discharged to the atmosphere via a stack on top of the HRSG.

Water for the HRSG is initially drawn from the public mains, is treated in the water treatment plant to achieve high purity and is then stored prior to use. The steam produced is supplied through inter-connecting pipework to the steam turbine and is then exhausted to the condenser. The steam turbine drives the electricity generator to produce the additional power output.

The electricity generated is fed to transformers where the voltage is stepped up for transmission via a local substation to the National Grid.

Cooling water is used to condense the steam used in the steam turbine element of the combined cycle. The steam is condensed to hot water, which is then recirculated to the HRSG. The cooling water will be abstracted from Cork Harbour and following its use it will be returned to the harbour in a slightly warmer condition.

The description above is of a single-shaft arrangement, although it is applicable to the multi-shaft process also. A multi-shaft arrangement, where the gas turbine and steam turbine would operate on separate shafts, each with its own generator, is also possible.

Plant Efficiency

The plant will have an efficiency of circa. 57% and this means that 57% of the chemical energy contained within the fuel is converted into electrical energy. The plant will employ technology recognised as being the most advanced for power production on the scale proposed. The high overall efficiency will lead to lower specific emissions to the environment generally compared to any other form of conventional thermal plant.

2.3.2 Plant Operations

Brief descriptions of the principal individual unit operations follow.

- **Gas Compressor (if provided)**

Depending on the plant selected and gas supply pressure, it may be necessary to compress the gas for supply to the gas turbine.

- **Gas Turbine (GT)**

The GT will essentially comprise a multi-stage axial-flow compressor section with movable inlet guide vanes, a combustion chamber with several burners, and a multi-stage axial-flow turbine section. Natural gas will be burned using air from the air compressor. The hot gas will pass through the turbine blades. Mechanical energy will be converted into electrical energy in the electrical generator coupled to the gas turbine. The exhaust gases will pass to the HRSG.

- **HRSG**

Exhaust gases from the gas turbine will be used to produce steam, which will feed a steam turbine. The cooled exhaust gases will then be emitted to atmosphere. The HRSG will be multi-pressure and will be unfired.

- **Steam Turbine and Condenser**

The steam turbine will be of a multiple cylinder type suitable for direct coupling to a two-pole generator for power generation at 50Hz. The thermal energy of the steam generated by the HRSG will be converted to mechanical energy in order to drive a generator to produce electric power. The exhaust steam will flow radially out of the steam turbine to a condenser system cooled by estuarine water.

- **Condenser Cooling**

As is the case for the existing station, direct once through cooling is envisaged for the proposed development. Cooling water will be provided by abstraction of water from Cork Harbour. A new cooling water pumphouse is to be provided for the new development, adjacent to the existing cooling water intake. The maximum 98-percentile flow rate through the plant will be 7.5 m^3/s with a corresponding 98-percentile temperature rise across the condenser of 11.5 °C.

The flow from the pumphouse will be piped to the condenser, from the condenser through a new discharge culvert over a seal weir to a buried offshore pipe to a discharge location approximately 440 m off-shore to the north-west of the site.

- **Cooling Water Treatment**

Cooling water will be screened mechanically at the point of abstraction. Chemical treatment of the cooling water by chlorination will be needed to prevent build-up of deposits of marine organisms on the condenser tubes and in the culverts. This is essential to maintaining optimum cycle efficiency. Chlorination will be achieved by electrochlorination of sea water or by intermittent dosage of a sodium hypochlorite (NaOCl) / sodium bromide (NaOBr) solution.

- **Boiler Water Treatment**

The steam-water cycle will be a closed-loop system with make-up supplied from the domestic water supply via an on-site water treatment plant where water for use in the HRSG will be treated to achieve a high purity. The water treatment process will consist of organic scavengers, and cation, anion and mixed bed ion-exchange. Regeneration of the ion-exchange resins will utilise sulphuric acid (H_2SO4) and caustic soda (NaOH).

The HRSG feedwater must be deaerated (removal of oxygen) and pH controlled to prevent corrosion. It will be dosed with ammonia (NH_3), caustic (NaOH) or Phosphate (Na_3PO_4). In addition an oxygen scavenging chemical, dilute hydrazine (N_2H_4), may be required during commissioning to achieve the required water quality.

- **Electrical Transformer**

The electricity generated will be fed to a generator transformer where the voltage will be stepped up. It will be an outdoor, three phase unit and of the oil immersed design. It will be bunded and blast protected with a deluge system for fire protection. Power will flow from this transformer to the electrical compound and thence to the national grid.

2.3.3 Plant Enclosures

The development will comprise the main structures as listed below. Exact dimensions of each element will become known only after contractor selection. Dimensions given below are regarded as maxima and height dimensions in particular may be reduced depending on the equipment of the successful tenderer. The main difference between the multi shaft and the single shaft option is that the gas turbine and steam turbines would be housed in separate buildings in the multi shaft option rather than in one building (single shaft). Dimensions for both options are given.

- Control and Administration Building: This will be approximately 30 m long x 20 m wide x 15 m high.
- Gas and Steam Turbine Enclosures

Single Shaft

- Enclosure to house the gas and steam turbines: This will be approximately 60 m long x 40 m wide x 30 m high.
- Electrical Building to house switchgear enclosure: This will be approximately 14 m long x 25 m wide x 12 m high.
- One main transformer bay of approximately 32 m long x 13 m wide x 12 m high.

Multi Shaft

- Enclosure to house the gas turbine: This will be approximately 35 m long x 40 m wide x 30 m high.
- Enclosure to house the steam turbine: This will be approximately 50 m long x 32 m wide x 30 m high.
- HRSG: Depending on the configuration of the plant selected, this will be approximately 35 m long x 35 m wide x 45 m high.
- Enclosure to house water treatment plant: This will be approximately 45 m long x 20 m wide x 12 m high with chemical storage tank area.
- Stacks: An exhaust stack will be about 6.5 m diameter with a discharge approximately 70 m above ground. Depending on the configuration of the plant selected, an additional by-pass stack of lower height (50 m approximately) and 6.5 m diameter may also be provided.
- Electrochlorination plant: This will be approximately 25 m long x 15 m wide x 9 m high with chemical storage tank area.
- Fenced enclosure to house gas compressors (if provided): This will be approximately 45 m long x 25 m wide x 2.4 m high. Gas compressor container type enclosures will be 10 m long x 3 m wide x 4 m high and a control room of 5 m long x 5 m wide x 4 m high will be within the compound.
- Building to house workshops and stores: This will be approximately 40 m long x 20 m wide x 10 m high.

- Electrical building to house switchgear enclosure: This will be approximately 230 m long x 20 m wide x 12 m high.
- Main transformer bays: These two bays will be located outdoors and approximate dimensions are 20 m long x 20 m wide with separating bays of 12 m high each.
- Auxiliary boiler (if provided): This will be approximately 20 m long x 12 m wide x 12 m high with a 48 m high stack, 1.5 m diameter.
- Oil storage tanks: Two oil storage tanks of 20 m diameter and up to 20 m in height will be provided. These will located in a bunded area.
- Three water storage tanks will be provided up to a height of 15 m. One raw water storage tank and one treated water storage tank, each of 20 m diameter and one semi-treated water tank of 14 m diameter.
- BGE compound: This will be approximately 65 m long x 65 m wide.
- 220 kV Switchyard: An additional Bay will be provided.

Some of these buildings may be combined or be subdivided depending on the final choice of plant and

The structural form of buildings will be conventional structural steel supported on reinforced concrete foundations. Steel columns will be fire protected as necessary to comply with the Building Regulations. Floors will be concrete.

Profiled metal cladding will be used for external walls and the colour of finishes for main buildings proposed is a light grey (RAL No. 9002). Colours of buildings will be agreed with the Planning Authority prior to construction.

Roofs will be constructed of profiled metal decking on purlins spanning between rafters and will be flat or shallow pitched. Buildings will be single storey with access gantries and walkways for access to plant and equipment. These will be constructed of stainless/galvanised steel open grating type flooring supported on steel beams and columns.

External personnel and escape doors will generally comprise metal flush doors and mild steel frames. Fire doors will comply with BS 476 Part 22, 1987.

Stacks will be fabricated from painted insulated carbon steel.

2.3.4 Cooling Water System

The cooling water system will involve the construction of:

- A 2.0 m internal diameter, 440 m long cooling water outfall pipe with a reinforced concrete diffuser structure constructed at the point of outfall, approximate co-ordinates, E183270 N65320. An elevated piled platform will be constructed at the point of discharge into Cork Harbour. This will contain a light beacon and the structure will be approximately 10 m x10 m in plan with a deck level of 7.0 mOD (Poolbeg Datum).
- A cooling water intake pumphouse constructed to the north-east of the existing cooling water pumphouse. Plan dimensions of deck 57 m x28 m. Pumphouse building 10 m high.

2. 4 PROJECT COMMISSIONING AND OPERATION

2.4.1 Commissioning

Description of Commissioning Activities

Plant commissioning will follow completion of the plant construction phase and will involve setting up and testing the equipment to ensure that it is fully functional and that all technical, environmental and safety requirements have been met.

Environmental Factors

Emissions particular to the commissioning phase will include the following:

- **Noise:** On a small number of occasions during commissioning there will be additional noise for short periods. Experience of equivalent activities on similar projects indicates that no disturbance results.
- **Waste:** Water-side cleaning of the HRSG tubes is carried out during commissioning to remove deposits of metals and other impurities on the tubes' surfaces. This work will be undertaken by specialist contractors and will involve the use of acids, alkalis and proprietary chemicals.

  The process effluents will be taken off-site by the contractor for safe treatment/disposal at environmentally licensed facilities.

2.4.2 Operation

Running Regime

It is expected that the plant will operate at base load i.e. continuous operation, 24 hours per day, 365 days per year and will be staffed on a shift basis for plant operation. An average annual load factor of circa. 90-95% is initially expected for the plant with the non-operational balance of hours being downtime for maintenance.

Normal operation of the plant will be as a combined cycle power station fuelled with natural gas. It is envisaged that the plant will operate in open cycle mode in exceptional circumstances, but only if a by-pass stack is provided.

Occasional Processes & Activities

- **Operation on Gasoil:** Gasoil will be available for stand-by purposes.

  The necessity for an alternative fuel supply arises in part from the nature of gas supply which usually has some unavailability due to, for instance, maintenance work on the production platform. Faults may also arise in the supply system.
- **Peaking Capacity:** The CCGT will have a peaking capacity of approximately 3% above its nominal output for use in exceptional circumstances. Because operation in this mode accelerates degradation of plant components, it is avoided wherever possible. Emissions would increase slightly in this mode of operation.

Materials Used

The principal materials used will be as follows:

- **Natural Gas:** Natural gas will be delivered to the station via a new below ground high pressure gas pipeline from the existing BGE network.

- **Gasoil:** Gasoil for use as stand-by fuel, will be stored in bulk storage tanks. It will be delivered by road.
- **Water:** Water for use in the HRSG will be stored in bulk storage tanks filled by the supply from the public mains. This storage will also serve as the supply for fire-fighting purposes.
- **Bulk Chemicals:** Regeneration of the resins used in water treatment will utilise sulphuric acid (H_2SO_4) and caustic soda (NaOH). A small amount of hydrochloric acid (HCl) will also be used to clean electrochlorination plant cells.

  To maintain optimum boiler and steam conditions the HRSG will be dosed with small quantities of caustic (NaOH), phosphate (Na_3PO_4) and ammonia (NH_3).

  Chlorination of cooling water to prevent build-up of deposits on the condenser tubes and in the culverts will be achieved either by continuous electrochlorination of sea water or by intermittent dosage of a sodium hypochlorite (NaOCl) / sodium bromide (NaOBr) solution.

Environmental Factors

This section details the emissions that arise from the power production process. For details on the existing environment, the environmental impact of the emissions and the mitigation factors, refer to the relevant Part of the EIS (Water, Air, etc.).

- **Thermal Emissions**

  In combined cycle mode on natural gas, the flue gas discharge to the air via the HRSG stack will have a heat content of approximately 65 MWth at about 100 °C. Thermal emissions to the air via the by-pass stack (if provided) from the GT in open cycle mode would be over 400 MWth. The average heat rejection to the harbour via the cooling water discharge will be approximately 185 MWth.

- **Main Air Emissions**

  The plant fired on natural gas will utilise advanced CCGT technology and will meet the National and EU emission limit values for new, high efficiency CCGT plant.

  Natural gas fuel is a mixture of gases, with methane (CH_4) predominating. The main products of combustion released to atmosphere will be carbon dioxide (CO_2), water vapour (H_2O) and small quantities of oxides of nitrogen (NOx), which is formed due to the high temperature oxidation of atmospheric nitrogen. In addition, use of gasoil will give rise to sulphur dioxide emissions arising from its sulphur content (0.2% sulphur, falling to 0.1%S in 2008). The following are the maximum annual tonnage of CO_2 and NOx (expressed as NO_2) that will arise from continuous full load operation on natural gas. A small annual tonnage of SO_2 will be emitted in the event that gasoil use is required.

  Table 2.1 – Maximum Annual Tonnages of NO_X, CO_2 and SO_2

Oxides of Nitrogen (NOx)**	Carbon Dioxide (CO_2)	Sulphur Dioxide (SO_2)
1,530 t	1,330,000t	61*

  * Based on 18 days

  ** NOx and CO_2 data based on 95% load factor on gas plus 5% on gasoil.

- **Minor/Fugitive Air Emissions**

  Minor air emissions from the proposed development will include the following:

Auxiliary Boiler (if provided): An auxiliary boiler may be used for station start-up and will be equipped with low-NOx burners to achieve 350 mg/Nm^3 when fired with natural gas. It will also be equipped to use gasoil.

Gas Turbine Lube Oil Vents: An oil mist will be released by the lubricating oil vent on the gas turbine. A demister will be installed.

HRSG: Steam will be discharged to atmosphere at various stages through safety valves under certain process fault conditions and through HRSG vents and drains during HRSG start-up. The emissions will be of short duration and will have no significant impact.

Natural Gas: Purging of gas pipelines and the gas compressor (if provided), will lead to venting of natural gas to the atmosphere. The emissions will be of short duration and will have no significant impact.

Storage Tanks: Storage tanks used for bulk storage of gasoil and chemicals will be vented to the atmosphere. The volumes of resulting gaseous emissions will be very low and will have no significant impact.

Hydrogen: Electrochlorination of estuarine water in the chlorination plant adjacent to the cooling water pumphouse will lead to continuous discharge of a small amount of hydrogen.

Ventilation: Various parts of the plant will be provided with positive ventilation. The volumes of resulting emissions will be very low and will have no significant impact.

- **Odours**

  None of the air emissions from the proposed plant will give rise to odours external to the site.

- **Cooling Water Discharge**

  It is estimated that at full load the maximum 98-percentile flow rate will be 7.5 m^3/s with a corresponding 98-percentile temperature rise of not more than 11.5 °C across the condenser. Chlorine dosing of the cooling water will result in a residual chlorine concentration of 0.3 ppm at the exit from the cooling water discharge point.

- **Low Volume Aqueous Discharges**

  In addition to the cooling water discharge, there will be a number of low volume aqueous discharges associated with operation of the power station that will discharge to the aquatic environment. Discharges that will arise frequently comprise surface water drainage, band screen washing, treated water treatment plant effluents and treated sewage effluent. Less frequent discharges will include HRSG blowdowns (ultra pure water). Other infrequent discharges may arise from time to time associated with e.g. compressor cleaning. All discharges to water will be subject to licensing by EPA.

Surface Water Drainage

Drainage arising from paved surfaces within the station site, such as the turbine floor and maintenance areas, and from controlled discharges from bunds to bulk storage tanks, will be discharged to the cooling water system following passage through an appropriate oil interceptor.

Screen Washing

Screening of incoming cooling water will consist of a fixed coarse screen and then a mechanically operated screen which removes fine particles. This mechanical screen will be continuously backwashed with water extracted from the cooling water system.

Water Treatment Plant Effluent

The incoming domestic water supply from Cork County Council will be treated to achieve a high level of purity and then stored prior to its use in the HRSG. Regeneration of the ion-exchange resins will be by sulphuric acid (H_2SO_4) and caustic soda (NaOH). Effluent will be neutralised prior to discharge which is expected to last up to one hour daily with a flow rate of up to 7 kg/s.

Sewage Effluent

Sewage effluent has been estimated as having a hydraulic load of 1,800 l/day and a BOD load of 0.75 kg/day. The effluent will be directed to a proprietary water treatment plant for treatment before discharge.

HRSG Blowdown

The water in the HRSG will be blown down intermittently to remove accumulation of impurities. This blowdown water will be discharged to a tank to reduce pressure prior to entering station drains and then the cooling water discharge. The average volume of the discharge will be approximately 60 m^3/day. This heated water will be of high purity and may contain hydrazine, sodium phosphate, caustic soda and ammonia in very low concentrations.

Plant Cleaning

Water washing of the gas side of the HRSG tubes may be carried out to remove deposits, which mostly comprise carbonaceous material, that build up and reduce plant efficiency. Minimal deposits would be expected with natural gas being used as the principal fuel and washing may arise only on a couple of occasions over the life of the plant. Wash-water will be discharged following treatment to isolate and remove suspended particles and will be subject to EPA licensing.

HRSG Storage Solutions

Two methods may be used to protect an HRSG when it is out of use for an extended period and these are referred to as dry storage and wet storage. Dry storage, which is the preferred method, will comprise circulation of dry air or the use of the inert gas nitrogen (N_2). There are no resulting discharges. Wet storage may use a solution of hydrazine (N_2H_4) and ammonia (NH_3). The resulting discharges, should they arise, will be either sent for disposal by a licensed waste contractor or else suitably treated to meet IPC licence requirements prior to release.

- **Noise and Vibration**

The main potential sources of noise from the plant, mitigation of which will be an integral feature of the plant design, will be as follows:

Gas Turbines: High noise levels originate in the air inlet and flue gas exhaust. Strong pure tonal components are associated with the inlet while the exhaust results in high levels of low frequency noise. Specially designed silencers are provided to control such noise emissions to acceptable levels.

HRSG: Venting of steam will occur, during HRSG start up and blowdowns. This is routinely controlled by suitable silencers. Boiler safety valves are tested on an annual basis for insurance certification. Outside of such testing, operation of safety valves will occur for very short periods under fault conditions. They will be fitted with silencers but will be audible outside the plant. Owing to their safety function it is not possible to totally abate noise from such high temperature/high volume sources.

Steam Turbine: The steam turbine, together with a range of auxiliary plant, much of which contains rotating or reciprocating machines, is a source of noise. This is attenuated by acoustic lagging and enclosure and by the acoustic design of the turbine house.

Gas Release: When it is required to purge the gas pipelines and gas compressor (if provided), gas will be vented to the atmosphere. This will last for a short period and may result in slightly increased noise levels. It may occur up to ten times annually.

Transformers: Fans on generator and other large transformers are provided for cooling purposes. The transformers themselves may emit noise at multiples of the power line frequency (50 Hz) but are treated to minimise noise emission and will be inaudible at the site boundary.

The plant will not give rise to significant vibrations.

- **Traffic**

  Road traffic associated with plant operations will consist of the movement of a relatively small number of station personnel to and from the site together with maintenance and servicing activities. Routine delivery of consumables will not lead to significant additional traffic.

- **Waste Management**

  Waste generated in the operational phase will include the following:

  Air Filters: Filters on air intakes will require changing periodically.

  Auxiliary Cooling Water: Drainage solution containing an anti-freeze and possible corrosion inhibitors.

  HRSG Washing: Insoluble and precipitated materials from treatment of HRSG wash water.

  Canteen Waste: Waste from food preparation, including packaging.

  Gas Turbine Washing: Intermittent liquid effluent arising from off-line washing with detergent of the air compressor.

  General Cleaning: Rags, etc. arising in maintenance and cleaning operations.

  Lamps/Batteries: Lighting units replaced as required.

  Metal Waste: Waste comprising scrap metal.

  Oil Interceptors: Oily sludge from cleaning of oil interceptors.

  Pumphouse Screens: General debris removed from the incoming cooling water at the pumphouse.

  Waste Oils: Waste oils arising from maintenance activities.

  Water Treatment: Spent ion exchange resins.

  Packaging Waste: Timber, cardboard, plastic etc.

  All wastes will be removed off site by recognised contractors for appropriate treatment/disposal at licensed facilities.

  Arrangements are being made in consultation with the Radiological Protection Institute of Ireland to assess potential levels of Naturally Occurring Radioactive Material (NORM) on site. Their recommendations will be followed and relevant legislation complied with.

- **Radon in Ambient Air**

As the proposed site is located in a High Radon Area. Radon barriers will be provided over the footprint of any building occupied by workers.

2.4.3 Hazards

The European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations, SI 476 of 2000 classifies sites according to risk based on the weighted quantities of relevant hazardous substances stored on site.

The existing Aghada Generating station is currently classified as an upper tier "Seveso" site. This is because the quantity of gasoil stored on site exceeds the current threshold set in the Regulations for gasoil of 2,000 t up to 16,300 t of gasoil is stored on site at present.

Following an update next year of this legislation, which will transpose Directive 2003/105/EC ("Seveso III" of 16/12/2003) into Irish law, the upper tier threshold will be increased to 25,000t for gasoil (see table below for existing and future thresholds).

Procedures have been put in place limiting the amount of gasoil stored on site to less than 25,000t at any time. In addition quantities of other hazardous substances relevant to the risk classification such as oxygen, hydrogen and ammonium hydroxide will be controlled and will be significantly below lower tier limits. According, the site will not come into the upper tier risk category as defined in the new Regulations. This will mean in particular that Regulation 16(1) which requires the preparation of an "External Emergency Plan" by the local competent authority will not apply.

The proposed development will not result in a change in the risk classification of the site under the Regulations as the quantities of gasoil and other substances stored on site will be maintained within the required limits.

Table 2.2: Hazardous Substance Thresholds

Hazardous Substance		Gasoil	Hydrazine Anhydrous	Propane	Hydrogen	Ammonia Hydroxide	Oxygen	Acetylene
Current Reg Quantities	LT	500 t	50 t	50 t	5 t	200 t	200 t	5 t
	UT	2,000 t	200 t	200 t	50 t	500 t	500 t	50 t
Future Reg Quantities	LT	2,500 t	0.5 t	10 t	5 t	100 t	100 t	5 t
	UT	25,000 t	2 t	50 t	50 t	200 t	200 t	50 t

2. 5 PROJECT CONSTRUCTION

2.5.1 Construction Works

Duration and Phasing: It is envisaged that construction work will commence in 2005 and that commissioning of the plant will be completed in the winter of 2007. The existing station will continue to operate throughout the construction period.

Employment: Peak number employed during construction will be approximately 500.

Working Hours: Working hours will normally be daylight hours from 8.00-8.00pm.

Temporary Site Facilities: A dedicated site entrance will be provided located approximately 250 m to the north of the existing generating station entrance.

The CCGT site will be fenced off from the existing generating station.

A suitably surfaced contractor's laydown area will be provided. Portacabin-type structures will be used to provide temporary site facilities and temporary Portaloo-type toilets will be installed. A metered potable water supply will be provided from the Cork County Council watermain. Temporary direction notices will be erected for construction traffic. All temporary facilities will be fully removed upon project completion and the respective areas will be reinstated.

Any damage caused as a result of the construction works will be repaired. Large plant items will be delivered to the site either by sea or by road on specialised long transporter vehicles.

The Contractor will provide chemical toilets/sump and provide for regular collection by a licensed company for discharge to the nearest council sewage treatment plant.

Preparatory Works Method Statement: All works will be carried out under the supervision of Consulting Engineers with appropriate experience. Works will be carried out by experienced contractors using appropriate and established safe methods of construction. All requirements arising from statutory obligations including the Safety, Health and Welfare at Work Act and associated regulations will be met in full.

2.5.2 Construction Materials and Haulage

Construction of the CCGT plant will involve the importation of the following materials to the site:

Excavated Material

The construction will involve excavation and removal from the site of approximately 20,000 m^3 of spoil material. Disposal will be off site to a licensed waste disposal facility and will involve approximately 1800 truck loads.

Stone Fill

Crushed stone fill material will be required for internal site road and parking areas. The quantity of fill material required will be approximately 10,000 m^3. Approximately 900 deliveries are assumed.

Concrete, Reinforcement

Concrete required for construction of building foundations and plinths will be sourced from a local concrete batching plant. Over the construction period approximately 5,500 deliveries are anticipated.

Reinforcement for the building foundations will be delivered on flat bed trucks. Approximately 375 deliveries are anticipated.

Other Building Materials

Miscellaneous other building materials will be required for project construction. These will include cladding, blockwork and roofing materials for buildings, shuttering, drainage pipes, electrical cabling, etc. These should involve no more than 2,000 additional deliveries over the project duration.

Plant Items

The total number of loads involved in plant deliveries will be approximately 2,000.

Total Traffic Movements

On the basis of the above, the total number of heavy vehicle deliveries involved in the construction of the CCGT development has been calculated and is as shown in Table 2.2.

Table 2.3: Construction Traffic

Excavated material	Pipework, cladding, blockwork etc.	Stone Fill	Concrete	Steel	Plant	Misc.	Total
1,800	2,000	1,000	5,500	575	2,000	1,250	14,125

The total number of movements of Heavy Goods Vehicles (HGVs) on and off the site will be approximately 28,250.

Environmental Factors

Environmental impacts during project construction will be as follows:

- **Traffic**

  Construction of the project will require delivery of materials, plant and equipment, and construction personnel to the site. However, the volume of additional traffic will be relatively small. The site is located in an industrial area and the additional traffic during construction will be within the capacity of the existing road network and will not cause a disturbance.

  No mitigation is required.

- **Noise**

  Noise during construction could arise from piling of foundations.

  If piling works become necessary for construction of foundations, they will be restricted to daytime hours.

- **Air**

  Some site preparation and construction activities are a potential source of local dust emissions. To prevent dust becoming a nuisance during the construction phase, dust suppression will be used within the site.

- **Waste**

  Construction waste will be generated. All regulations in relation to waste management will be fully met. Arrangements are being made to assess potential levels of Naturally Occurring Radioactive Material (NORM) on site in consultation with the Radiological Protection Institute of Ireland. Its recommendations will be followed and relevant legislation complied with.

- **Dredging**

  Dredging will be required at Aghada for the construction of the new CW intake structures and for the 440 m submerged offshore cooling water outfall pipe trench.

  The selected dredging procedure will ensure minimal disturbance of bed sediment in order to minimise environmental impact and also to ensure there is no interference with the existing power station which will be fully operational during the dredging works (silt in intake cooling water can deposit in the condenser tubes and give rise to serious maintenance problems). Silt curtains will be constructed if required to prevent excessive spread of silt during the dredging operations

- **Disposal of Dredged Spoil**

Once the trench has been excavated to the desired depth, it will be backfilled with any residual coarse material, i.e. sand or gravel, obtained from the excavations but will also require the importation of additional suitable material (sand). The dredged material that is suitable for backfilling the excavated trench will be reused. Offshore disposal of material dredged during construction is proposed for the excavated silt material because it cannot be beneficially re-used. Such offshore disposal will be to the existing designated dredge disposal site outside Cork Harbour, within 15 km of the site, subject to licence. The material has been sampled and tested and is suitable for disposal. Dredged material will be assessed by the RPII to ensure radiological composition of material is similar to the sediments of the chosen disposal site.

2. 6 PLANNING CONTEXT

2.6.1 Planning Permissions

The following Planning Permissions relating to power generation have been issued by Cork County Council for developments at the site.

Table 2.4: Site Planning Permissions

Date	Reference	Subject
April 1976	1665/75	Erection of 270 MW gas fired generating station
August 1979	2438/79	Erection of 2 X 85 MW gas turbines
December 1979	4518/79	Erection of an 85 MW gas turbine
July 2000	S/00/2710	Temporary electricity power generating plant consisting of 3 mobile power units – total nominal rating of 69MW

2.6.2 Planning Framework

Local

The County Cork Development Plan 2003 is the framework document for guiding and controlling future developments in the county. It takes into account strategies outlined in the National Development Plan. The relation between specific objectives of the Development Plan, including protection of visual amenity, ecology and architectural heritage and the potential impacts of the proposed development are addressed in the specific chapters of the EIS relating to the relevant potential impact.

The Development Plan notes as a point of clarification, where particular zoned lands have a scenic landscape designation or adjoin a scenic landscape designation, there is still a presumption in favour of development for the specific land use, but special attention may need to be paid to design, siting and landscaping depending on the individual area and the type of development proposed.

A new development boundary has been proposed for Whitegate-Aghada. It includes Aghada station and all of Whitegate Bay as far as the end of Whitegate Jetty.

In the overall strategy of this plan, Whitegate-Aghada is designated as a strategic industrial area. The strategic aims for Whitegate-Aghada support the consolidation of their industrial and harbour related roles within their sensitive scenic and coastal setting. The strategic aim provides for only a limited expansion of residential uses. The station is shown as an established industrial/enterprise site.

Whitegate-Aghada is also designated in the Cork Area Strategic Plan as a strategic industrial location particularly because of the capacity of the area to accommodate large scale industrial undertakings that require either dedicated port facilities or access to large volumes of sea water. Provision is made for both the expansion of existing undertakings and the development of new industries when opportunities arise.

Planning permission has been granted for the construction of a 220kV transmission line from Aghada to the 220kV transmission station at Raffeen.

National

The Generation Adequacy Report in 2004 identified a need for new large scale generating capacity by 2006-7. The proposed plant is designed to alleviate this shortfall.

The station is consistent with Government Climate Change policy which envisages increased efficiency in electricity generation and the use of Kyoto Protocol flexibility mechanism including emissions trading to ensure compliance with the European Union and Kyoto protocol national greenhouse gas quotas.

2. 7 ALTERNATIVES EXAMINED

The proposed development is a large-scale thermal generating station capable of operating at base load. It will meet the needs for large scale despatchable generating capacity identified in the 2004 Generation Adequacy Report.

Gas fired Combined Cycle capacity was the only technology considered by ESB for the Aghada site to fulfil the duty required. This is due to a range of economic and technical factors relating to the electricity system and generation market. At present new coal or oil fired generating capacity is not competitive relative to gas fired high efficiency Combined Cycle Gas Turbines. In addition, such coal and oil plant are inherently less energy efficient than CCGT plants and give rise to a greater level of emissions to air per unit of electricity produced.

2.7.1 Alternative Sites

As the proposed development on the existing Aghada generating station site will not give rise to any significant local environmental impact and the site has key infrastructure already available, no alternative sites could offer significant advantage in respect of environmental impacts. Accordingly, the use of alternative sites was not studied in detail.

Construction of the proposed plant on an existing ESB site has many economic and technical advantages over the development of a new green field site. ESB considered the possibility of locating the proposed plant at other existing ESB power station sites, in particular at Tarbert or Great Island.

Neither of these alternative sites has natural gas available on site at present. In addition, no environmental benefit would arise from locating the proposed plant at either of these sites (or on a green field site) in comparison to Aghada.

The environmental benefits of locating the proposed plant at Aghada relate to available natural gas supply, proximity to the national grid and availability of sea water for cooling purposes, which greatly improves the thermal efficiency of the proposed plant, a significant consideration in light of climate change concerns relating to CO_2 emissions.

2.7.2 Combined Heat and Power (CHP)

The proposed CCGT unit at Aghada could be designed to supply heat in addition to power. Heat could be extracted as hot gas from the gas turbine exhaust (at a temperature in excess of 600 °C) or from various parts of the steam cycle at temperatures ranging up to 565°C. It can be demonstrated that combined generation of heat and power is more efficient than separate generation. The energy savings resulting from CHP depend on the temperature of heat extraction, with the highest savings being achieved with low heat extraction temperatures.

ESB has carried out studies to identify CHP opportunities at its power stations and has been involved in development of CHP schemes. Examples are as follows:

- Following a number of pre-feasibility studies that gave promising results, in 1982 ESB carried out an in-depth investigation of the feasibility of large district heating schemes in central Dublin and the Mahon peninsula in Cork, to be supplied by its nearby ESB power stations. The study indicated that district heating might be viable in central Dublin provided natural gas was not distributed in the target. District heating was not viable in suburban Dublin or Cork because of the relatively low housing density and the resulting low heat demand. ESB sought Government approval to proceed with a district heating scheme for central Dublin. The Government had made a decision to bring natural gas to Dublin and the success of this project depended on capturing the same heat market as was targeted for the district heating scheme. Approval of the district heating scheme for Dublin was not forthcoming. It should be noted that energy prices in 1982 were more than twice as high in real terms as at present. Updating of the district heating study in the light of reduced energy prices over the past 20 years indicated that the scheme would have had large losses and would not have repaid its investment.
- ESB has developed a gas turbine-based CHP plant at Ballyragget and gas engine based CHP plants at a number of factories and educational institutions. These plants have heat demands ranging from 1 MW to 30 MW thermal. Modern gas turbine and gas engine technology allows CHP schemes to be developed close to the heat load and matched to it. If natural gas is available, it is generally more economical to develop CHP close to viable heat load rather than to transport heat from a central power plant to the load.

ESB studies, corroborated by studies in other countries, indicate that heat demand must be high and cost saving potential must be large to economically justify modification of large power plants for CHP.

Whitegate oil refinery is relatively close to Aghada and would have a significant heat load. However, the oil refinery already has a gas turbine-based CHP scheme that uses refinery waste gas to provide its heat demand. There is no significant additional heat demand from the refinery that would be viable to supply from Aghada.

Apart for Whitegate, ESB has not identified any other large heat load in the vicinity of Aghada that could provide the basis for CHP using the proposed new CCGT. There is also no local urban development in which district heating could be installed to provide a heat demand. Heat can be extracted from the generation process at high temperatures and, if a use can be found for the extracted heat, this increases the overall efficiency of the process. This joint production of heat and power is called Combined Heat and Power (CHP) and has been the subject of multiple studies in the context of Dublin power stations.

Despite the potential advantages of generating electricity and useful heat simultaneously, the lack of availability of a suitable heat load precludes consideration of CHP as a viable option at this time.

2.7.3 Alternative Cooling Systems

There are three heat dissipation systems commonly used for condensing steam from the steam turbine. These are:

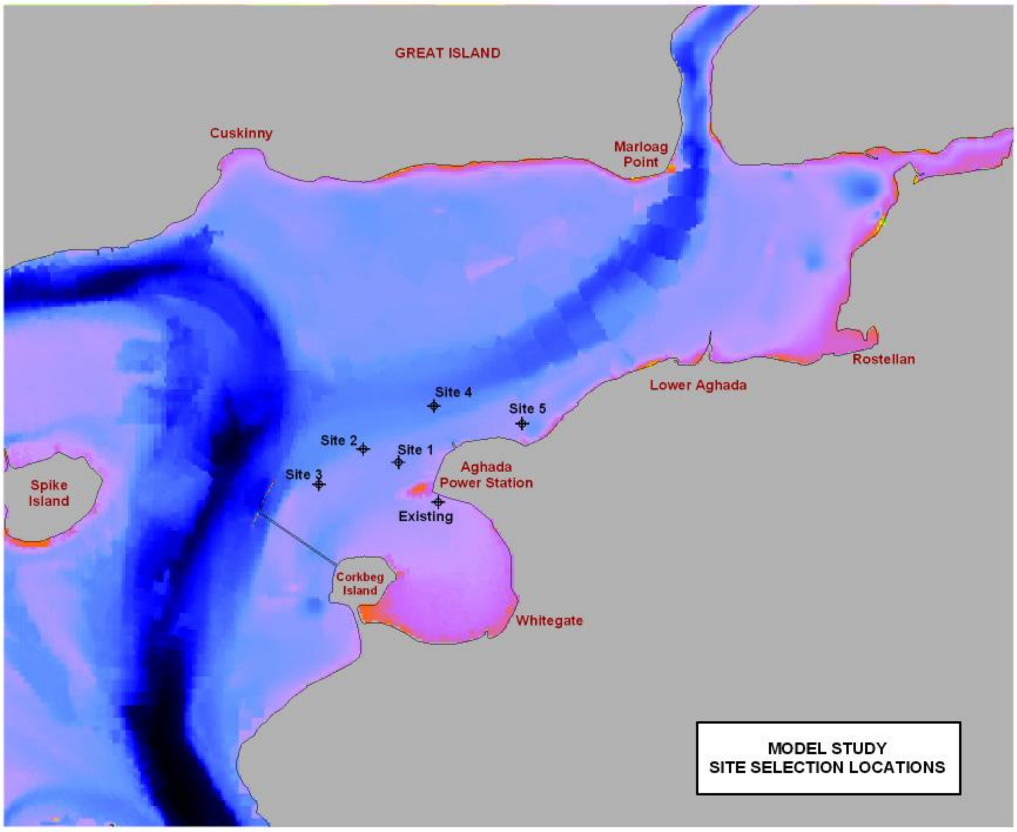
- Direct once-through cooling using river water or sea water, where heat transfer results in an increase in the temperature of the cooling water.
- Evaporative cooling water systems using cooling towers.
- Direct air-cooled, closed loop, condensing systems utilising motor-driven cooling fans.

Direct cooling with estuarine water is the most suitable cooling technology for the proposed plant since it maximises the achievable plant efficiency. The other systems result in lower plant performance and lead to other environmental impacts, such has high visual impact, significant townswater requirement and noise.

2.7.4 Alternative Cooling Water Discharge Locations

Five marine outfall sites of varying length and depth from west to northeast of Aghada power plant were examined for the purposes of identifying a suitable outfall location for the proposed cooling water discharge. The site options investigated are shown in Figure 2.5.

Figure 2.5 - Outfall Site Selection Options



A combined discharge at the existing outfall at the entrance to Whitegate Bay was also examined.

The model predictions showed that locating the new outfall outside of Whitegate Bay significantly reduces the potential thermal impact on Whitegate Bay. The favoured option for the proposed cooling water discharge taking into account distance offshore, near-field mixing and the thermal impact on shallow shoreline waters (particularly the impact on Whitegate Bay and the Aghada existing and proposed cooling water Intakes) was Outfall Option 4, located opposite the Intake at 440 m offshore to the northwest.

2.7.5 Benefits of the Proposed Combined Cycle Plant

The main advantages associated with the latest combined cycle technology that will be employed in the proposed plant are as follows:

- The thermal efficiency of the process is high compared to conventional thermal power plants. While thermal efficiencies of up to 45% are possible with advanced conventional thermal plant, the thermal efficiency of the proposed plant in combined cycle will be circa. 57%, resulting in the consumption of less fuel.
- The rejection of heat to cooling water will be reduced compared to conventional fossil fuel plant. The potential environmental impacts of emissions to waters are thereby reduced.
- The volume of gaseous emissions released to the atmosphere will be substantially less per electricity unit generated compared to conventional plant.
- The period for construction of the plant will be much shorter than for conventional plants with reduced impacts from construction activities.

2.7.6 Conclusions

Based on availability of existing infrastructure, minimum impact and least cost, a summary of the conclusions reached with regard to alternatives is as follows:

- Where no constraints applies to gas availability, the CCGT technology chosen is accepted world-wide as the most suitable technology for a power plant of this size, with significantly higher efficiency and lower relative emissions.
- Other thermal plant options would result in a decrease in cycle efficiency, increase emissions and ultimately lead to higher costs.
- The site at Aghada is the most suitable site available for this development as the area is zoned as a strategic industrial area, has a long association with power generation, has direct access to gas supply and national grid, and is located at the centre of the major electricity demand centre of Cork.

Direct estuarine cooling is the most suitable cooling system as it maximises the thermal efficiency of the plant.

3. HUMAN BEINGS

3. 1 RECEIVING ENVIRONMENT

3.1.1 Population, Employment and Socio-economics

The site is located in the District Electoral Division of Corkbeg in the Midleton Rural Area of Co. Cork. The populations of each from Census of Ireland data produced by the Central Statistics Office are shown in Table 3.1.

Table 3.1: Population Trends

Area	1996	2002	%Change (1996-2002)
State	3,626,087	3,917,203	8.0
Co. Cork	420,510	447,829	6.5
Midleton Rural Area	18,558	21,133	13.9
Midleton	3,266	3,798	16.3
Whitegate	293	440	50.2
Aghada - Farsid - Rostellan	786	774	-1.5

The 2002 Census of Population showed an increase of 27,319 (6.5%) in the population of Co. Cork since 1996. The population of Midleton Rural Area rose by 13.9% to 21,133 in the same period. The village of Whitegate experienced a significant growth of 50% in population from 293 to 440. Overall the general trend in the area was an increase in the population although Rostellan DED only showed a very slight increase of 0.4%, while Aghada – Farsid - Rostellan's population decreased slightly by 1.5%.

The employment status of persons aged 15 years and over, living in Cork city and county was most recently recorded in the 2002 census. The following figures were taken from Table 6A of the 2002 census:

Table 3.2:Employment Status

Area	At Work (%)	Unemployed (%)	Retired (%)
Co. Cork	54	3.2	10.6
Cork City & County	51.7	3.9	11

ESB Aghada together with Conoco Philips Irish Refining provides significant employment in the local area.

Electricity Supplies

Present growth levels in electricity demand and known planned developments of additional generating capacity indicate that further large scale generating capacity is required from 2007 onwards to meet anticipated electricity demand.

3.1.2 Land Use

The site is bounded by the open water of Cork Harbour to the north and west. Whitegate Bay with extensive intertidal habitats forms the southern boundary of the site. Corkbeg Island is located across Whitegate Bay to the southwest of the lower Long Point section of the site where the proposed development will be sited. A large tank farm for oil storage is located on Corkbeg Island. Whitegate Oil Refinery is situated on the ridge of high ground to the south, which overlooks the bay.

The Midleton-Whitegate road (R630) bounds the lower part of Aghada site, within which lies the development area.

Whitegate – Aghada is a generally dispersed settlement with substantial and predominant areas of open land uses forming part of the settlement. The nearest houses are located approximately 600 m from the site to the east.

Amenities and Recreation

Leisure and recreational activities within Cork Harbour and its immediate surrounds include sailing, rowing, windsurfing, canoeing, hurling, football, angling, bird watching, swimming and walking.

Cobh, Crosshaven, Glenbrook and Ballinacurra are angling centres. Shore fishing is carried out throughout the harbour

There are a number of sailing clubs in Cork Harbour, including Lower Aghada Tennis and Sailing Club, Cove Sailing Club (Cobh), Royal Cork Yacht Club, Monkstown Bay Sailing Club and East Ferry Marina.

3. 2 IMPACT OF THE DEVELOPMENT

Impacts on all aspects of the environment ultimately impact on human beings. The general impact on human beings is addressed in those parts of the EIS dealing with these aspects.

As the proposed development contains no residential component, it is unlikely to have any significant direct impact on the composition of the population in the immediate area.

Economic Benefits and Employment

The anticipated total capital cost of the project is of the order of € 300 million and there will also be substantial annual operating costs. These expenditures will result in economic benefit to the national economy.

The proposed plant will have a positive impact with respect to jobs by providing long-term employment for up to 40 people.

At peak employment, up to 500 jobs will be created in the construction phase. Operations to be carried out on site will include site preparation, provision of access roads within the site, piling, forming of in-situ foundations, erection of structural steel work, erection of cladding and roofing to structures, and mechanical and electrical works. There will be also be indirect employment associated with the manufacture of building materials and equipment used in construction.

Electricity Supplies

The proposed plant will provide needed additional generating capacity to meet peak electricity demand forecast for 2007 onwards.

It will support national economic development which requires that adequate electricity generating capacity is available to meet demand.

Land Use

The use of the site for electricity generation is well established. Continued use for electricity generation will not adversely impact on other land uses in the area and is compatible with the Cork County Development Plan. No mitigation of impacts is required.

Amenities and Recreation

The proposed development will not adversely impact on amenities and recreation in the area. No mitigation of impacts is required.

Health and Safety

The basic technology to be employed in the project is well understood and has been used successfully in many equivalent projects both nationally and internationally. There are no implications for health and safety.

3. 3 MITIGATION

Mitigation of impacts on human beings has been considered in the context of mitigation of other aspects of this development in the relevant Sections of the EIS.

3. 4 CONCLUSIONS

In summary, the proposed development will not result in significant adverse impacts on human beings.

4. WATER

4. 1 RECEIVING ENVIRONMENT

4.1.1 Cork Harbour

Cork Harbour is a large inlet on the south coast of Ireland. The mouth of the Harbour is narrow and then broadens out into a large expanse of water. It can be divided into the Upper Harbours East and West and the Lower Harbour. Great Island is between the Upper and Lower Harbours. The Lower Harbour is connected to the Upper Harbours by the East and West Passages. The East and West Harbours are connected by Belvelly Channel. The West Upper Harbour contains Lough Mahon and the lower reaches of the Lee Estuary. The East Upper Harbour contains the very shallow inter tidal mudflats behind Great Island.

The Lower Harbour is bounded by the mouth of the harbour at Roche's Point to the south, and by the East and West Passages to the north. The lower harbour is shallow except for the main channels leading to the East and West Passages. There are a number of Islands and large areas of inter tidal mudflats within the Lower Harbour.

The long-term mean spring and neap high and low water levels for lower Cork Harbour obtained from the nautical almanac are presented below:

Table 4.1 Tide Levels

MHWS	MHWN	MLWN	MLWS
4.1 m	3.2 m	1.3 m	0.4 m

These levels refer to m above chart datum which is 2.58 m below OD Malin.

H.A.T. = 4.6 m Chart Datum, M.S.L = 2.2 m Chart Datum, L.A.T. = -0.1 m Chart Datum

4.1.2 Existing Discharges

Existing ESB Power Station

The site is currently subject to an Integrated Pollution Control Licence for which there are three licensed discharges to Cork Harbour. These are respectively cooling water discharge, boiler blowdown discharge (from large lagoon via station drains), and neutralised water treatment effluent (from the large lagoon following water treatment neutralisation sump).

In addition to these discharges, there are a number of low volume aqueous discharges associated with operation of the power station that discharge to the aquatic environment. Discharges that arise frequently comprise surface water drainage, band screen washing, water treatment plant effluents and sewage effluents. Less frequent discharges will include HRSG blowdowns, plant cleaning solutions and HRSG storage solutions.

Cooling Water

Cooling water is abstracted from Cork Harbour at a pumphouse and is subsequently returned to Whitegate Bay with no net increase in discharge. The cooling water is discharged to the north foreshore in Whitegate Bay, on the south side of the Aghada headland. The discharge first passes through a boulder cascade so that local scouring of the bottom is prevented. The grid location of the outfall point is E18342, N64641.

The current IPC licensed heat loading for the plant is summarised as follows:

Table 4.2: Existing Cooling Water Discharge

Parameter		**Emission Limit Value**
Temperature	98-percentile	12.5°C above ambient estuarine water
	Maximum	15°C above ambient estuarine water
Thermal Load	98-percentile	335 MW
	Maximum	355 MW
Chlorine		0.3 mg/l
Volume	Maximum in any one day	768,000 m^3
	Maximum Rate per hour	32,000 m^3
Flow rate (m^3/s)		8.89 m^3/s

In the operation of the plant conditions of maximum flow and maximum temperature do not generally coincide.

Cooling water inlet temperatures vary seasonally and diurnally and historical records show a minimum of 6 °C and a maximum of 19 °C. The temperature at the condenser outlets has varied between 11.4 °C and 32 °C. Based on recent daily monitoring of Aghada's summer cooling water discharge the 98-percentile flow is 7.92 m^3/s and the 98-percentile temperature rise is 12.5 ³C above ambient.

At full load operating conditions the heat rejection is in the range 320 – 350 MW (operating conditions for more than 98% of the time). The heat rejection can increase to 355 MW in exceptional circumstances, but this occurs less than 2% of the time and is in winter only. The cooling water pumps are rated at 32,000 m^3/hr for the Highest Astronomical Tide (HAT) condition. Thermal plume surveys were undertaken in 1996 and 1999 with the existing station on load.

The cooling water is chlorinated at the intake when the temperature of the sea water exceeds approximately 9 °C, which is usually from March/April to December/January. This is done to control slime formation and to inhibit the settlement of shellfish larvae on the condenser tubes. The chlorine is produced on site by the electrochlorination plant located in a small building near the cooling water intake.

Other Discharges

Whitegate Bay

Whitegate Bay receives surface run-off from the surrounding rural watershed in the form of small streams the main one situated in the southeast corner of the bay. Domestic sewage also discharges into the bay from several pipes and the bay is probably nutrient enriched.

Cork Harbour

There are five major chemical companies in the Lower Harbour area, namely ADM, Pfizer, SmithKline Beecham, Hicksons and Warner Lambert, located at Ringaskiddy. These chemical companies all have Integrated Pollution Control (IPC) Licenses from the Environmental Protection Agency (EPA) and most effluent arising is simple organic in nature.

Wastewaters, both domestic and industrial, generated in the Carrigaline/Ringaskiddy industrial area are primarily catered for by discharge to Lower Cork Harbour. The discharge is via a long sea outfall terminating in a deep-water channel close to Dogsnose Bank.

4. 2 IMPACT OF THE DEVELOPMENT

4.2.1 Cooling Water

As is the case for the existing station, direct once through cooling is envisaged for the proposed development. A new cooling water pumphouse is to be provided for the new development, adjacent to the existing cooling water intake. It is proposed to route the CCGT cooling water discharge through an outfall approximately 440 m off-shore to the north-west of the site, downstream of the existing intake.

4.2.2 Thermal Plume

Formation and Composition

A consequence of direct cooling of the condenser will be the production of low-grade thermal energy which is absorbed by cooling water as it passes through the condenser. The heated water thus produced will increase the temperature of the receiving water. The temperature increase is eventually dissipated to the atmosphere by radiation, evaporation, convection and conduction.

Introduction to Cooling Water Hydrodynamic and Dispersion Study

In order to examine the environmental impacts, a detailed hydrodynamic and dispersion study was undertaken. Details regarding the model development are provided in Appendix D.

Hydrodynamic modelling of Cork Harbour was carried out using a two-dimensional hydraulic model which resolved depth-averaged current velocities and water depths on a refined 25 m x 25 m grid for the entire Cork Harbour Area which included both lower and upper Cork Harbour. This model was calibrated and verified against recorded current measurements and water surface elevations at a number of locations in the Aghada / Whitegate Bay area including measurements taken close to the proposed outfall point. The calibration and verification process demonstrated that the two-dimensional model reproduces reasonably well the flow regime within the study area and that the vertical profile of velocity is essentially logarithmic.

A hydrographic field survey investigation of Lower Cork Harbour was carried out to support outfall site selection, the hydrodynamic model development and model verification. This survey comprised an extensive bathymetric survey, tidal height measurements, discrete and continuous velocity measurements at selected water column depths(surface, mid and near bottom), drogue tracking and dye release surveys and also included temperature transects and fixed station vertical profiles of salinity and temperature.

The velocity and drogue tracking survey results showed reasonable strong rectilinear ebb and flood flows on both spring and neap tides indicating good tidal flushing. The current metering, drogues and dye dispersion measurements consistently showed a preference for ebb flow direction at all sites on both neap and spring tides commencing approximately 1 - 2 hours before high-water and continuing until low water (typically 7 – 8 hours duration). This pattern suggests that on the flooding tide the incoming water enters the bay centrally via the deeper main channel and then spreads laterally over the shoals setting up a large scale clockwise eddy flow on the east side of the Harbour in the vicinity of Aghada and Corkbeg Island. This circulation feature has positive implications for the proposed cooling water outfall as it will ensure that the majority of the plume is carried seaward thus reducing the impact upstream (northeast) in the east bay section of the Harbour.

The validated hydrodynamic model was used to:

- Investigate the suitability of a number of potential outfall sites as part of the preliminary outfall site selection process (Refer Section 2.7.4).
- To determine the spread and fate of a thermal discharge modelling both depth-averaged and a surface layer temperature plumes.
- To determine the impact of Chlorine residual in the form of Chlorine Produced Oxidants in the cooling waters on the water quality of Cork Harbour.
- To provide the hydrodynamics at the proposed outfall site for input to a near-field mixing/ initial dilution model (CORMIX).

Temperature Rise Assessment

General

The approach adopted in the cooling water study was to use a depth-averaged model DIVAST which assumed full vertical mixing to predict the longer term equilibrium temperature rise within the harbour (i.e. build-up over a number of tidal cycles by which time the temperature plume would have undergone full vertical mixing in the water column) and to use a quasi-3D hydrodynamic particle tracking surface plume model to predict the shorter term transport effects (i.e. the buoyant thermal plume characteristics over a single tidal cycle duration). This approach allowed a full examination of the thermal plume impact quantifying both short term and longer term effects on the water column and on the seabed.

The following outfall discharge scenarios were modelled:

- The Existing 98-percentile cooling water discharge and 98-percentile temperature rise (7.92 m^3/s at 12.5°C).
- Proposed 98-percentile cooling water discharge and 98-percentile temperature rise (7.43 m^3/s at 11.5°C).
- Combined 98-percentile cooling water discharges and 98-percentile temperature rises at proposed and existing outfalls
- These cooling water discharge scenarios were simulated using both the vertically mixed depth-averaged and surface plume models.
- The combination of the 98-percentile discharge and 98-percentile temperature rise does not generally coincide and therefore the thermal load simulated will be greater than the 98-percentile thermal load from the plant.

Depth-Averaged Model Results

The depth-averaged model provides a reasonable assessment of the temperature rise from the existing outfall as the site and surrounding receiving water is very shallow, practically drying out at low water, which induces good vertical mixing over a large portion of the tidal cycle. In the case of the proposed outfall the receiving water is relatively deep, 6 m at mean sea level, the cooling water plume is buoyant and therefore rapidly rises to the surface forming a surface plume. Consequently, the depth-averaged model, which assumes full vertical mixing, will not accurately predict the temperature rise in the near to medium field (i.e. within a tidal excursion), under-predicting the surface temperature rise and exaggerating the bottom / sea bed temperature rise.

The depth-averaged temperature simulations provide a conservative estimate of long-term equilibrium temperature rise within the bay as it under predicts temperature loss to the atmosphere in the near to medium field when the plume is predominantly a surface plume having a much greater gradient for temperature loss to the atmosphere due to its higher temperature than a vertically mixed plume.

For the existing outfall, the depth averaged model results agreed reasonably closely with the thermal survey results measured in 1992 and particularly with those measured in 1996 (refer to report on model for calibration details).

(i) Existing Cooling Water Temperature Rise

Under the existing 98-percentile discharge, the region of impact is confined primarily to Whitegate Bay, its immediate approaches and a narrow strip of sea running along the northeast shoreline from approximately 600 m northeast of Dogsnose to 500 m west of Aghada. Outside of this region the temperature rise is less than 0.2 °C. For a large section of the east Lower Cork Harbour the predicted tide-averaged temperature rise is 0.1 - 0.2 °C and in the west section of Lower Cork Harbour the predicted average temperature rise is less than 0.05 °C. The strong rectilinear flow regime within Lower Cork Harbour that accompanies the main east and west channels partitions the east side of the harbour from the west side with little opportunity for cross mixing from one side of the channel to the other without first having to flow on the ebbing tide beyond Roche's Point and then return on the flooding tide.

The predicted average temperature rise within Whitegate Bay is 2.5 – 3 °C on a neap tidal cycle and 1.5 - 2.0^{o}C on a spring tide. Temperature rise of 4.5 – 5 °C is predicted around the inner Whitegate shoreline, to the east and southeast of the outfall. Outside of Whitegate Bay an average temperature rise of 0.75 °C is predicted for the waters adjacent to the shoreline from south of Corkbeg Island to the north of the Aghada site. At the intake an average temperature rise of 0.5 °C and 0.9 °C for spring and neap tides and a maximum temperature rise of 2 °C are predicted. In the vicinity of the licensed shellfishery site to the north of Aghada pier the predicted tide averaged temperature rise is 0.1 °C and 0.2 °C and the maximum instantaneous temperature rise is 0.3 °C and 0.35 °C for spring and neap tides respectively.

(ii) Proposed Cooling Water Temperature Rise

The simulations of the proposed outfall with 98-percentile cooling water discharge show little impact on Whitegate Bay producing an average temperature rise of 0.1 °C and 0.2 °C and maximum instantaneous temperatures rise of 0.15 °C and 0.3°C on spring and neap tides respectively. The impact of the discharge on the cooling water intake is slight with average temperature rise of 0.15 °C and 0.4 °C and maximum temperature increases of 0.25 °C and 0.5 °C for spring and neap tides respectively being predicted. In the vicinity of the licensed shellfishery area to the north of Aghada pier the predicted tide averaged temperature rise is 0.2 °C for spring and neap tides and the maximum instantaneous temperature rise is 0.4 °C, occurring on a neap tide.

(iii) Combined Effect

The impact region from the combined discharge from the two outfalls will be confined principally to Whitegate Bay, its approaches and an 800 m to 1 km wide strip running parallel to the shoreline from 500 m northeast of Dogsnose Headland to 400 m west of Aghada pier. Outside of this region the predicted average temperature rise is less than 0.5 °C on a neap tide and less than 0.25 °C on a spring tide. Little impact is predicted in the west section of Lower Cork Harbour as the hydrodynamic regime does not encourage crossflow from east to west.

The combined effect of both discharges on Whitegate Bay shows a minimal increase in temperature over the existing discharge scenario with the predicted average temperature rise in the bay 1.5 – 2 °C and 2.5 - 3 °C on spring and neap tides respectively. Outside of Whitegate Bay along the shoreline from south of Corkbeg Island to north of the Aghada site the combined effect of the two outfalls is more noticeable with the average temperature rise being increased by approximately 0.5 °C. At the cooling water intake the combined average temperature rise is 0.65 °C and 1.2 °C on spring and neap tides with a maximum instantaneous temperature rise of 2.25 °C °C. The shellfishery site located to the north of Aghada pier has a predicted average temperature rise of 0.3 °C and 0.4 °C and maximum rise of 0.55 °C and 0.65 °C for spring and neap tides respectively.

Figure 4.1: Tide-Averaged Temperature rise for existing Cooling Water Discharge – Depth Averaged Spring Tide Simulation

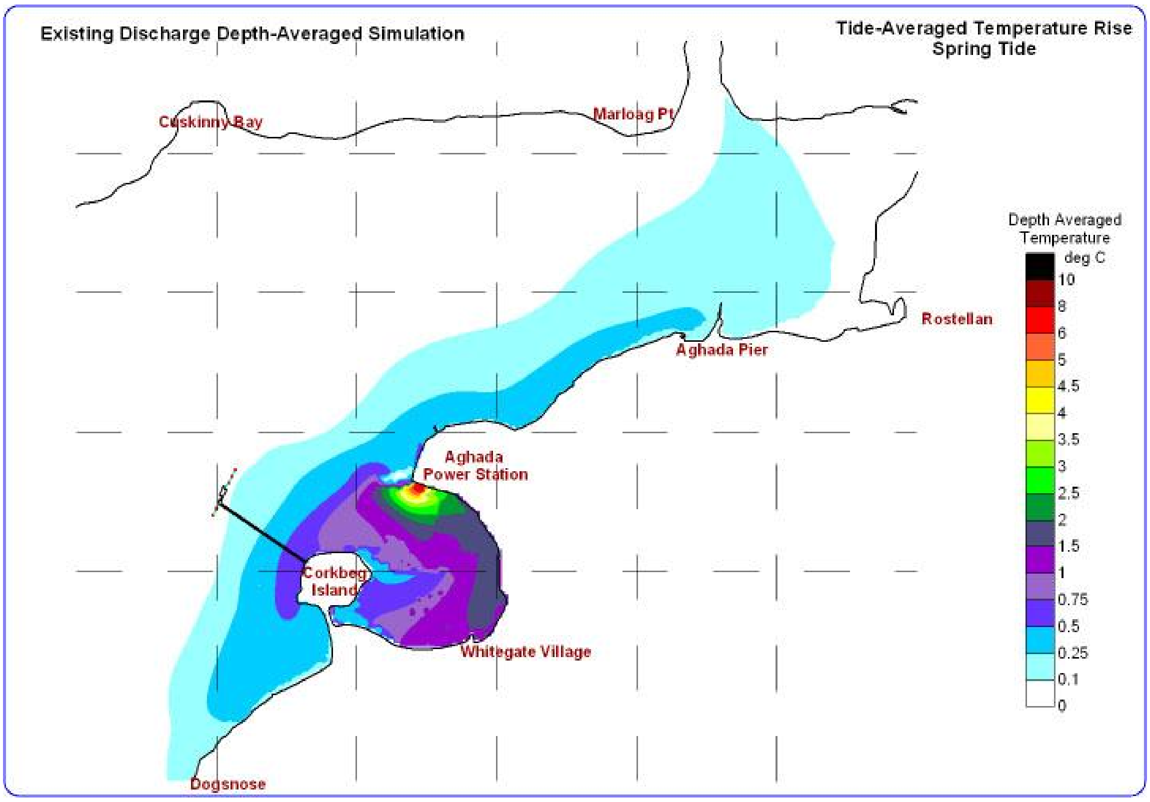


Figure 4.2: Tide-Averaged Temperature rise for existing Cooling Water Discharge – Depth Averaged Neap Tide Simulation

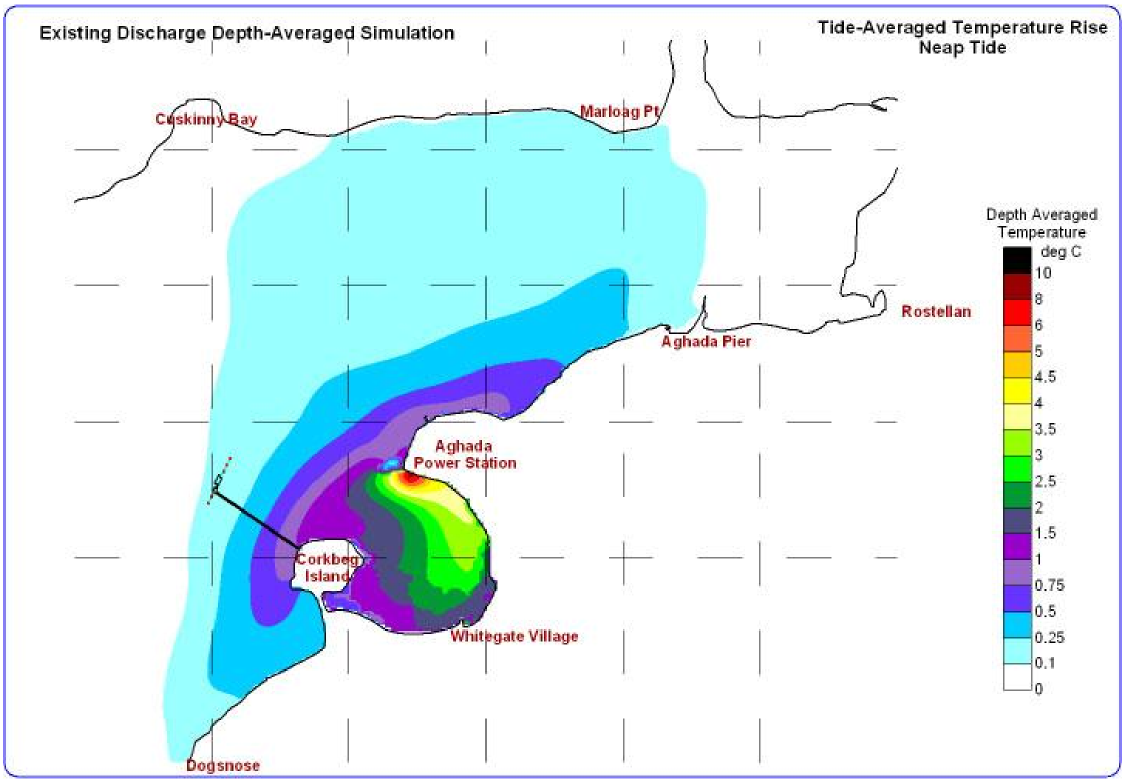


Figure 4.3: Maximum Temperature rise for existing Cooling Water Discharge – Depth Averaged Spring Tide Simulation

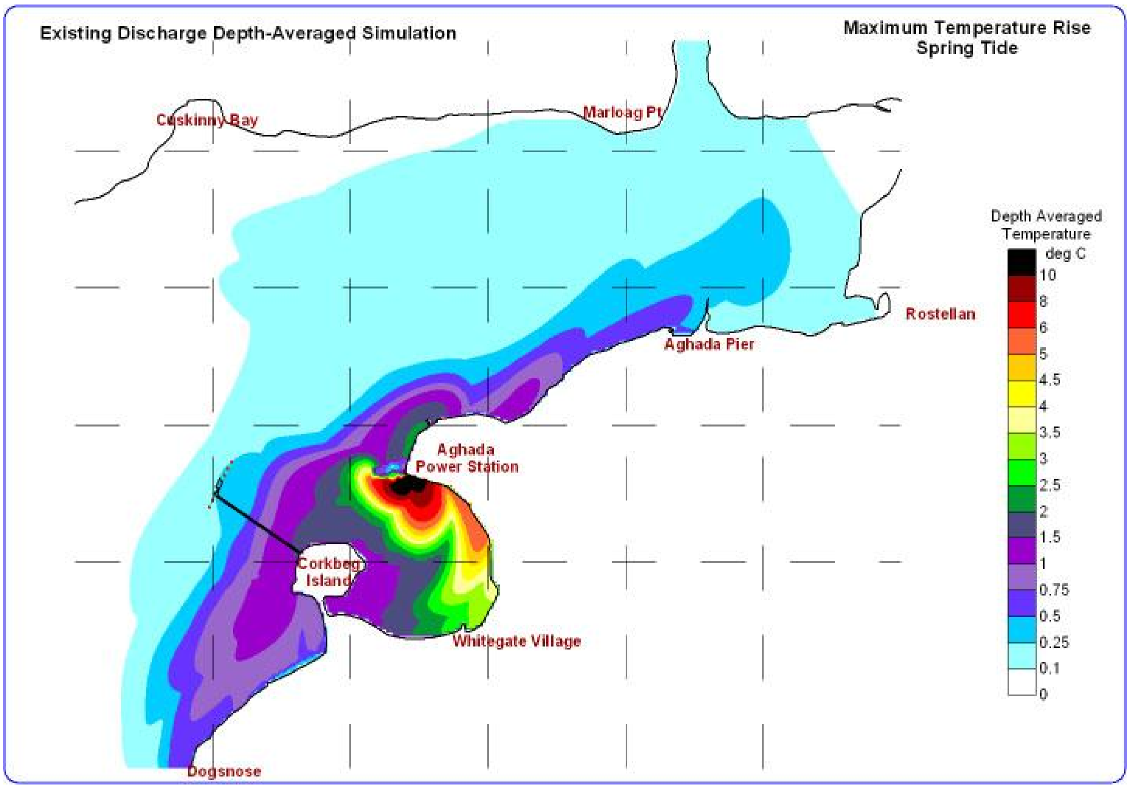


Figure 4.4: Maximum Temperature rise for existing Cooling Water Discharge – Depth Averaged Neap Tide Simulation

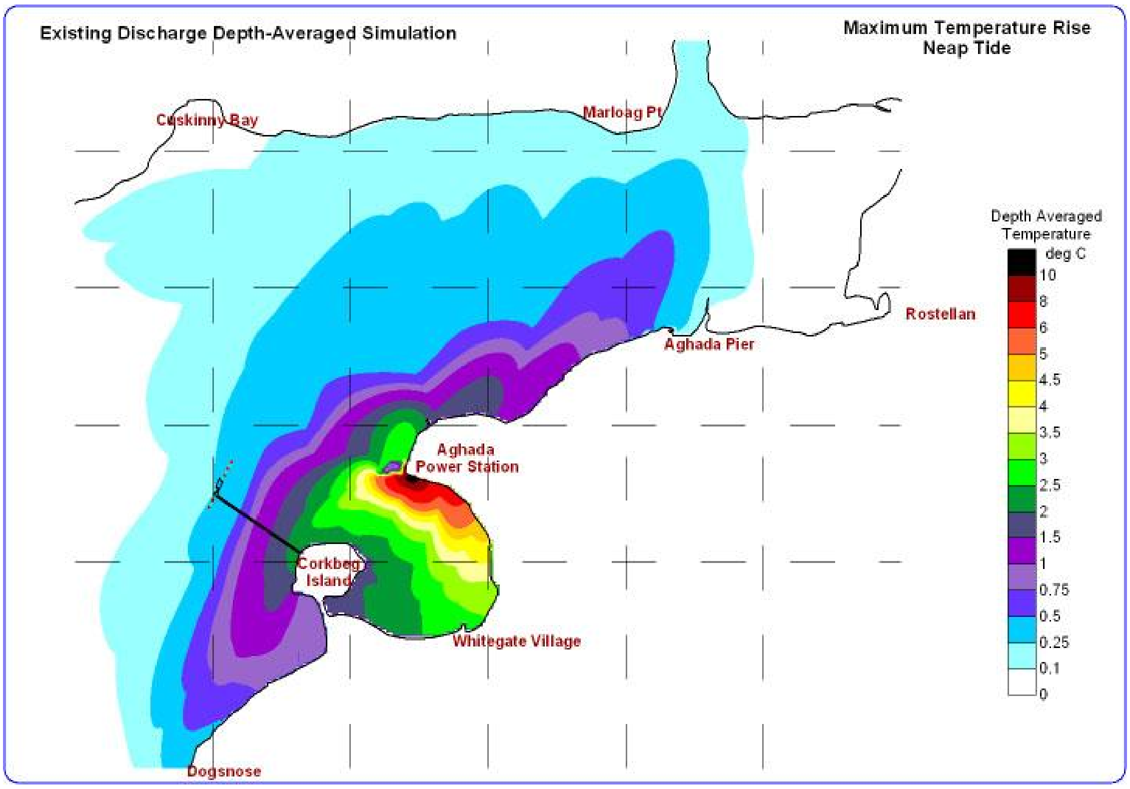


Figure 4.5: Tidally Averaged Temperature rise for Proposed Cooling Water Discharge – Depth Averaged Spring Tide Simulation

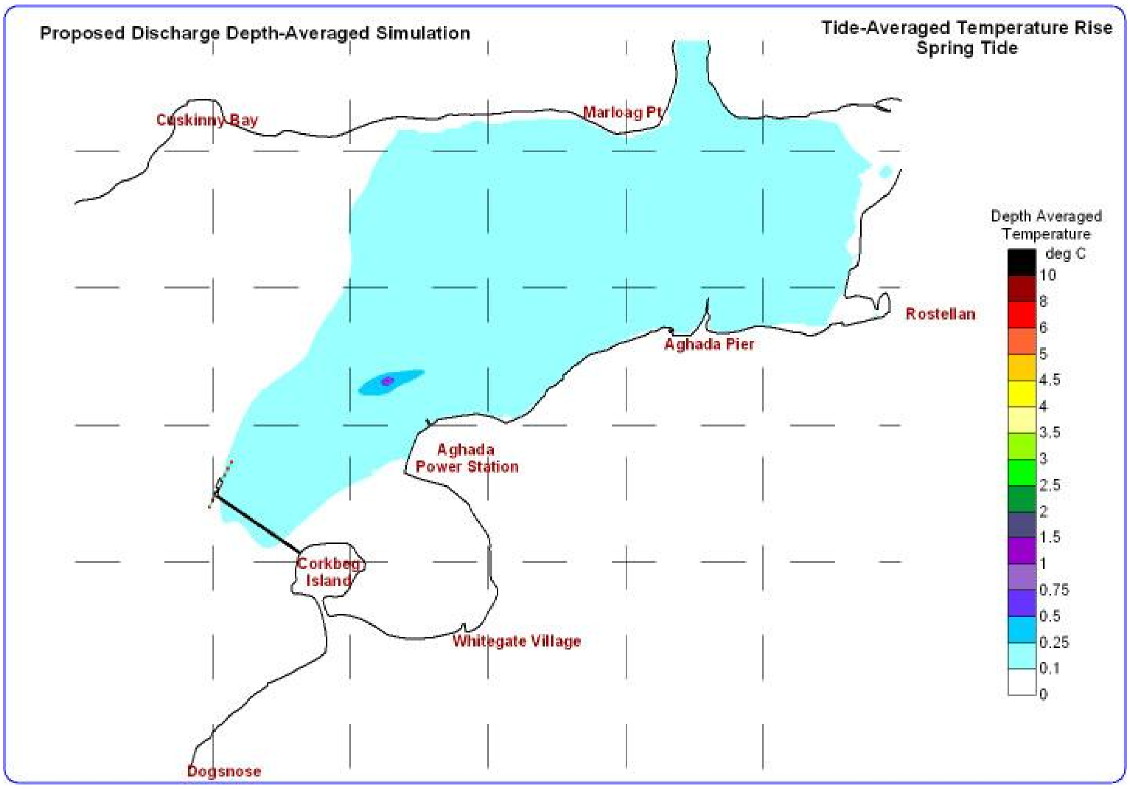


Figure 4.6: Tidally Averaged Temperature rise for Proposed Cooling Water Discharge – Depth Averaged Neap Tide Simulation

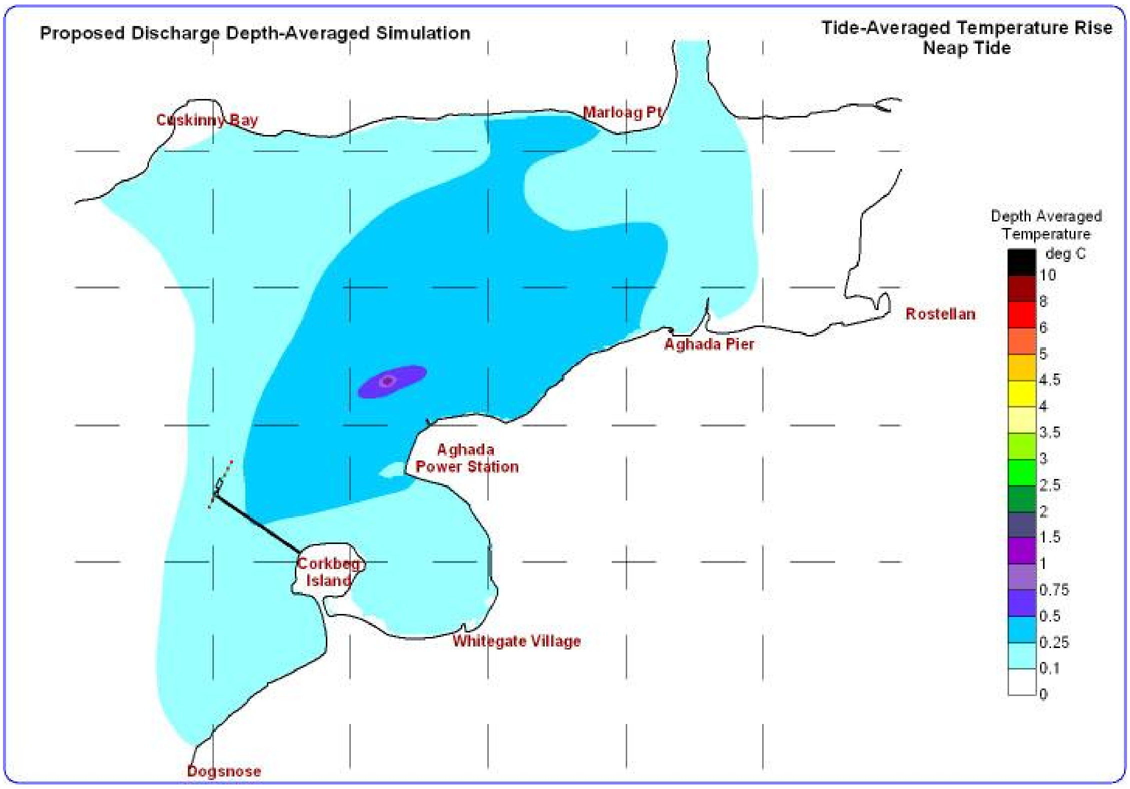


Figure 4.7: Maximum Temperature rise for proposed Cooling Water Discharge – Depth Averaged Spring Tide Simulation

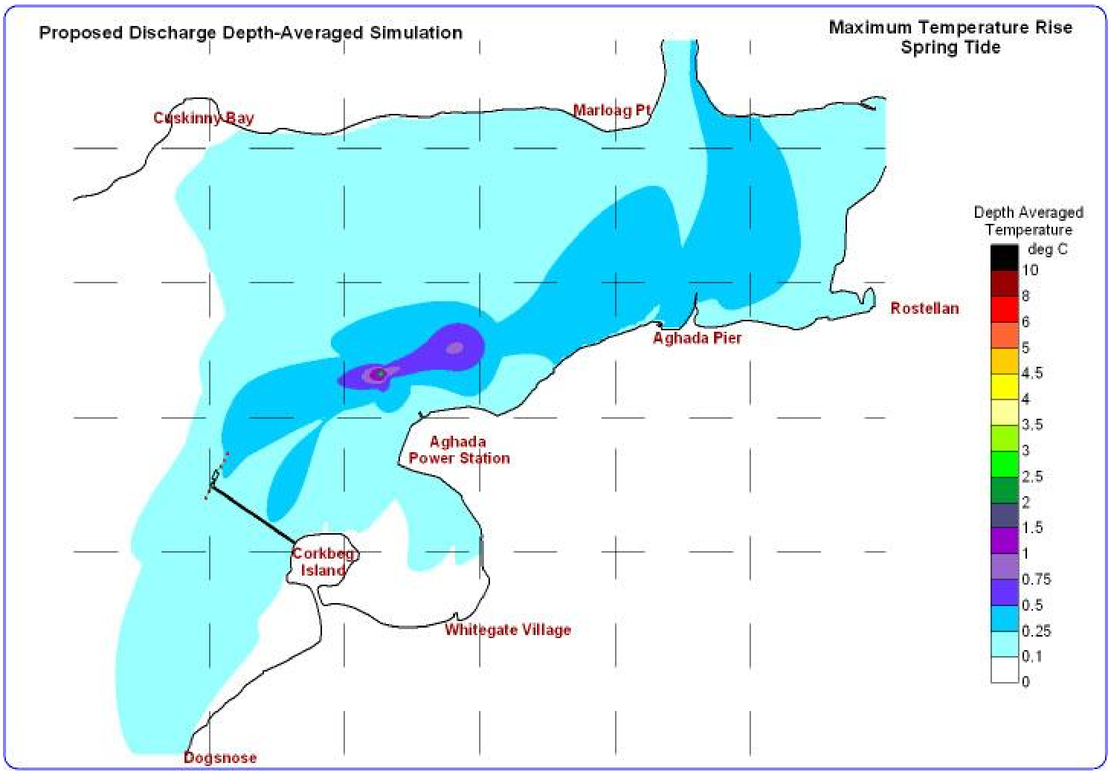


Figure 4.8: Maximum Temperature rise for proposed Cooling Water Discharge – Depth Averaged Neap Tide Simulation

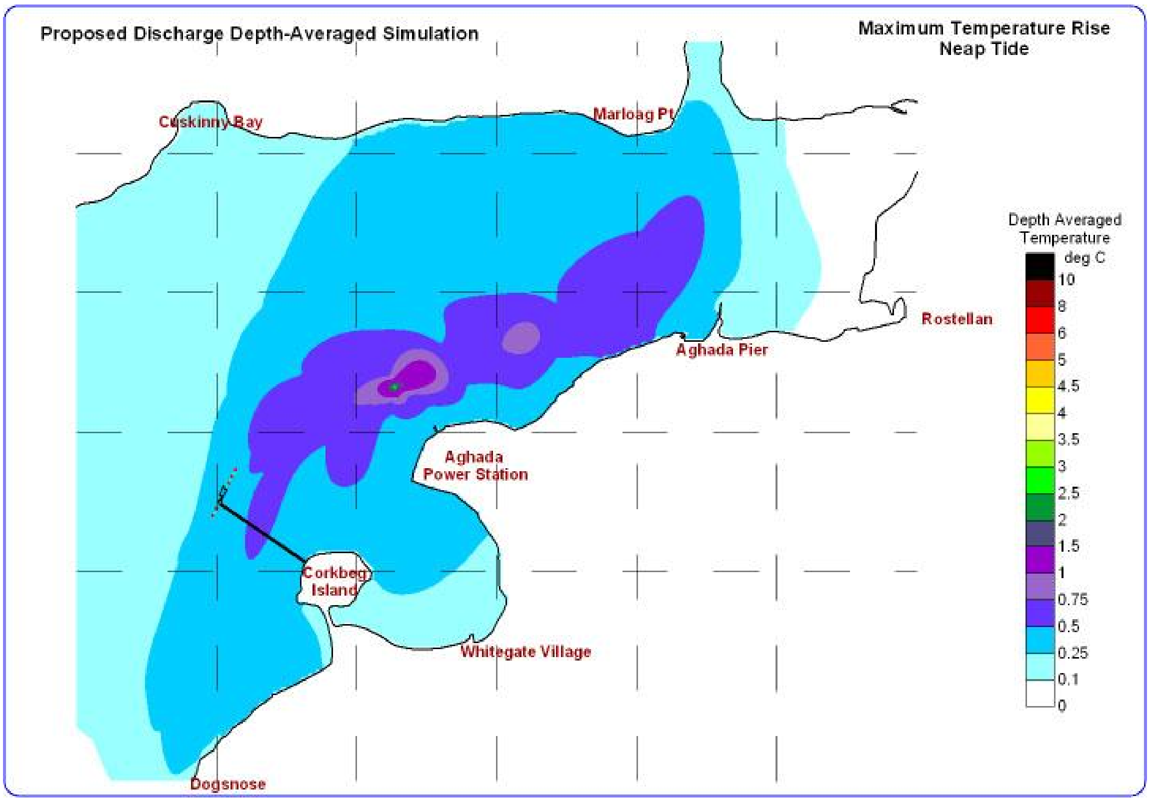


Figure 4.9: Tidally Averaged Temperature Rise for Combined Cooling Water Discharges – Depth Averaged Spring Tide Simulation

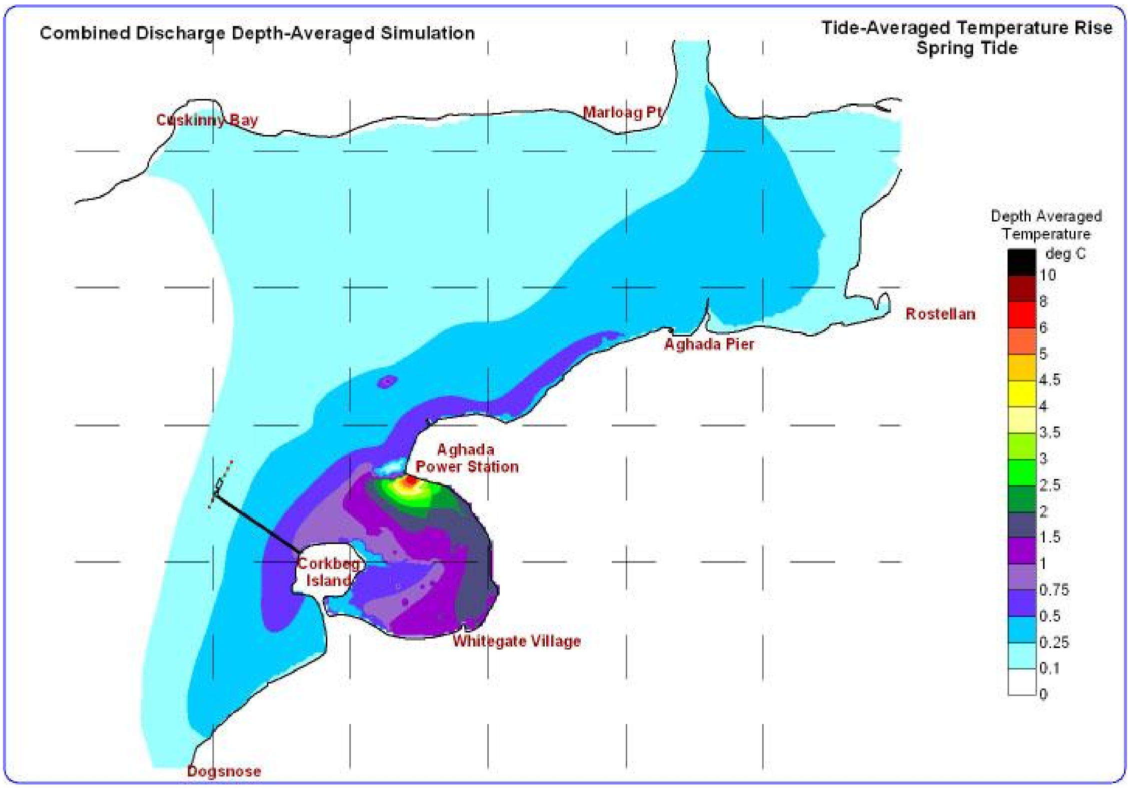


Figure 4.10: Tidally Averaged Temperature Rise for Combined Cooling Water Discharges – Depth Averaged Neap Tide Simulation

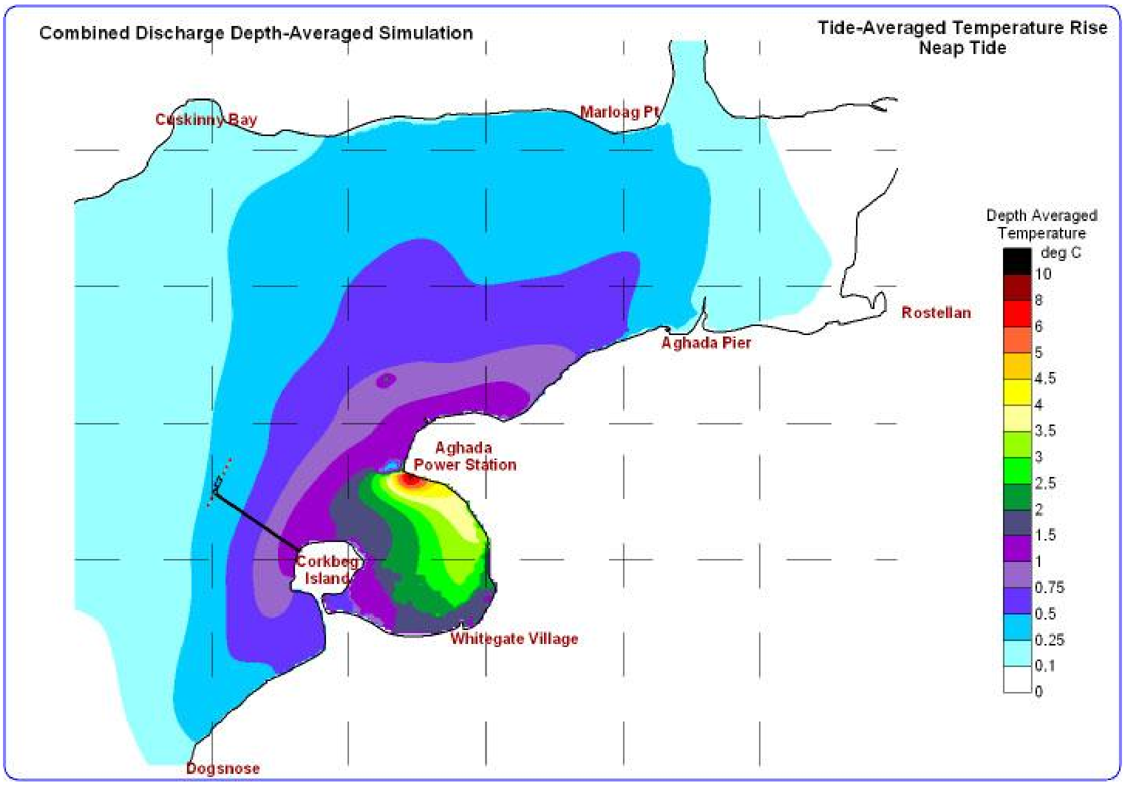


Figure 4.11: Maximum Temperature Rise for Combined Cooling Water Discharges – Depth Averaged Spring Tide Simulation

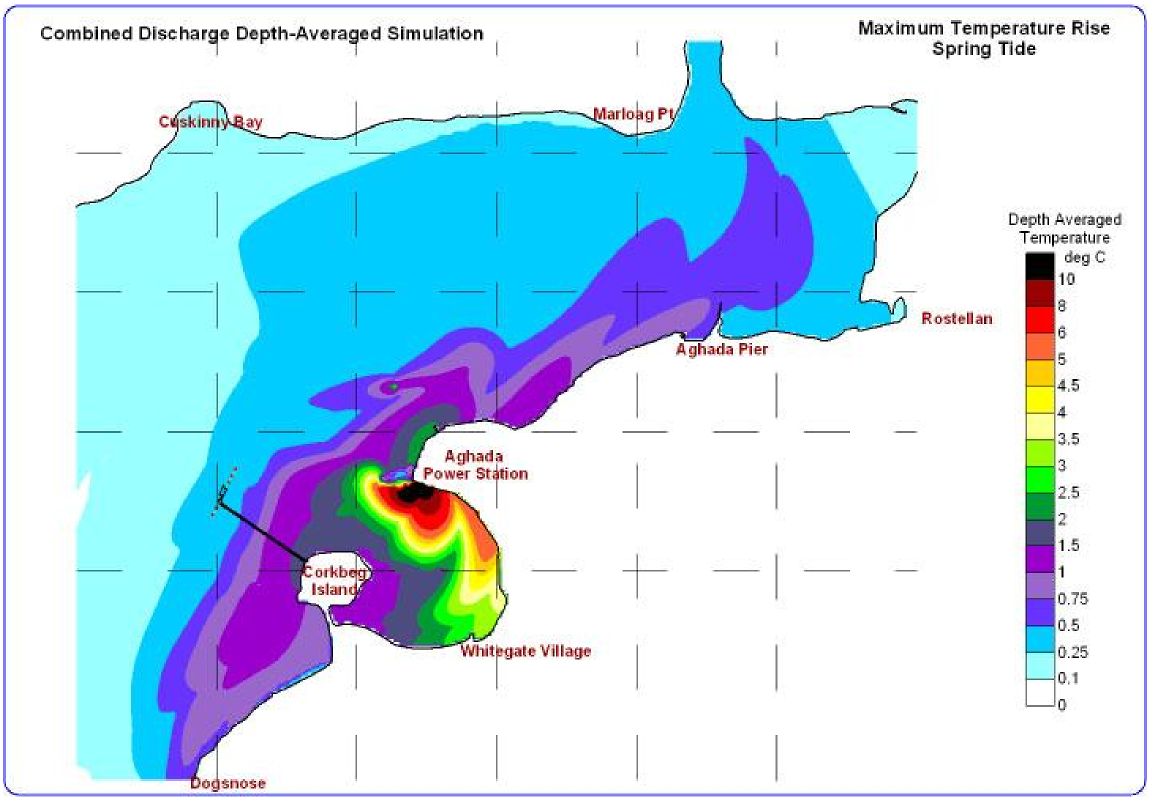
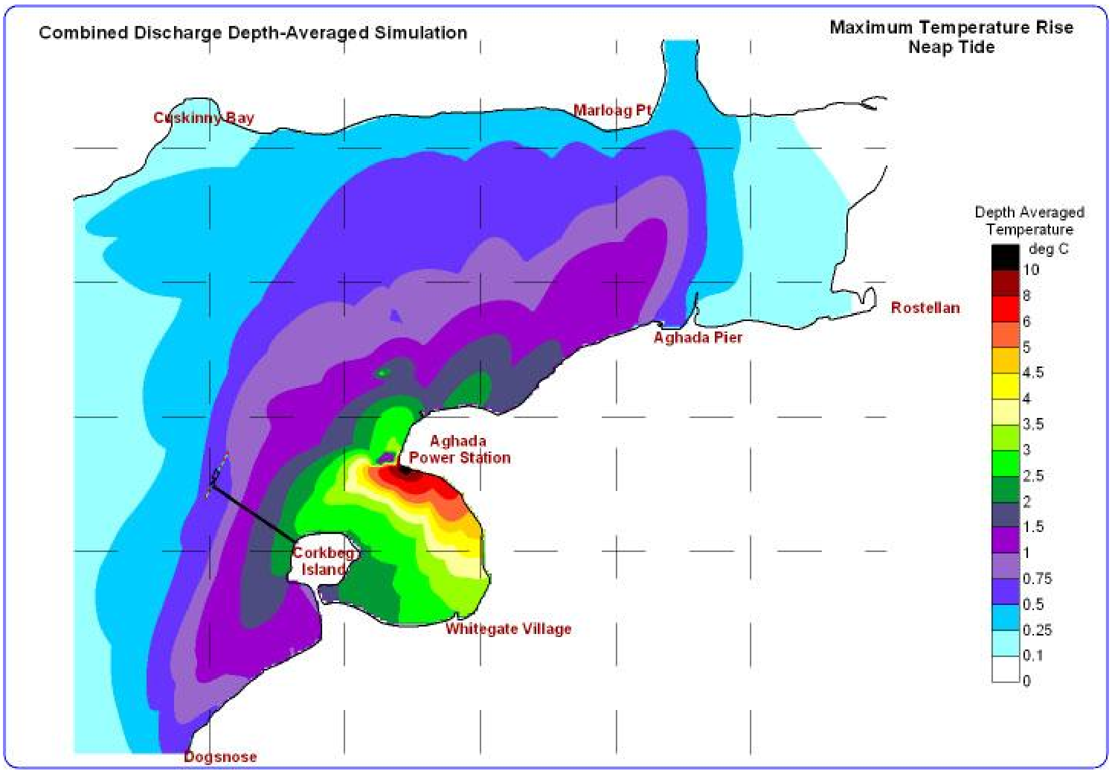


Figure 4.12: Maximum Temperature Rise for Combined Cooling Water Discharges – Depth Averaged Neap Tide Simulation



Surface Plume Model Results

The surface plume simulations were performed using the random walk particle tracking technique which transports parcels of heated water under tide and wind induced advection and dispersion, using a quasi 3-D hydrodynamic flow field derived from the depth-averaged hydrodynamic model (refer to Section 2.4). The temperature plume was modelled assuming an average surface layer thickness of 2 m. In shallow waters of less than 2 m the actual water depth was used. The vertical mixing and plume thickness depends on sea state with vertical mixing being influence by wind and tide induced turbulence. Initial dilution simulations show that within 500 m of the outfall the surface plume thickness is 0.5 – 1 m and by 1 km from the source the layer thickness is between 1 m and 2 m, under relatively calm wind conditions and depending on the tidal stage and range. This particle tracking surface plume model is used to predict the surface plume temperature rise in medium field defined here as within one tidal cycle and is particularly suited to the proposed outfall site which is offshore and away from the shoreline avoiding the difficulty of unrealistic shoreline stranding of particles which can produce spurious results.

(i) Existing Outfall Discharge

This simulation predicts a less dispersive plume than the depth-averaged simulation with the primary area of impact being Whitegate Bay and the shoreline area immediately west of Corkbeg Island to north of Aghada. The plume hugs the shoreline waters outside of Whitegate bay both to the south towards Dogsnose headland and north and northeast towards Aghada Pier. The circulation pattern which flows parallel to shoreline outside of Whitegate Bay prevents lateral westward spreading of the Whitegate plume. This simulation does not include temperature build-up over a number of tidal cycles which is a significant factor for Whitegate Bay. In Whitegate Bay the plume on the flooding tide hugs the shoreline area spreading in a clockwise direction along the edge of the Bay towards Whitegate pier. The predicted tide-averaged surface temperature rise occurring along the inner shoreline of Whitegate bay is 3 - 3.5 °C and 4.5 – 5 °C on spring and neap tides respectively and a maximum temperature rise of 6 – 8 °C. At the outfall practically no dilution is achieved at the slack tide periods of low and high water.

At the cooling water intake on the north side of the Aghada site the predicted tide-averaged surface temperature rise is 1.5 °C and 0.75 °C and the maximum surface temperature rise is 2.5 °C and 4.5°C on spring and neap tides respectively. The predicted tide averaged surface temperature rise at the shellfishery area to the north of Aghada Pier is 0.1 °C and 0.25 °C and the predicted maximum surface temperature rise is 1 °C and 1.5 °C for spring and neap tides respectively.

(ii) Proposed Outfall Discharge

The region of impact extends from south of Dogsnose Headland north to the entrance to the east passage. The plume is elongated in the direction of flow, it is well diluted and remains essentially offshore in a southwest to northeast orientation. The model output of maximum instantaneous surface temperature rise shows the 3 °C temperature rise contour exceeded for approximately 350 m in the ebb flow direction (southwest direction) and for 1200 m in the flood flow direction (northeast). This relatively high temperature rise remote from the outfall is caused by the ebb and flood advection of the poorly diluted slack tide (low water and high water) thermal plume and is of short duration.

The model predicts minimal impact on Whitegate bay (< 0.1°C rise) and predicts only a slight impact on the cooling water intake producing tide-averaged surface temperature rises of 0.1 °C and 0.2 and maximum temperature rises of 0.3 °C and 0.5 °C on spring and neap tides respectively. There may be certain combination of wind and tide conditions that will give rise to higher surface temperature rises at the intake than predicted here (i.e. slack tides and a moderate to strong north-westerly wind condition). Such conditions will be the exception rather than the norm. The simulations show the shellfishery located to the north of Aghada pier to be slightly impacted having a predicted tide-averaged surface temperature rise of 0.3 °C and 0.25 °C and maximum surface temperature rise of 0.7 °C and 1.1 °C on spring and neap tides respectively.

Figure 4.13: Tidally Averaged Temperature Rise for Existing Cooling Water Discharge – Surface Plume Spring Tide Simulation

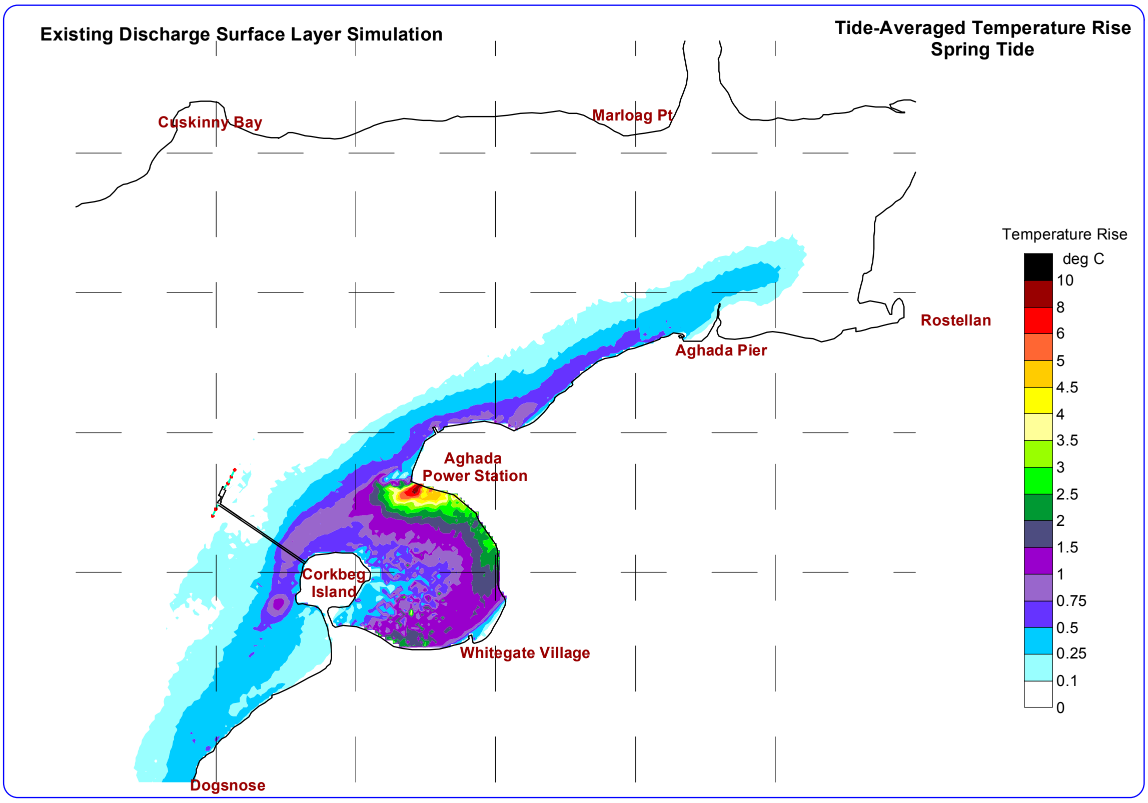


Figure 4.14: Tidally Averaged Temperature Rise for Existing Cooling Water Discharge – Surface Plume Neap Tide Simulation

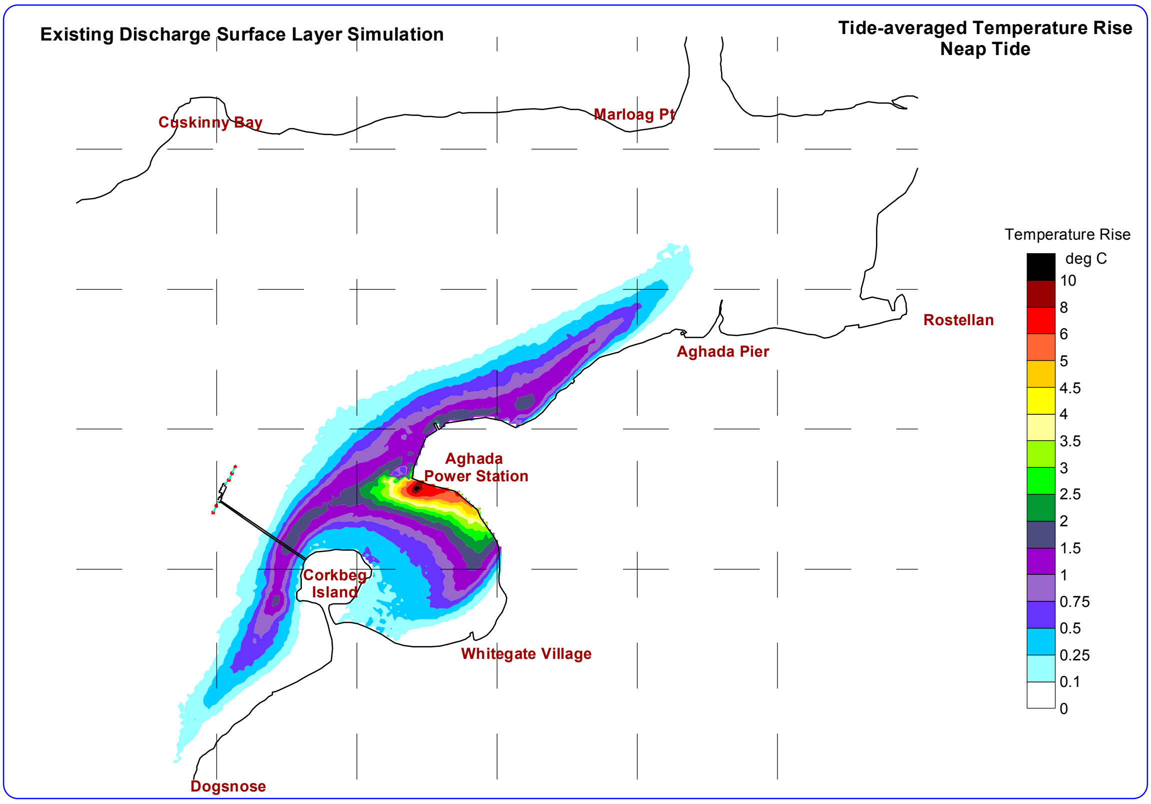


Figure 4.15: Maximum Temperature Rise for Existing Cooling Water Discharge – Surface Plume Spring Tide Simulation

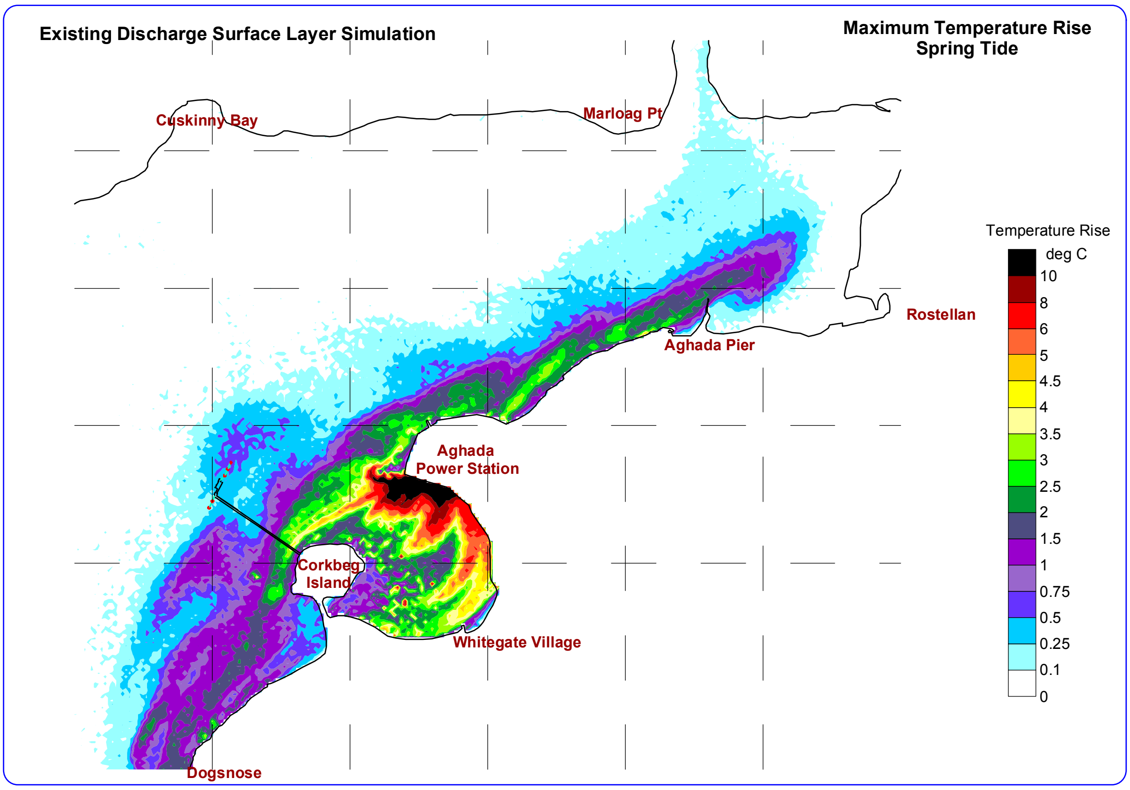


Figure 4.16: Maximum Temperature Rise for Existing Cooling Water Discharge – Surface Plume Neap Tide Simulation

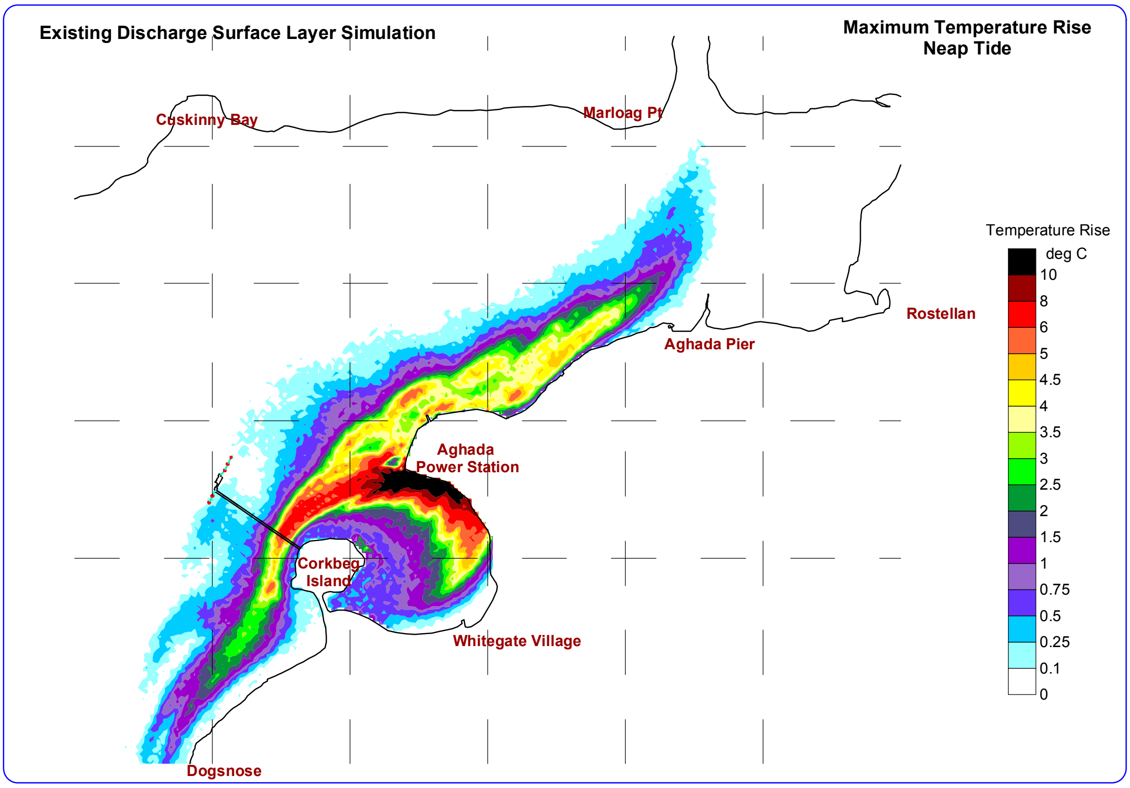


Figure 4.17: Tidally-Averaged Temperature Rise for Proposed Cooling Water Discharge – Surface Plume Spring Tide Simulation

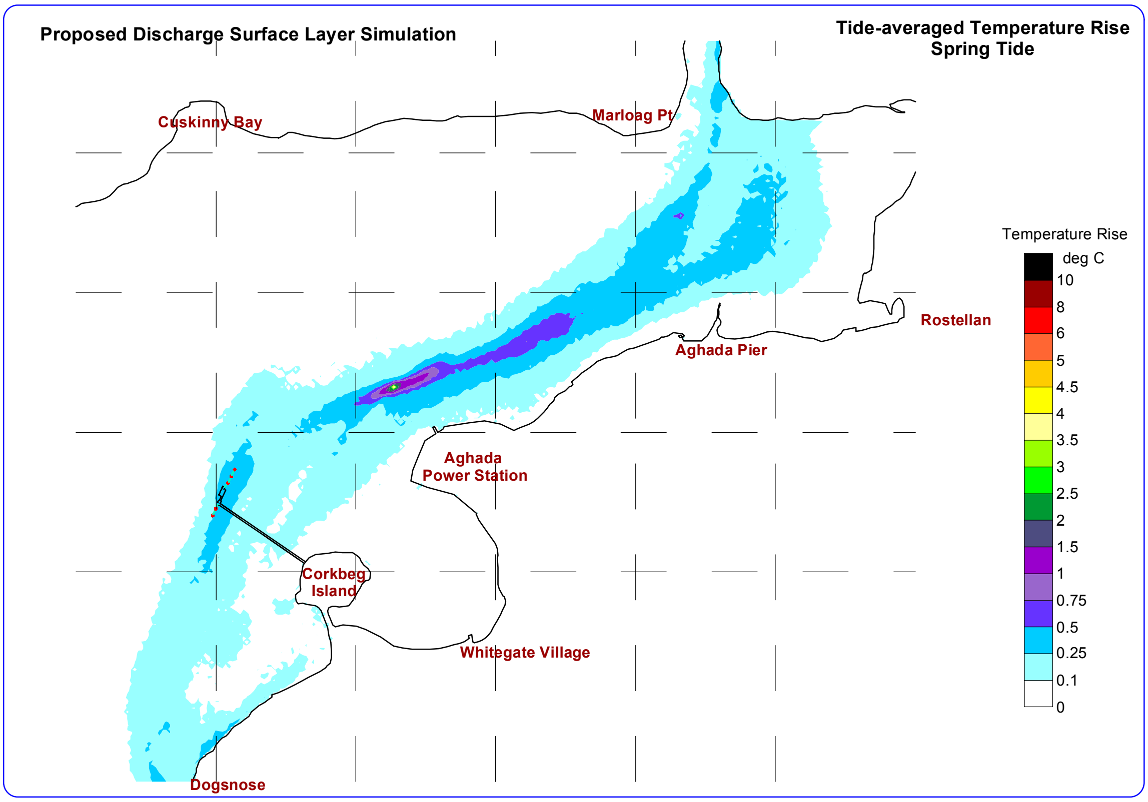


Figure 4.18: Tidally-Averaged Temperature Rise for Proposed Cooling Water Discharge Surface Plume Neap Tide Simulation

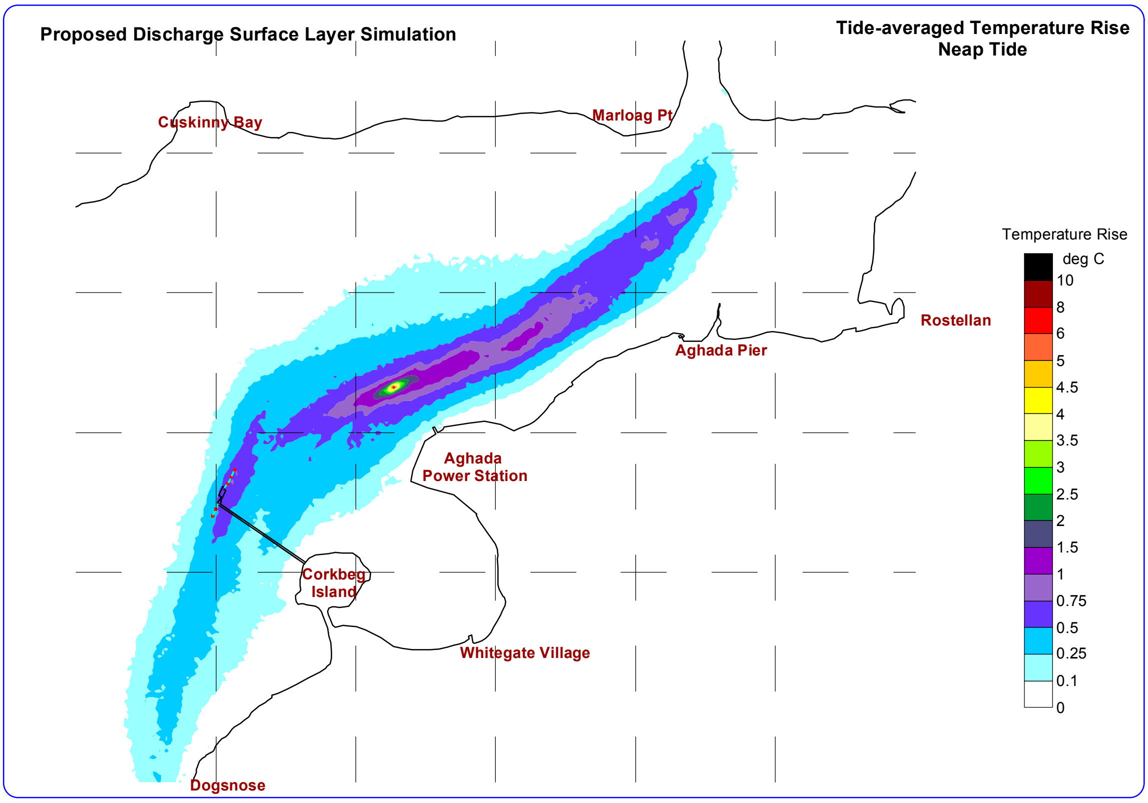


Figure 4.19: Maximum Temperature Rise for Proposed Cooling Water Discharge – Surface Plume Spring Tide Simulation

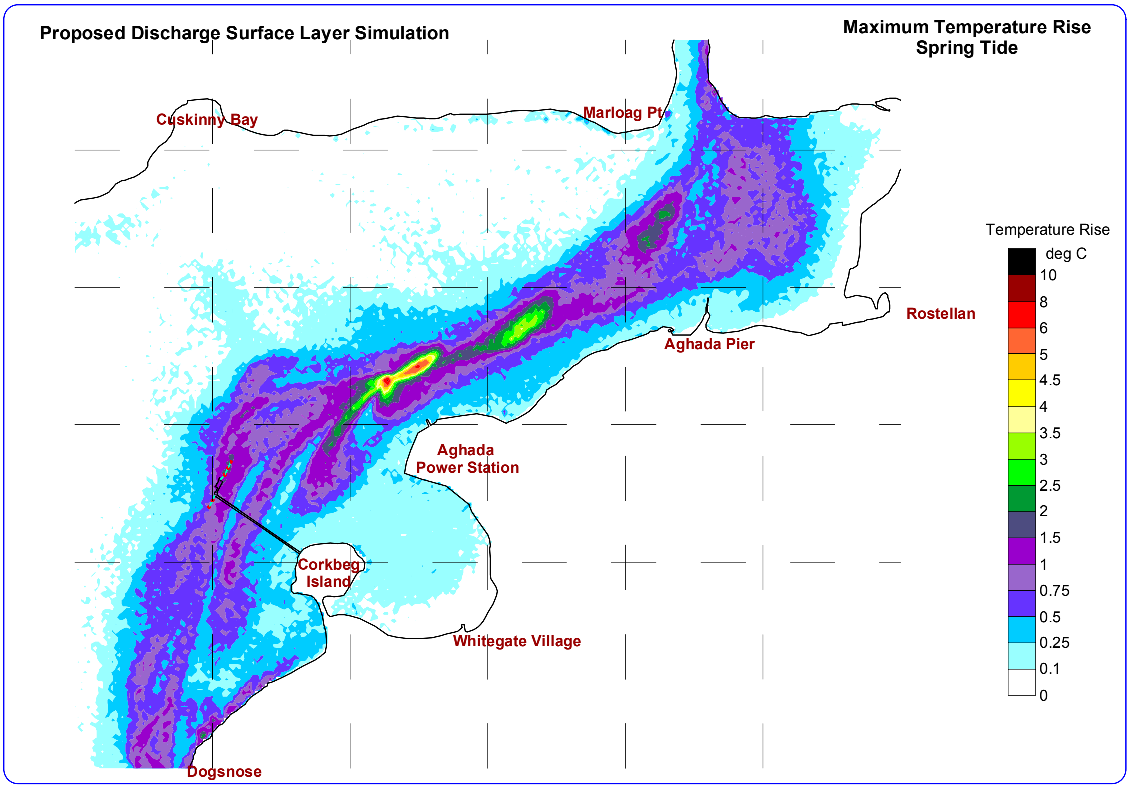


Figure 4.20: Maximum Temperature Rise for Proposed Cooling Water Discharge - Surface Plume Neap Tide Simulation

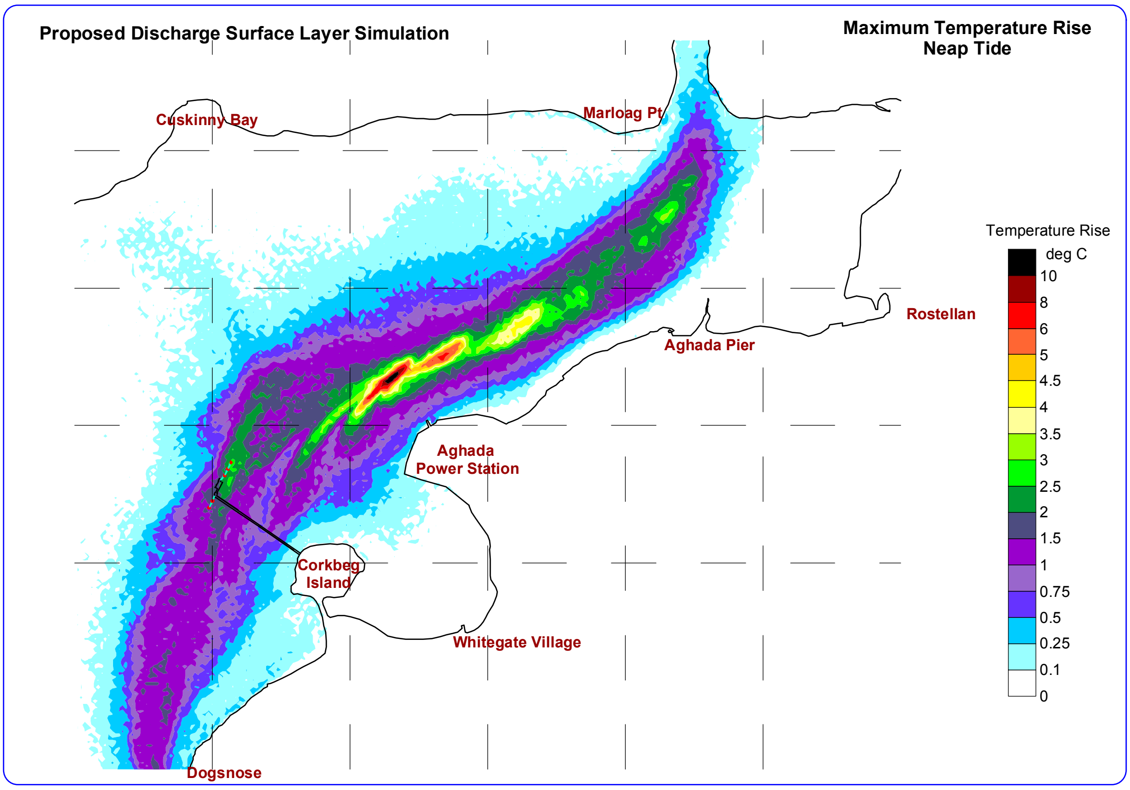


Figure 4.21: Tidally-Averaged Temperature Rise for Combined Cooling Water Discharge – Surface Plume Spring Tide Simulation

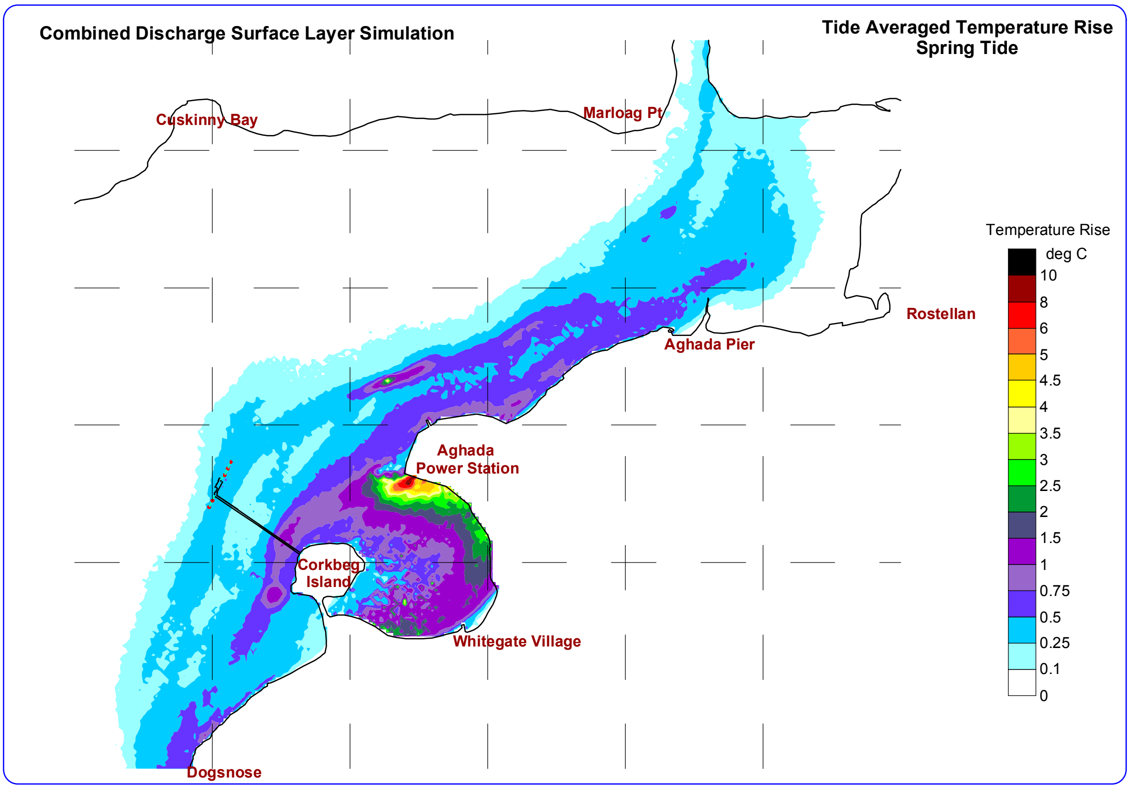


Figure 4.22: Tidally-Averaged Temperature Rise for Combined Cooling Water Discharge – Surface Plume Neap Tide Simulation

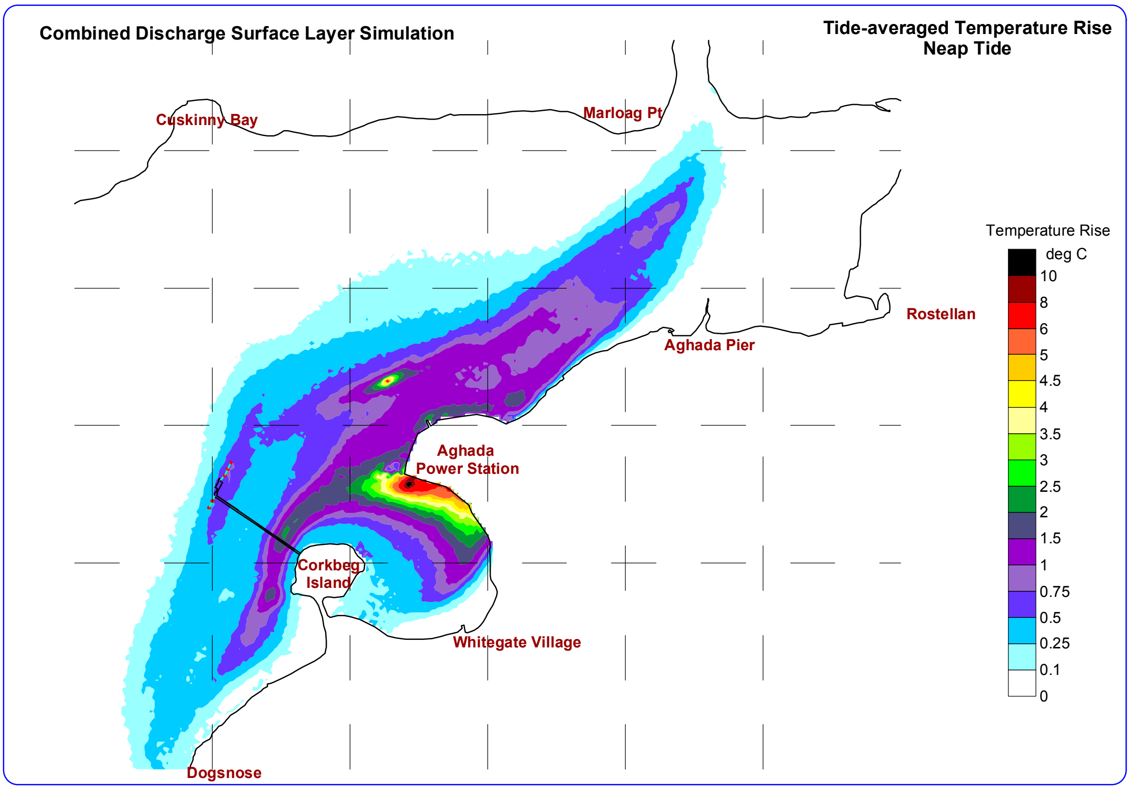


Figure 4.23: Max. Temp. Rise for Combined Cooling Water Discharge – Surface Plume Spring Tide Simulation

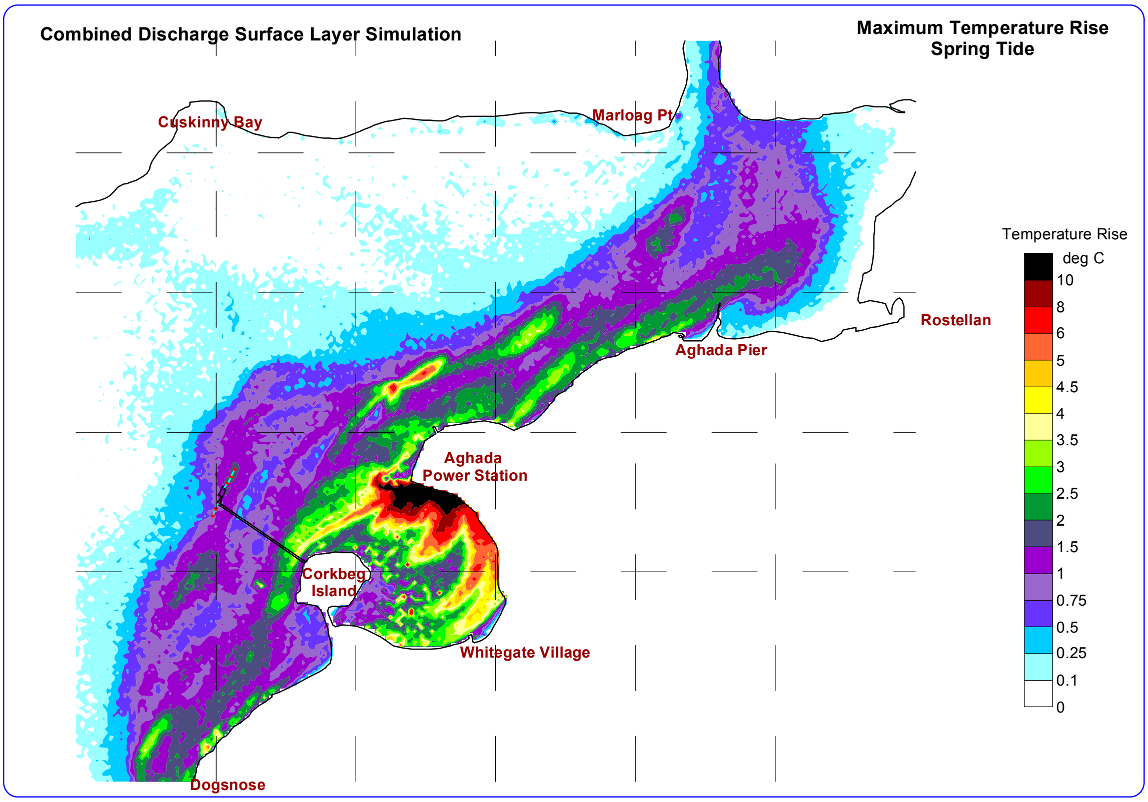
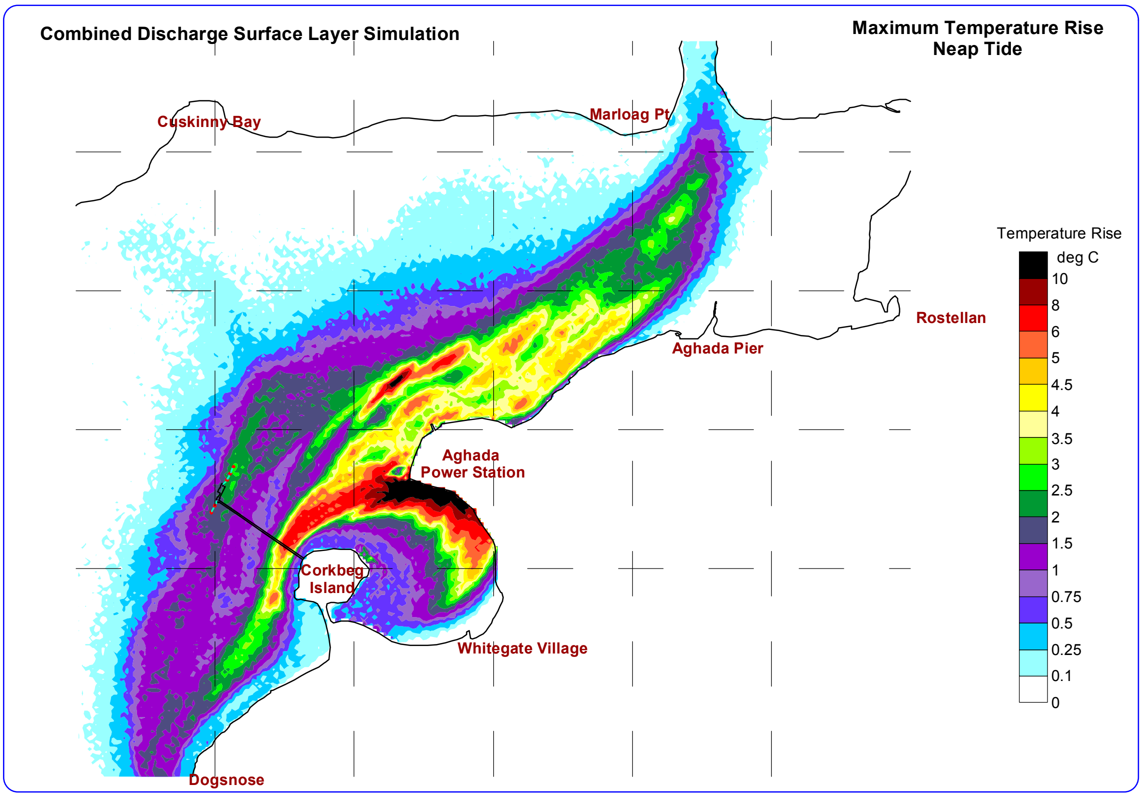


Figure 4.24: Maximum Temperature Rise for Combined Cooling Water Discharge – Surface Plume Neap Tide Simulation



Cooling Water Chlorine Impact

The impact of cooling water residual chlorine on the receiving water quality was assessed by modelling the existing outfall discharge, the proposed outfall discharge and the combined discharges under repeating mean tide conditions until equilibrium concentrations built-up. The amount of chlorine remaining after the initial decay phase is referred to as the residual chlorine and a more general term of chlorine produced oxidants (CPO) is used in the context of seawater mixing.

Therefore a conservative estimate using a first order exponential decay of half life 48hours was used. The chlorine discharge was modelled at 98-percentile load with a cooling water CPO concentration of 0.3 mg/l.

For the combined case the computed tide-averaged and maximum CPO concentrations at the existing outfall are 0.21 mg/l and 0.29 mg/l and 0.05 and 0.08 mg/l at the proposed outfall. The average concentration within Whitegate Bay is c. 0.05 mg/l with persistently higher concentrations occurring around the edge of the Bay fanning out in a clockwise direction from the existing outfall source. The tide-averaged concentration in the approaches to Whitegate Bay is of the order of 0.015 to 0.02 mg/l. The average concentration in the vicinity of the nearest shellfishery site located to the north of Aghada Pier is slightly less than 0.01 mg/l and maximum instantaneous concentration is 0.018 mg/l.

The impact of the cooling water discharge from the new proposed outfall on CPO concentrations in Whitegate Bay is very small relative to the existing outfall contribution providing an additional concentration of 0.0025 to 0.003 mg/l (approximately 5% of the existing outfall contribution). The predicted average increase in the receiving waters of the east side of lower Cork Harbour is 0.005

mg/l and at the nearest shellfishery located to the north of Aghada pier the tide-averaged concentration is 0.006 mg/l and the predicted maximum concentration is 0.01 mg/l.

Figure 4.25: Tidally-Averaged CPO Concentration for Existing Cooling Water Discharges - Depth-Averaged Mean Tide Simulation

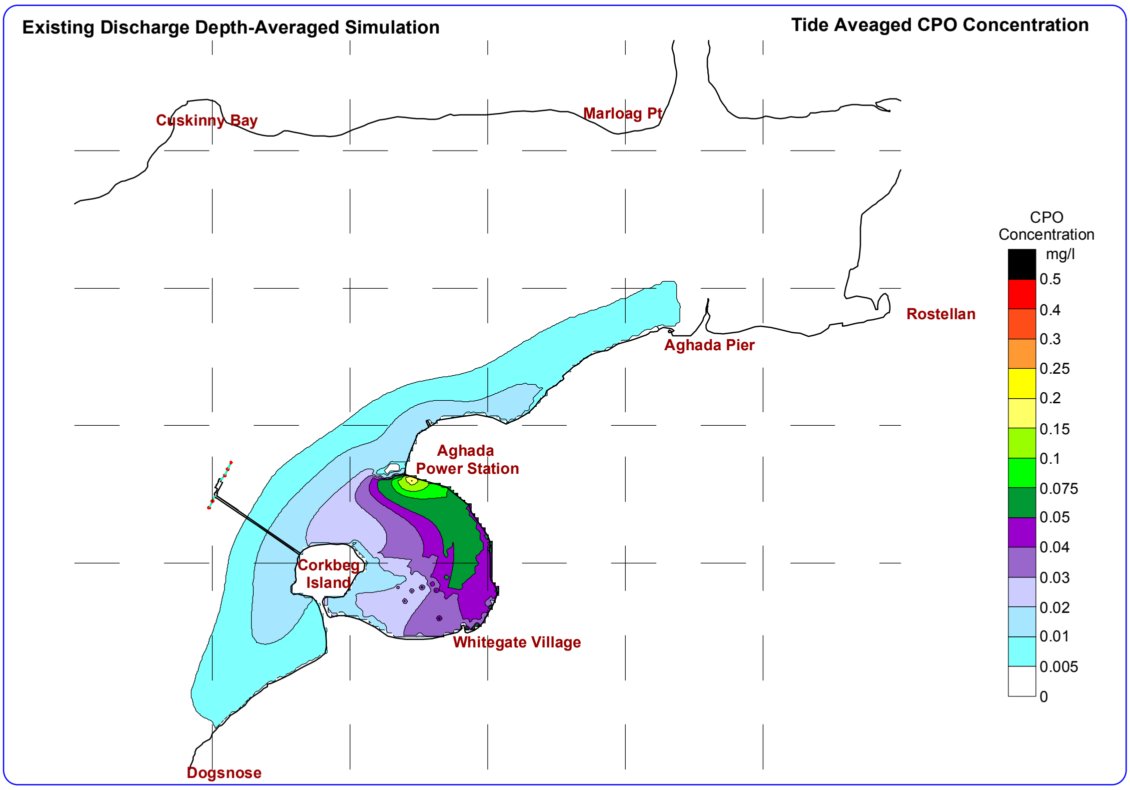


Figure 4.26: Maximum CPO Concentration for Existing Cooling Water Discharges - Depth-Averaged Mean Tide Simulation

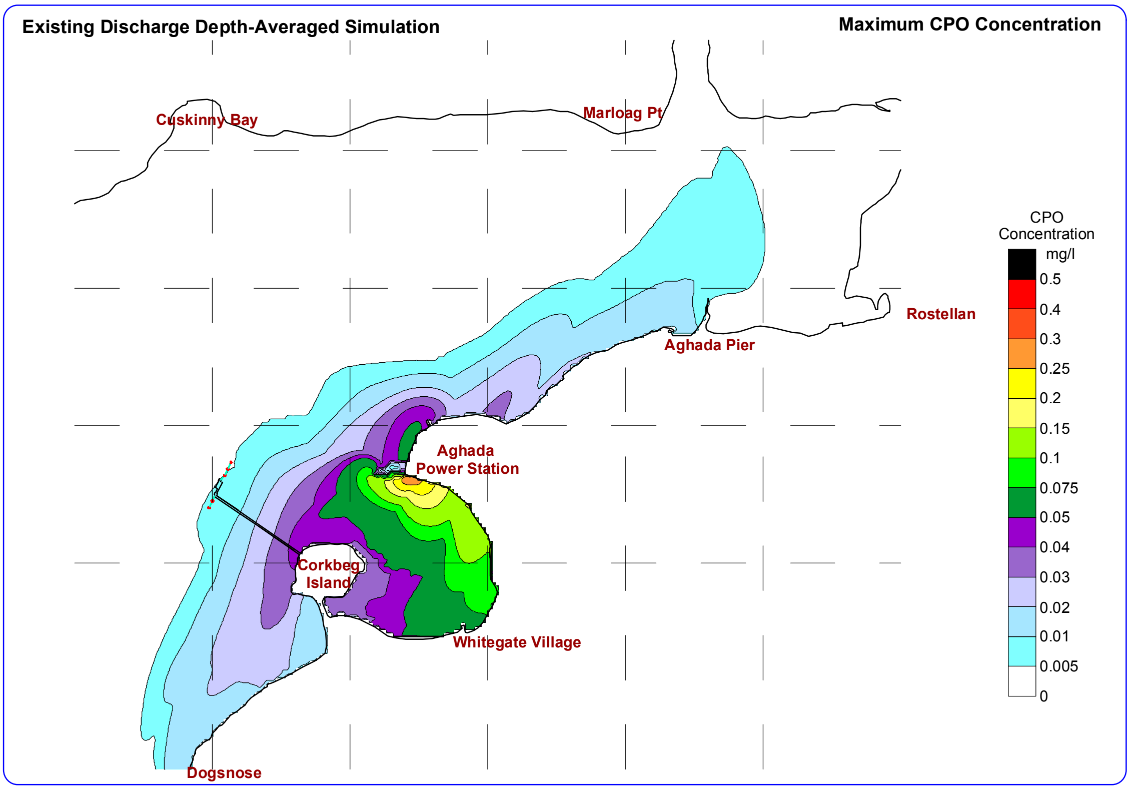


Figure 4.27: Tidally-Averaged CPO Concentration for Proposed Cooling Water Discharges – Depth-Averaged Mean Tide Simulation

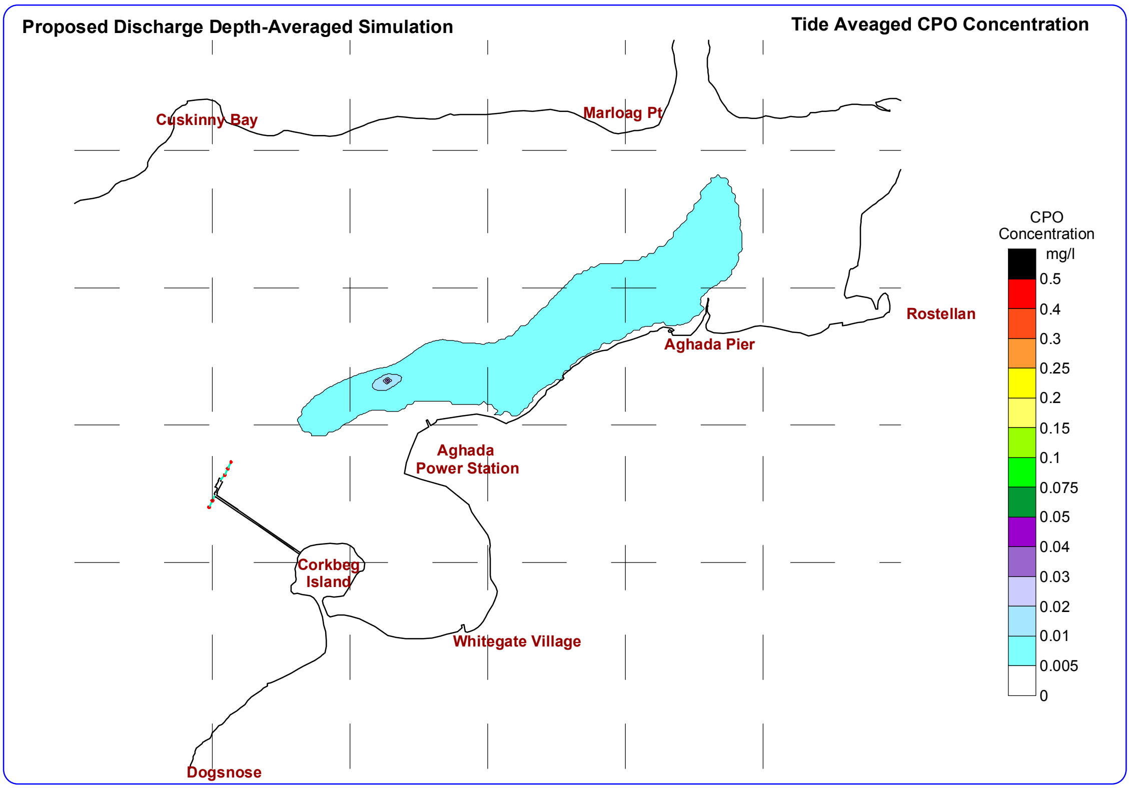
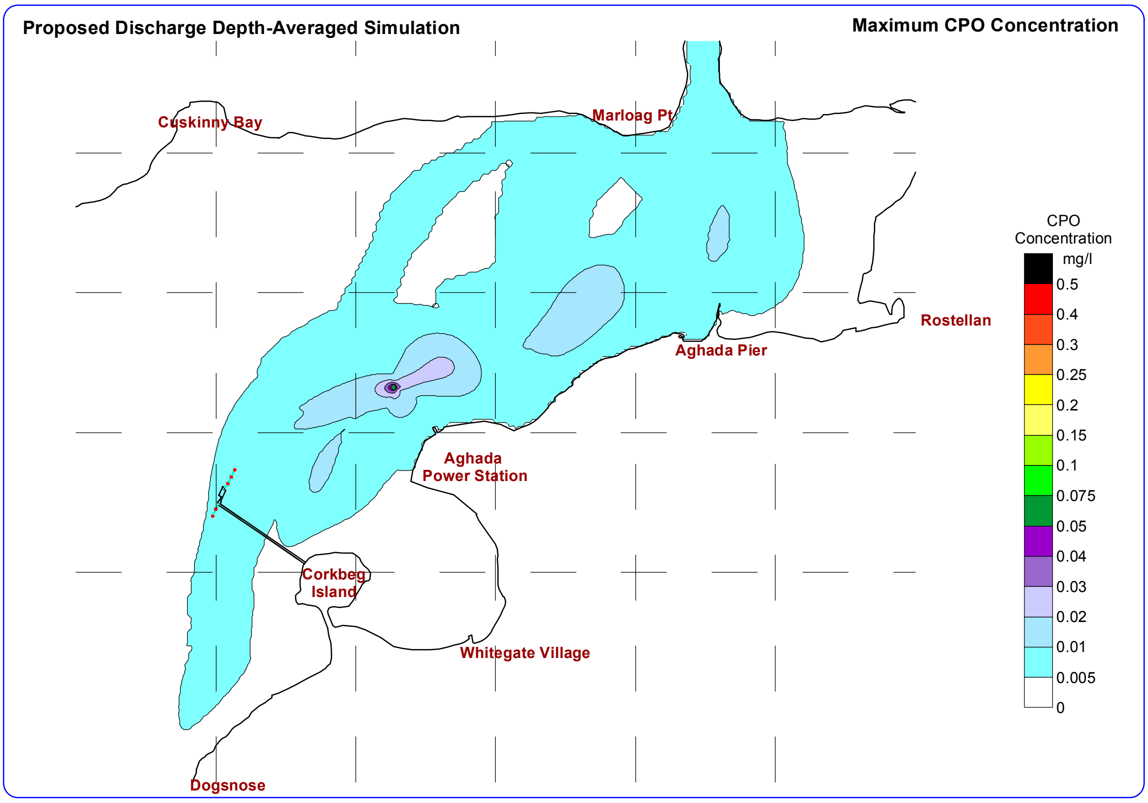


Figure 4.28: Maximum CPO Concentration for Proposed Cooling Water Discharges - Depth-Averaged Mean Tide Simulation



Near-field Dilution Assessment

The near-field mixing characteristics of the proposed outfall site were modelled using the USEPA approved CORMIX model originally developed by Cornell University. This model is the Industry standard for predicting initial dilutions and plume characteristics within the initial mixing zone. The physical characteristics of the outfall site and ambient water in terms of current speed, tidal height, local water depth, density profile, and distance from shoreline along with the physical characteristics or the proposed outfall and effluent properties were input to the model. CORMIX simulations were carried out for spring and neap tides with winter and summer salinity-temperature-density profiles.

The computed tidally averaged near-field initial dilutions at the outfall site itself are 2.4 and 1.6 for spring and neap tides respectively. The minimum near-field dilution is 1.4 occurring at low water slack tide, which at 98-percentile load would produce a temperature rise of 8.2 °C.

At a longitudinal distance of 100 m from the discharge point the plume is a surface plume having a tidally-averaged initial dilution of 3.7 and 2.5 for spring and neap tides respectively. A minimum dilution of 2 just after low water is predicted at this distance.

At a longitudinal distance (in the flow direction) of 500 m from the outfall the computed tidally-averaged initial dilutions are 5.1 and 3.3 for spring and neap tides respectively and the minimum initial dilutions are 4.2 and 3.2 respectively. The maximum predicted temperature rise is 2.74°C and 3.59 °C and the average temperature rise is 2.25 °C and 3.48 °C for spring and neap tides respectively. The characteristics of the thermal plume at this distance depend on the tide and but typically it is a surface plume having a vertical thickness of 0.5 - 0.6 m and transverse half-width (measured from the plume centreline)of 180 m on a neap tide and a plume thickness of 1 m and transverse half-width of 110 m on a spring tide.

At a longitudinal distance of 1,000 m CORMIX was only able to model mid-ebb and mid-flood conditions giving initial dilutions of 12 and 6 for spring and neap tides respectively. At the 98-percentile load this represents a temperature rise of 0.96 °C and 1.92 °C respectively.

In general the neap tides initial dilutions are lower than the spring tide dilutions, approximately one-third lower. There is little variation in computed dilutions between summer and winter density profiles with the summer profile producing marginally higher dilutions.

4.2.3 Other Characteristics of the Discharge

In addition to the thermal component of the discharge, there will be a number of low volume and intermittent aqueous streams associated with operation of the power station that will discharge to the aquatic environment in combination with the cooling water.

Surface water discharge from the site will be collected and passed through an oil-interceptor before discharge to the cooling water outfall.

Water Treatment

Effluent containing a dilute solution of sodium sulphate (Na_2SO_4) will arise from the regeneration of resins used in water treatment. These will be neutralised prior to discharge and will have no significant environmental impact.

HRSG Blowdowns

The volume of HRSG blowdown water will be inconsequential relative to the volume of cooling water flow with which it will combine. In addition, the concentrations of hydrazine and ammonia will be so low that no significant environmental impact will result.

4.2.4 Construction Impacts

Dredging

During construction of the CCGT plant the existing station will be in operation. In addition to environmental protection, it is a priority for the existing station to minimise silt disturbance to prevent ingress of silt into the existing cooling water intake which could damage the condenser tubes.

Dredging has been carried out for the nearby oil jetty with no silting problems.

The selected dredging procedure for the pumphouse and outfall pipe will ensure minimal disturbance of bed sediment in order to minimise environmental impact and also to ensure there is no interference with the existing power station, which will be fully operational during the dredging works. Silt curtains will be constructed if required to prevent excessive spread of silt during the dredging operations

Disposal of Spoil

Material and Quantity

Two separate investigations of the harbour bed in the area of the proposed intake and outfall have been carried out. The first was a sonar-based investigation that determined approximate thickness of the soft silt stratum and the level at which rockhead lies. The second comprised a full geotechnical investigation of 23 boreholes and cone penetration tests at 14 separate locations to determine the structural properties of the harbour bed materials.

These investigations indicate that the material dredged for the outfall pipe trench and the intake will comprise 15,000 t of hard material (rock and granular material) and 30,000 t of soft silt.

Sediment sampling and analysis was carried out in order to assess the materials' its suitability for disposal either on land or at sea. Sample numbers were agreed with the Marine Institute and with the Radiological Protection Institute. Seven samples were positioned along the line of a proposed 440 m cooling water discharge point and on the site of the proposed cooling water intake.

The sediment testing concluded that concentrations of PCBs, Organochlorine Pesticides and TBT were all below the detection limits requested by the Marine Institute for these constituents. In the case of heavy metals, levels were at or below both the Canadian and Dutch low-level guidelines. Exceptions to this are mercury and arsenic at one site which are above the lower Canadian limits which are more exacting for both these metals than the Dutch guidelines. In every case however, the levels are well below the second level, which in the case of the Dutch is the highest permitted. In the case of PAHs the levels were in general somewhat higher for most of the congeners than the lowest of the Canadian and Dutch guidelines at each of the four sites sampled. In all cases (bar anthracene & naphthalene in the case of the Dutch guidelines) they are below, generally well below the upper limit set in both sets of guidelines.

The results indicate that the material is not problematical and is suitable for disposal and reuse.

Alternative Uses

The disposal of dredged material at sea is permitted only if no other beneficial use or financially viable alternative for dredged material is available. The OSPAR Guidelines list three possible uses:

- Engineering uses, i.e. land creation, fill material etc.
- Agriculture and product uses
- Environment enhancement

Dredged rock and granular materials will be re-used, either as backfill material for the pipe trench or elsewhere in construction of the power plant.

However, the dredged silt contains none of the physical or chemical properties required for the above uses. In particular, the option of disposing of the material within the existing lagoons on site was examined in detail.

Option: Reuse in the large lagoon on site

The dredged material would be pumped onto the base of the large lagoon. During construction, the existing drainage outlets will be closed. As the material settles to the bottom, a controlled decanting system will drain away the water from the top of the lagoon back to the harbour. Following completion of the works, the extent of the large lagoon is such that the material would settle below the lagoon low water level and there would always be water in the lagoons, varying in depth from 0.5 m to 4 m.

Option: Reuse in the small lagoon on site

The material could be used to fill completely the small lagoon. There would be considerable surplus material left over which could be placed on the base of the large lagoon.

However, after detailed consideration, these options were discounted for the following reasons:

- The silt is not suitable material for structural fill and would not contribute to reclamation of the lagoon as any future foundations will have to be piled.

- Safety is a key issue with regard to reuse of dredged material in the lagoons. Soft silt placed to full height in the small lagoon would require a period of years to dry out and may form a safety hazard. The level of the area of the site adjoining the lagoons is quite low, approximately half a metre to one metre above high tide, so only the top portion will tend to dry out and it may take an extended period to do so.
- There would be a risk of a silt plume emerging into Cork Harbour from the large lagoon
- From the ecological perspective, any further reduction in the extent of the area of the large lagoon over the 25% (which should be further minimised if possible) required to accommodate pipework between the proposed CW intake and the new CCGT station is not recommended (Refer Section 5.3.3). This is considered to be the maximum extent to which the area of the eastern lagoon can be reduced without impacting on its attractiveness as a feeding site for red-breasted mergansers, which could occur occasionally in numbers approaching national importance during some years. Roosting use by little egrets could also be affected.
- There will be less interchange of water between the harbour into the lagoon which could give rise to stagnant conditions in the lagoon

Therefore, disposal at sea is the only viable solution.

Marine Disposal Site

Dredged material from maintenance works in the navigation channels and berths in Cork Harbour is disposed of at sea at present. There is a designated location for disposal, directly south of the harbour.

Regular disposal of spoil has been carried out at the disposal site since 1978. Approximately 7 million cum has been deposited since regular disposal began and no known negative impacts have arisen.

The deposit, which extends to 1.4 km x 2.8 km, is located south east of Roche's Point.

From 1998 to 1998 maintenance dredging volume was approximately 95,000 m^3 per annum. From 1997 to 2001 the maintenance dredging volume amounted to approximately 100,000 m^3/annum. The following quantities of dredge material are envisaged by Port of Cork over the next few years.

Table 4.3: Summary of Current Port of Cork Application Dredging Requirements 2002-2007

<table>
<tr><th colspan="2">Year</th><th>2002</th><th>2003</th><th>2004</th><th>2005</th><th>2006</th><th>2007</th></tr>
<tr><td rowspan="2">Total</td><td>M^3</td><td>154,000</td><td>170,000</td><td>170,000</td><td>170,000</td><td>170,000</td><td>170,000</td></tr>
<tr><td>Tonne</td><td>231,000</td><td>255,000</td><td>255,000</td><td>255,000</td><td>255,000</td><td>255,000</td></tr>
<tr><td colspan="8">Estimated quantities per campaign</td></tr>
<tr><td rowspan="2">Likely requirement</td><td>M^3</td><td>Nil</td><td>340,000</td><td>20,000</td><td>360,000</td><td>20,000</td><td>360,000</td></tr>
<tr><td>Tonne</td><td>Nil</td><td>510,000</td><td>30,000</td><td>540,000</td><td>30,000</td><td>540,000</td></tr>
</table>

* based on major campaigns in 2003, 2005 and 2007

Predicted Impact

The Cork Harbour disposal site has been subject to assessment by Port of Cork as required by the Department of Marine for permitting under the Dumping at Sea Act, 1981.

To date there are no known negative impacts from the disposal of spoil at the site.

The material excavated from the Aghada site is suitable for disposal.

The quantity of material to be disposed of is minimal in comparison to the annual quantities which will be arise from the general Harbour area over the next few years. Dredge disposal for the project is a one-off requirement.

4. 3 MITIGATION

4.3.1 Thermal Plume

The outfall location was chosen for its distance of over 400 m from the Aghada shoreline, its good depth of water, i.e. 6 m at MSL, and most importantly its strong rectilinear currents that run parallel to the shoreline. The selected location is further enhanced by its preference for ebb-flow, flowing seaward for 7 - 8 hours of the 12.4 hour tidal cycle. This minimises the impact upstream of the outfall and on the nearby intertidal shoreline areas.

The outfall discharge characteristics will ensure optimum initial mixing, with the plume rising rapidly due to its positive buoyancy to form a shallow surface plume that can maximise the natural cooling process through transfer of energy from the water surface to the atmosphere.

The initial tidal excursion of the plume will remain offshore in a narrow surface plume elongated in the direction of flow and is not predicted to attach itself to the east shoreline within the first tidal excursion. The plume will also be partitioned from spreading westward and northwards across the deepwater channel towards Spike Island and Great Island by the strong streamline flows within the channel itself. These characteristics ensure maximum channel width for the passage of fish.

The outfall will always be submerged by at least 2 m at low water spring tide, thereby minimising potential for foaming at the surface.

4.3.2 Surface Water Drainage

Dedicated storage areas will be provided for oil in drums and for waste oil. Drummed oil will be held in a purpose designed storage facility having a drip tray, with valved outlet, to collect any spills or leakage. Oil absorbent material will be available for use in the event of any accidental spillage.

To eliminate any possibility of discharging contaminated water, drainage will be routed through appropriately designed oil separators before addition to the cooling water system.

Drainage from bunded areas will be controlled by providing valved outlets which will normally be in the closed position. The contents of bunds to bulk chemical tanks will be tested prior to their release.

Delivery of bulk chemicals will take place at a designated area, drainage from which will be directed to the neutralisation system of the water treatment plant.

4.3.3 Water Treatment

All effluents from water treatment and all floor drainage will be directed to a central sump within the water treatment building. This comprises a tank for fully mixing and storing the waste and a neutralisation system where acid or caustic are added as required to neutralise the waste before controlled discharge.

Monitoring of the discharge will include continuous recording and an alarm facility.

4.3.4 Dredging

As recommended in Section 5.2.9 following, the dredging will be timed for the start of the year January-April, to avoid the main fishing seasons and to facilitate re-commencement of recolonisation by benthic and other aquatic life.

4.3.5 Disposal of Spoil

Dredged rock and granular materials will be re-used, either as backfill material for the pipe trench or elsewhere in construction of the power plant.

4. 4 CONCLUSIONS

The proposed outfall site is located 440 m northwest of the Aghada cooling water intake. The site is characterised by reasonably strong ebb and flood flows (0.4 - 0.5 m/s spring tides and 0.2 - 0.3 m/s neap tides) with the duration of ebbing flow 30 to 40% longer than the incoming flooding flow, thus favouring a net seaward excursion. The flow is rectilinear and parallel to the shoreline reducing the opportunity to impinge directly on the inter-tidal areas of this side of the harbour. The available water depth for mixing is 6 m at MSL.

In the initial site selection study the objectives in selecting the outfall were to minimise impact to Whitegate Bay, prevent recirculation and achieve good initial mixing at the outfall to reduce medium and far field impacts. These objectives were achieved with the proposed outfall site.

At the outfall site average dilutions of 2.4 and 1.6 for spring and neap tides is achievable for the proposed single discharge configuration at the 98-percentile discharge rate. At 500 m from the outfall the average dilution is 5.5 and 3.3 for spring and neap tides reducing the temperature rise to 2 °C and 3.5 °C respectively. The surface plume modelling show minimal impact to Whitegate Bay with the predicted temperature rise less than 0.1 °C. The predicted impact on the licensed shellfishery sites located north of Aghada pier is slight having tide averaged surface temperature rise of 0.3 °C and maximum instantaneous temperature rise of 1.1 °C. The impact on the cooling water intake is also small with predicted tide averaged surface temperature rise of 0.2 °C and maximum instantaneous temperature rise of 0.5 °C. Under certain adverse wind conditions in combination with slack tide periods the maximum temperature rise may be higher than 0.5 °C, but will be of a very short duration as modelling and measurement have identified strong longshore tidal flows at the intake point.

The long term temperature contribution of the proposed discharge to the east side of lower Cork Harbour is 0.1 - 0.2 °C. On the west side of the Harbour the long term temperature rise resulting from the proposed Aghada discharge will be less than 0.05 °C.

The water quality impact of cooling water chlorination from the proposed new outfall was quantified in terms of Chlorine Produced Oxidants concentration. The predicted long-term increase in CPO concentrations in Whitegate Bay is 0.003 mg/l. The predicted average increase in the receiving waters of the east side of lower Cork Harbour is 0.005 mg/l and at the closest shellfishery it is on average 0.006 mg/l with a maximum concentration of 0.01 mg/l. These concentrations suggest that the chlorine impact from the proposed outfall will not be significant in terms of toxicity effects on marine organisms.

Dredged rock and granular materials will be reused, either as backfill material for the pipe trench or elsewhere in construction of the power plant. Disposal at the licensed Cork Harbour marine disposal sea is proposed for the silt portion of the dredged material for which there is no alternative beneficial use. Negative impacts are not anticipated.

5. FISHERIES, FLORA & FAUNA

5. 1 FIN FISHERIES

5.1.1 Description of Existing Environment

A general review of the finfish resource in Cork Harbour is presented in Appendix E, which also contains information on fin-fish surveyed by the Central Fisheries Board at selected sites in Cork Harbour during 2001.

Salmon Salmo salar and sea-trout Salmo trutta

Four rivers contribute salmon and sea-trout to the Cork Harbour area: Owenacurra, Glashboy, Owenaboy and the Lee. The largest run of salmon is in the Lee, which takes place mainly during the summer months. There are 20 draft net licences in the area north and west of Corkbeg Island. A reduced fishing season, 12 May – 31 July on a four day per week basis, is in line with recommendations for salmon conservation made by the Salmon Management Task Force Report of June 1996. An annual restocking programme takes place, consisting of about 135,000 smolts on the Lee with an estimated return to the Irish coast of adult salmon of about 2-4%.

Runs of salmon into the River Lee (verified by adult census work at Inniscarra Generating Station, where 1,000 – 2,000 salmon are counted each year) and the recreational fishery harvest on the River Lee downstream of Inniscarra Generating Station (where in the region of 1000 salmon are taken by anglers each year) demonstrate that salmon populations in the lower River Lee are in a healthy state. Additionally, the performance of salmon smolt released into the River Lee, in terms of adult return rates, has been comparable to the performance of reared smolt released into Irish rivers which do not receive thermal discharges from generating stations.

In conclusion, the status of salmon populations in the lower River Lee shows that the thermal discharge from the existing Aghada Generating Station has had no impact on them.

The South Western Regional Fisheries Board was contacted in the course of the consultation process and the issues raised have been addressed in the EIS.

5.1.2 Impact of the Development

The main potential environment impact of the proposed development on fisheries will result from the thermal plume generated by the cooling water discharge.

A literature review of the environmental issues associated with the operation of cooling water systems associated with thermal electricity generating stations at coastal, estuarine and inland sites has been carried out and is presented as Appendix F. This comprehensive review examines Irish, European and worldwide experience of the environmental impact of cooling water systems on fin-fish with particular reference to the issues of impingement / entrainment of aquatic organisms and the effects of biocides and thermal effluents on organisms in the receiving aquatic environment. Water intake velocity and screening issues are reviewed with particular reference to existing Irish legislation.

In summary, the review of literature indicates that no cases have been identified where the population of a fish species has been significantly depleted by cooling-water systems, either by impingement, entrainment or thermal discharge mortalities. Industry-based marine biologists have investigated a wide range of issues relating to coastal power generation since its expansion in

Britain in the 1950s. Early fears of wide-scale ecological damage arising from discharge of heated effluent proved to be unfounded. The removals of fish and other organisms by cooling water abstraction have also been shown to be of no consequence, either ecologically or to the fishing industry.

The existing thermal power station at Aghada has been in operation since 1979 and there is no evidence that the operation of the existing cooling water system has had any impact on the fin-fisheries resource in Cork Harbour or on migratory fish passing through Cork Harbour.

While the cooling water system at the existing station impinges and entrains various quantities and species of fish throughout the year, there is no evidence that the losses of fish from quantities impingement and entrainment have had any impact on the overall wellbeing of fish populations in Cork Harbour.

There is no evidence that the thermal discharge has had any impact on local fish populations or on the ability of migratory species to migrate through Cork Harbour. With the plume confined to the surface layers, smolt on their migration from freshwater to the sea and returning adults on their migration from the sea to freshwater are capable of passing the area of the thermal plume, most probably by diving under it.

The proposed new intake structure will be located approximately 100 m north-east of the existing intake structure while the cooling water discharge location for the proposed new station will be 440 m offshore with the pipeline to the discharge point located approximately 60 m south-west of the existing intake structure.

The outfall discharge characteristics will ensure optimum initial mixing, with the plume rising rapidly due to its positive buoyancy to form a shallow surface plume that can maximise the natural cooling process through transfer of energy from the water surface to the atmosphere. Furthermore, the plume will be partitioned from spreading westward and northwards across the deepwater channel towards Spike Island and Great Island by the strong streamline flows within the channel itself. These characteristics ensure maximum channel width for the passage of fish.

5.1.3 Mitigation

The cooling water intake design velocity will not exceed of 0.3 m/s. This intake velocity is recommended by the statutory fisheries authorities. Screening arrangements will be standard and include a coarse screen with c. 50 m bar spacing and a suitable trash raking system.

The selected dredging procedure for the pumphouse and outfall pipe will ensure minimal disturbance of bed sediment in order to minimise environmental impact.

Local disturbance can be expected during construction but, again, fish will be able to swim away from such areas.

5.1.4 Conclusions

Fin fisheries will not be adversely affected by the development.

5. 2 AQUATIC FLORA AND FAUNA

An independent consultant was commissioned by ESBI to provide inputs to the EIS relating to aquatic flora and fauna in the vicinity of Aghada. The resulting report is included in full in Appendix G.

5.2.1 Receiving Environment - Intertidal Habitats

In 1976, a baseline shore survey was undertaken in advance of the construction of the Aghada Generating Station as part of the Environmental Impact Assessment for the project (AFF 1976). Detailed follow-up surveys have been undertaken in the same areas in 1992 (Anon 1992) and 1999 (Anon 1999). The study area was centred on Long Point, much of which was removed as part of the original construction, and Whitegate Bay along the roadside (eastern) shore.

The methods used for all these studies were the typical transect studies involving an assessment of % cover of algae and numbers of fauna along a line from the upper to the lower shore. These studies have revealed the strongly zoned distribution of large seaweeds (macro-algae) and to a lesser extent associated faunal elements.

The distribution patterns are generally a product of a number of factors. Plants and animals that are most tolerant of exposure to the atmosphere and all its attendant stresses are to be found higher up on the shore, while the reverse is true of those species which can only tolerate a short period of exposure to the atmosphere. Overlain on this is the impact of short-term events, e.g. effluent or oil spills, periwinkle or seaweed harvesting or more sustained events e.g. cyclical patters of seawater temperature change, on-going enrichment from sewage or catchment-derived nutrients or thermal and biocidal effects from power station cooling water discharges, for example.

Current Study

The thermal plume model output for the proposed offshore CW discharge shows a rapid attenuation of temperature within the plume such that elevated temperatures (3 –10 ºC) are predicted to occur only within a short distance around the outfall and elevated temperatures do not impinge on the inter-tidal areas of this part of the harbour. For this reason it is anticipated that any intertidal impacts are likely to be marginal. Nevertheless, the thermal output from the new plant will have a small additive affect on the existing one in certain areas and will extend the enhanced thermal influence, albeit it a very weak one, over a larger section of the eastern side of the harbour.

For these reasons it was decided to undertake an intertidal survey at selected points within the overall study area, the locations for which were informed by the predictive spread of the combined thermal plumes. An objective was to assess whether there were any obvious gross changes in the immediate area of the current plant, i.e. where the model predicts the greatest thermal enhancement effect, and provide a qualitative baseline for the wider area where lower thermal enhancement is predicted.

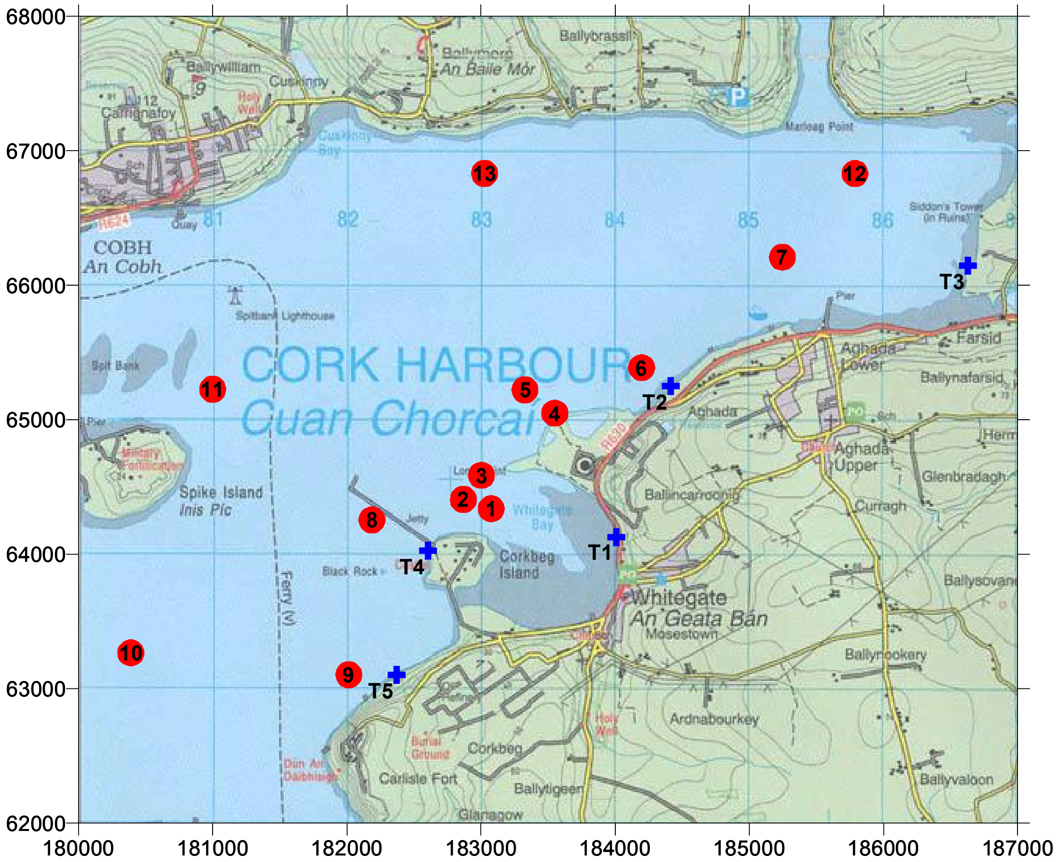
Five transects sites were chosen for survey, as shown in Figure 5.1

5.2.2 Results

The shore transects generally contained a typical range of rocky intertidal plants and animals which displayed the typical zonation patterns expected in a range of sheltered to semi-exposed sites. There were no obvious features in the data, which would suggest that the thermal discharge was having a significant impact on the flora and fauna present. All of the main algal and faunal species previously encountered in the baseline survey and follow-up surveys in the general area were present.

Much of the rock armour embankment that surrounds the power station was covered in a heavy growth of brown macroalgae especially *Ascophyllum* but also *Fucus vesiculosus* throughout the middle shore with *Fucus spiralis* and *Pelvetia* on the upper levels and *Fucus serratus* on the lower shore.

Figure 5. 1: Map showing sub-tidal sampling Positions (Red Circles) and Intertidal Transects (Blue Crosses)



Only on the southern side of the embankment as it abuts the north-eastern corner of Whitegate Bay are some of the very large limestone boulders on the shore more or less free of brown seaweeds and covered instead with barnacles and effect also seen in the Rostellan Shore area and on Corkbeg Island. However, heavy growth of *Fucus vesiculosus* and *Ascophyllum* are present on top of or between these boulders west as far as the CW outfall. All along the lower part of the same shore *Fucus serratus* is abundant as are localised beds of large blue mussels (*Mytilus edulis*) and locally dense colonies of *Lanice conchilega* (the Sand Mason worm).

Moving in the other direction from the CW outfall i.e. west to Long Point, all the same red and brown algae previously recorded from the area were in evidence, e.g. *Ascophyllum* and the other fucoid algae abound and littorinid snails, topshells (*Gibbula umbilicalis* and [1]*Trochococlea lineata,*) dog whelks (*Nucella lapillus*), beadlet anemones, and juvenile shore crabs were all common within 20-50 m of the outfall.

Most of the algal species found on Long Point were noted in the baseline survey (1976) and in follow-up surveys in the 1990s.

At low spring tide on 6th May 2004, a large bed of Laminaria was present on the tip of Long Point comprising mainly *L digitata / hypoborea.* Laminaria saccharina was also present although slightly less common. On the same day across the channel on the northern shore of Corkbeg Island, *Laminaria* beds were also observed along the full length of the shore with *L. saccharina* becoming more common in toward the Whitegate Bay end. In September 2003, grab sampling in the

[1] Formerly *Monodonta lineata*

channel between Corkbeg Island and Long Point frequently came up with Laminaria saccharina, Ulva, Chorda filum and occasional *Dictyota dichotoma*. During low spring tide on May 6th 2004, *Asterias rubens*, (Common starfish), brittle stars, cushion stars (*Asterina*) sponges, sea slugs, colonial ascidians (*Botrylloides leachi* mainly and *B. schlosseri*), hydroids (especially *Clava multicornis*) and bryozoans (epiphytic of fucoids), were noted in the lower shore on both sides of the channel.

5.2.3 Receiving Environment - Benthic Communities

As part of the current study, 13 stations were selected for benthic faunal analysis, both in proximity to Aghada and further afield. A total of 68 taxa were encountered, the majority of which were identified to species level. A full listing of all taxa encountered and their numerical abundance can be found in the main report in Appendix I.

All species can be assumed to be widespread in Cork Harbour and based on available information in numerous publications and unpublished internal reports further afield in Irish coastal waters, although it must be stressed that several are rarely recorded in faunistic surveys, e.g. the nemertean worm *Tubulanus annulatus*.

Very few taxa occurred in the majority of samples, with 24 species only occurring in a single station. Of the widespread species, the majority were infaunal polychaete worms. In addition, three bivalve molluscs and one epifaunal amphipod also occurred in more than 8 stations. In terms of numerical dominance, the same species featured but, in addition, the polychaete fan worm *Sabella pavonina* and the bivalve mollusc *Tellina fabula* also achieved dominance, mainly due to their high numerical abundance at a few stations.

In terms of the sedimentary environment, all stations were similar, with the majority being muddy sand with a variable admixture of gravel, much lower at station W10 and W11, which contained virtually no gravel. On the whole, the majority of stations harboured relatively high levels of silt, as can be expected in an enclosed ria environment. Notable exceptions were Stations W1, W2, W9 and W10, which harboured much lower silt percentages.

In terms of water depth, all sampled stations are quite comparable, spanning the 0.7 - 3.0 m depth range, with the majority of samples being around 1 m deep.

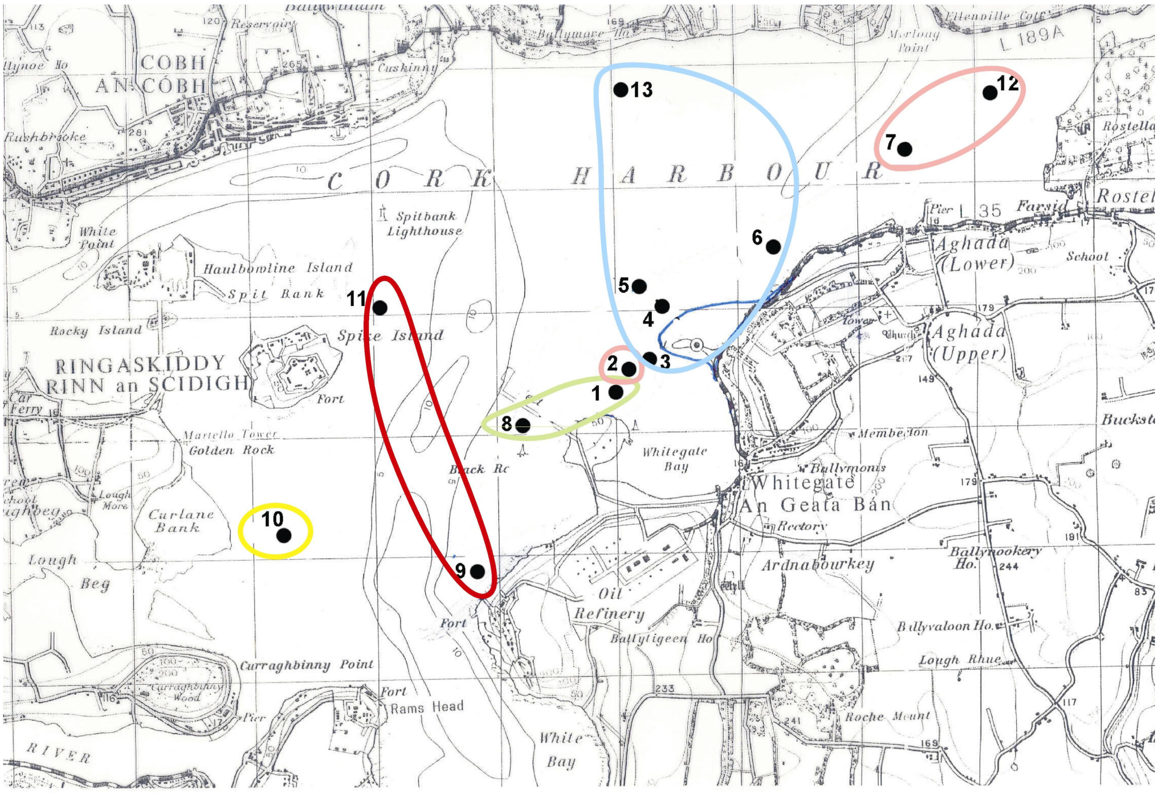
In terms of the intrinsic diversity of the community, much higher numbers of species (e.g. 30) were found at Station W11, with the other stations harbouring approximately either 20 odd species or slightly less (about 12 species).

Combining the results from both multivariate techniques, the following communities emerge (Figure 5.2).

<u>Stations W9 + W11,</u> present off the Dogsnose and Spike Island. This community is characterised by low densities of the polychaete, *Melinna palmata*, but with high diversity, and low organic matter. This community is representative of areas closer to the central main channel of Cork Harbour, which experience greater water movement.

<u>Stations W1 + W8,</u> distributed around mouth of Whitegate Bay toward the west and southwest. This community is characterised by a slightly lower species diversity, combined with low species abundances. Compared to the above community, characteristic species are absent in this biotope, although the dominance of *Nephtys hombergii* can be noted.

Figure 5.2: Resultant Community Distribution



<u>Stations W2, W7 + W12,</u> distributed north of Aghada, but also including one station close to Whitegate Bay, around the projected dredge area. This community is characterised by high densities of the fan worm, *Sabella pavonina* and the feather star *Antedon bifida*. Previous studies in Cork Harbour have shown this community to be widespread along the northern part of Cork Harbour, principally off Cobh, with the community being characteristic of a more depositing environment, but with sufficient currents to maintain a rich epifaunal filter feeder community.

<u>Station W3, W4, W5, W6 + W13,</u> distributed in the central part of the study area, close inshore. This community is principally characterised by the high densities of the tube building polychaete *Melinna palmata*. It is know to occur all along the edges of the Harbour, on both the western and eastern sides and is widespread along other coastal areas. This community is characteristic of muddy, shallow waters, in areas with reduced tidal and current flow.

<u>Station W10,</u> situated off the Curlane Bank. This community is very similar to the above one, mainly being separated on the basis of a small number of species, which are characteristic of more sandy sites, such as *Perioculodes longimanus*; it has a lower intrinsic diversity. Although separated out by both multivariate techniques, this community is best interpreted as a variant of the above one.

5.2.4 Receiving Environment - Commercial Fisheries and Aquaculture

Bórd Iascaigh Mhara (BIM) was contacted in the course of the consultation process and it provided comments on shellfish designations which have been taken on board in this EIS.

Wild Shellfish Fishery

Vessels more than 12 m in length are not permitted to fish within Cork Harbour. Vessels fish mainly out of Cobh and Crosshaven. At present the maximum number of trawlers that fish within the harbour is four but normally there are just two.

Species Fished

Boats are engaged in potting for lobster (*Homarus vulgaris*), Edible or brown crab (*Cancer pagurus*), Velvet crab (*Liocarcinus puber*) and the common shore or crab or green crab (*Carcinus maenas*). Shrimp (*Palemon serratus*) are also potted extensively in late summer and autumn. A limited amount of mullet fishing takes place during the summer months and trawling takes place, particularly later in the year for codling and flat fish.

Occasional scallop fishing is undertaken south of Cuskinny on the south shore of Great Island. However, this is only an occasional fishery and the last time a significant fishing effort was made was about 4years ago.

Fishing Areas in the Eastern Harbour

Potting is undertaken extensively from the inside the Dogsnose (Fort Davis / Carlisle) along the rocky coast ('Jacco's), skipping the shallow sandy area west of the causeway to Corkbeg Island, around the tip of Corkbeg island into the entrance to Whitegate Bay, along the southern shore of Long Point and along the northern shore of Long Point all around the rock-armour-protected promontory of the existing power station into the shore at 'Kelly's House' on the Aghada shore just north of the power station. Up to 2,000 pots can be laid in this area at any one time and in general the area is considered very productive for all potted species.

Potting for shrimps crab and lobster is also undertaken along the Cobh shore east of Cuskinny and to a limited extent up the East Ferry channel. Green crab are also fished in the north channel.

Trawling is undertaken in several places around the harbour especially along the shelf bordering the main channels. Within the immediate study area trawling takes place from inside the Dogsnose inward to the north and east following the sweep of the bay toward Corkbeg Island outside the refinery jetty and north opposite Long Point and on toward the east channel.

Netting for mullet is undertaken around Aghada, mainly during the summer.

Overfishing is a threat to all fisheries and responsible management and conservation of the resources are required if long-term sustainability is to be ensured. In light of this, lobster conservation measures have been adopted by the Cork Harbour fishermen in line with their counterparts around the Irish Coast. This initiative, which is jointly funded by the DCMNR and the fishermen themselves, has been in operation for about 7 years.

Aquaculture

Mussel culture is totally banned in Cork Harbour because of the prevalence of the organisms that cause PSP (Paralytic Shellfish Poisoning). Oysters are the main species cultivated.

Atlantic Shellfish is the only aquaculture concern operating within the eastern inner harbour south of East Ferry and is one of the largest shellfish aquaculture concerns in Ireland.. The company possess an oyster order extending from the tip of Long Point to Cuskinny on Great Island and is permitted to undertake shellfish growing within this area. At present it undertakes bottom culture of native or flat oysters (*Ostrea edulis*) in a sub-tidal block off Siddon's Tower on the Rostellan shore of the eastern side of the harbour. Pacific or Japanese oysters (*Crassostrea gigas*) are also cultured along the lower intertidal at Rostellan where they are on-grown in bags placed on trestles.

The native oyster beds are seeded with spat produced in large hatchery ponds in the North Channel. At present three year-classes are laid (2001, 2002, and 2003) and harvesting is expected to begin in 2005. The Pacific oysters on trestles are stocked with juveniles from a nursery area near Saleen a little further north where the conditions are more sheltered. These in turn are seeded with imported spat.

5.2.5 Potential Impacts of Dredging

Dredging will be required for the construction of the cooling water intake structure and the cooling water outfall pipe trench.

Dredging will generate a turbidity plume in which suspended solids levels will be elevated above background concentrations. Predicting the precise concentrations present is difficult, as it will depend on several variables. These include the nature of the bottom material, the state of the tide, the weather, the type of dredger being employed and the rate of dredging. Given the moderately sizeable scale of the dredging operation required, a trailer suction dredger is the most likely vessel to be employed. In any case, close in to the dredger (say within 100 m) suspended solids levels of several hundred up to 1,000+ mg/l are possible, whereas outside this zone levels will drop rapidly and be more likely to exist in the range of hundreds to tens of mg/l. (Bohlen *et. al.* 1979, Pennekamp *et al*. 1996, and in Wilber and Clarke 2001). The shape of the plume will vary depending on the state of the tide, the local topography, etc. and the concentrations of suspended solids within the plume will consequently be very patchy depending on the distance from the dredger and the depth in the water column. Deeper areas will generally have higher solids levels (Wakeman *et al* 1975). Once dredging ceases, either routinely during the operation or at the end, the turbidity plume can be expected to collapse quite rapidly (1-2 hours), i.e. faster than would be predicted from the settling velocity of individual constituent particle sizes (Pennekamp *et al*., 1996), although there are exceptions where turbidity could remain elevated in the lower water column under particular conditions (Wakeman *et al*., 1975). Localised re-suspension may also occur for some time post dredging depending on local tidal / weather conditions.

In the case of Aghada, it is expected that the plume will run more or less parallel to the shore and at a distance offshore determined by the position of the dredger at the time. During the ebb tide, the plume will move in the general direction of the harbour mouth travelling under the oil terminal jetty in the process; on the flooding tide the plume will be directed north eastward in the direction of Aghada Pier.

Impact on Fish

The expected elevated suspended solids will almost certainly not result in direct mortalities of any adult or juvenile fish because the periods of exposure of these fish are likely to be very short, i.e. minutes to hours rather than days (Wilber and Clarke, 2001).

Commercial Shellfish Species

In addition to the intertidal animals and plants, commercial species such as shrimp, crabs, lobster, and oyster will all potentially be exposed to elevated turbidity as a result of dredging. In a review of the biological effects of suspended sediments in relation to estuarine dredging. It is reported (Wilber and Clarke, 2001) that various species of crab and shrimp are tolerant of very high levels of suspended sediments for extended periods, i.e. several thousands of mg/l for upwards of a week. American lobster (*Hommarus americanus*) is also know to be very able to tolerate turbid waters in nature (Moore 1978) and in survival experiments their larvae only began to experience mortalities after several days exposure to fine suspended solids levels of 10,000 – 50,000 mg/l and higher, although coarser suspended solids (>44μm) begin to see higher mortality rates depending on concentrations (Cobb 1972).

In reality, large mobile crustaceans would be in a position to actively avoid very high turbidity levels such that mortality levels arising as a result of the proposed dredging should be extremely low relative to the local population of these species as a whole, and would be most likely to affect green crab (*Carcinus maenas*) and to a lesser extent edible crab (*Cancer pagunus*) caught in the path of the dredger. Native lobster populations are not expected to be impacted as none of the soft-bottom habitats in and adjacent to the CW pipeline trench are suitable for juveniles, the only life stage which might potentially be impacted.

In a review of the literature on dredging impacts on bivalves (Appleby and Scarrat 1989) concluded that *'it appears that ample evidence exists suggesting that adult bivalves survive suspended sediment loading at levels far in excess of those commonly observed in nature, at least for relatively short time periods. It also appears that suspended sediments from dredging activities may not have detrimental impacts upon adult bivalves in the short-term'.* Oyster larvae are more sensitive to suspended solids, showing adverse effects in the range of hundreds of milligrams per litre rather than thousands as in the case of adults (Wilber and Clarke 2001). However, in this instance the nearest commercial oyster growing activity is 2.5 - 3.5 km away from the proposed dredging operation. Consequently turbidity above background levels at these sites arising from the dredging should be only barely detectable, if at all. Therefore, no adverse impacts are anticipated.

Non-commercial Benthic Species

The CW pipeline trench will cut through the surficial muddy sand or mud layers in order to expose the underlying harder substrate. As excavation proceeds, all fauna in this area will be progressively eliminated, due to physical removal of sediment. Small pockets of sediment may remain and may harbour residual faunal elements

Blanketing of substrate is likely to result from the fall-out of suspended solids from the dredging activity with the thickness of the deposited material being greater immediately adjacent to the line of excavation. This may well result in localised and patchy mortality among some of the benthic infauna due to smothering. However, many of the organisms involved (principally polychaet worms and bivalve molluscs) are capable burrowers so that they could actively avoid being smothered in many cases. Some species, such as the tube-dwelling polychaet worm *Sabella pavonia,* has its tube above the surface and can, therefore, survive a greater degree of sedimentation, but may not be able to escape deeper deposits due to its sedentary habit.

The present biota in this area consists of several communities characterised mainly by the abundance of the tube dwelling polychaete, Melinna palmata and the fan-worm, Sabella pavonina. As these communities are widespread in Cork Harbour, larval propagules are readily available to allow re-colonisation, once dredging ceases.

For recolonisation, most studies have reported a near return to pre-dredging conditions somewhere between 6 months and 3 years. Given the widespread availability of larval propagules within Cork Harbour, it can be safely assumed that the return to pre-impact community status should be within the lower end of this timescale.

Given the relatively small spatial scale of the dredging operation and the total area of the lower Harbour that is occupied by similar communities, it can be stated that this transient effect is of limited impact.

Impact on Shore Life

Ecological studies have shown that filter-feeding organisms e.g. sponges, bryozoans (sea-mats), soft corals, hydroids and ascidians (sea-squirts), tend to occur in greater diversity at sites that are less turbid. It is, therefore, speculated that such organisms will fare poorly in areas where turbidity is high. Although some adverse impacted is to be expected, this is likely to be short-term. Other intertidal animals e.g. littorinid and other gastropod snails and limpets, that are not filter feeders are very unlikely to be adversely impacted as a result of dredging.

Increased turbidity locally could reduce light penetration to bottom algae both in the intertidal and shallow sub-tidal resulting in perhaps lower growth rates in the impacted areas. However, significant seaweed mortality is not expected to arise as a result of this operation except where gross sedimentation occurs adjacent to the dredger.

Conclusions

The dredging operation is likely to affect some animals more than others depending in particular on their location, their size, their feeding mechanisms and their mobility. However, local but patchy adverse impacts can be expected. These impacts are most likely to affect non-commercial species and a full recovery can be expected to occur in most cases within one or two growing seasons after the operation has ceased.

5.2.6 Thermal Impacts

Intertidal Habitats

The only location where an impact on macroalgae, which could relate to thermal stress or a combination of thermal and biocidal (chlorination) effects, can definitely be discerned is in the immediate vicinity of the CW cascade. Here the *Ascophyllum* and *Fucus vesiculosus* plants on the tops of the large boulders forming the cascade are very clearly stunted and at the top of the spillway *Enteromorpha* (a green alga) is dominant. This is the classical thermal impact scenario as it relates to seaweeds as outlined by Devinny (1980). However, at Aghada this is only evident at the outfall and nowhere else. Within in a few metres either side of the outfall, macroalgae and fauna are again abundant and the *Laminaria* beds reported in the baseline survey are still present both at Long Point and along the western and northern shores of Corkbeg Island.

Overall, surveys indicate that the intertidal community in and around Whitegate Bay and Long Point have not changed appreciably since the baseline survey in 1976, with most of the dominant and common species of seaweed and invertebrates still present and still common / abundant.

While, it is clear that the existing thermal load to the Whitegate Bay and Long Point area is having no obvious serious impacts, subtle or locally more obvious ecological phenomena cannot be ruled out and would be expected where local thermal enhancement occurs. Such effects could include slightly enhanced or reduced productivity or slightly earlier or more extended spawning reproductive periods for certain plants and animals.

With the new CW outfall being 440 m offshore from the existing outfall the possibility of additive thermal impacts on intertidal habitats is limited. It is anticipated that the resultant discharge will only give rise to marginal additional impacts on the intertidal communities in the eastern section of Cork Harbour and that any impacts occurring will be minor and not upset the normal ecological functioning of the ecosystem in the area. Whitegate Bay, which at present experiences the highest degree of thermal enhancement, will only experience an additional rise of 0-0.3 °C so that changes to the current situation are not expected.

Benthic Community Impacts

Three temperature related factors are likely to be influential in respect of thermal impacts (Bamber, 1990, 1995): (i) the mean temperature of the habitat in relation to the norm, (ii) the absolute temperature of the discharge and (iii) tidal fluctuations in temperature. The latter can be further combined with the potential effect of biocides, i.e. chlorination, in the discharge.

Upper lethal temperatures are temperature limits above which an organism cannot function physiologically. Although these are not known for the majority of coastal invertebrates, most studies assume that a potential problem exists over 30 ºC and particularly over 33 ºC (Bamber, 1995). The existing CW discharge at Aghada rarely reaches 30 – 32 ºC in warm summers and generally operates several degrees below this level. For example, in 2003, which was a relatively good summer by Irish standards, the highest temperature recorded in the CW outfall was 28.6 ºC in August. Although these levels could occasionally peak above the lethal limit of a number of invertebrate species, this is expected to be rare and of short duration. Furthermore, many benthic species are mobile, in particular crustaceans, which appear most susceptible to these temperature extremes, and are capable of avoiding water bodies with such extreme temperatures. This is further ameliorated by the rapid dispersion and dilution of the thermal effluent, ensuring a very limited spatial extent of this effect.

Coastal and littoral zones undergo important, cyclical temperature fluctuations on a range of temporal scales, from diurnally (linked to tidal cycles) to annually (linked to seasonal cycles), with shallow water temperatures fluctuating between 4 ºC and 20 ºC, with potential hourly changes of up to 8 ºC in shallow waters. Heated effluent may cause similar tidally-cycled fluctuations, due to density differences between the effluent and the ambient water. Therefore, in tidal waters, this temperature front may repeatedly and perhaps cyclically move across the same stretch of seabed. Some studies (reviewed in Bamber, 1990, Langford, 1990) have demonstrated a link between this phenomenon and the reduction in diversity in the benthic community. Specifically, [2]stenothermal species with a calcareous exoskeleton, such as molluscs can be affected.

However, the greatest potential impact is from the temperature differential, which can be as high as 8-10 ºC close to the point of discharge, progressively decreasing with distance. The main effect is that conditions favour [3]eurythermal species, specifically estuarine species, and stenothermic species (often assumed to be boreal taxa) are inhibited.

As a result of these effects and possibly combining biocide effects, which are rarely separated from the thermal effects in the literature, the community composition in the vicinity of the outfall is likely to change, with most studies agreeing that this effect is restricted to within 200-300 m of the point of discharge. However, some studies have failed to demonstrate a community level impact (e.g. Lardicci *et al*., 1999) or have demonstrated changes in abundance, but not species turnover (e.g. Loi & Wilson, 1979).

Tidally averaged surface layer temperatures in the CW discharge plume are shown in Figure 4.18. It can be assumed that the actual temperature in the bottom layer of seawater is significantly lower, due to the fact that warmer water will be concentrated before mixing toward the surface. It can be seen that in the immediate vicinity of the proposed outfall, the thermal differential will be in the order of 4-5 ºC, rapidly decreasing to 1-1.5 ºC, and further afield dropping to 0.2-0.5 ºC. Any effects will thus be restricted to the immediate vicinity of the outfall and should not extend beyond a 100-150 m distance.

[2] Stenothermal species tend to exist within restricted temperature ranges.

[3] Eurythermal species can tolerate relatively wide temperature ranges.

Beyond the immediate vicinity of the outfall point, therefore, changes in sub-tidal benthic community composition are unlikely..

A further minor impact associated with the construction of the outfall pipe will be the provision of hard substrata at the outfall head. It can be assumed that a rich epifaunal and algal community will develop, similar to the community already on surrounding hard substrata, such as the oil terminal jetty and the surrounding littoral area. However, chlorination of the cooling water may suppress this diversity given its immediate proximity to the undiluted discharge. One species may deserve special mention, the exotic ascidian *Styela clava*, originally from Korea.

5.2.7 Cooling Water Chlorination and Potential Impacts

Chlorine decay in seawater depends on the local chemistry. In the case of Aghada a number of factors probably benefit the decay of chlorine and chlorine-produced oxidants, i.e. the high salinity (30-32ppt) and the pH (~ 8.0). These ensure the production of brominated residual oxidants, which are known to decay more rapidly that their chlorinated equivalents. Furthermore, ammonia levels in the intake waters to the existing CW are believed to be quite low. The EPA in its 1998 - 2002 water quality monitoring programme in Cork Harbour measured an average ammonia concentration of 0.047 mg/l NH^{3+4}-N at its Aghada site (ING - W 83360 65327,) which is about 400 m NE from the power station CW intake. This means that smaller amounts of bromamines, which are formed by the reaction of hypobromite and ammonia, are likely to be formed, thus speeding up the decay process (Venkataramiah *et al.* 1983). This is indirectly confirmed by low initial chlorine dose, i.e. 1.0 – 1.5 mg/l free chlorine, added to the cooling water at Aghada. This in turn points to a low chlorine demand in the raw water. This will continue to be the case at the current CW outfall. In the case of the new CW outfall, initial chlorine doses may have to be higher than those at the existing CW because of the need to maintain the biocidal efficacy over the length of the pipeline.

Chlorine and its associated Total Residual Oxidants (TROs), including hypochlorite and chloramines in freshwater and mainly hypobromite and bromamines in seawater, are known to be powerful biocides and much concern has been expressed about the potential environmental consequences of their use in marine and estuarine power stations employing once-through cooling water systems. Table 5.1 lists a range of acute and sub-lethal toxicities from chlorinated compounds which are given in USEPA (1985), Lewis *et al.,* 1994 and Lewis *et al.*, 1997 for several different faunal groups:

Table 5.1: Acute Toxicity Tests for Free and Combined Chlorine for Selected Marine Organisms (from USEPA 1985)

Species	**Duration**	**Effect**	**Conc. mg/l***
Dicentrarchus labrax (bass) (juveniles - 0.16g)	7 day	LC50	0.059
Pleuronectes platessa (Plaice - larvae)	4 day	LC50	0.028
Homarus americanus American lobster – larvae	60 mins	LC50	2.90**
Homarus americanus Larvae	60 mins	LC50	0.300***
Acartia tonsa (marine copepod zooplankton)	30 mins	LC50	0.320***
Acartia tonsa	48 hrs	LC50	0.029***
Crassostrea virginica (Eastern oyster – larvae)	30 mins	LC50	0.120 **
Crassostrea virginica (larvae)	30 mins	LC50	0.01 ***

Species	Duration	Effect	Conc. mg/l*
Ostrea edulis (Native oyster – larvae)	2 mins	EC50 (swimming)	0.500***
Crassostrea gigas (Pacific oysters - adult)	96 hrs	EC50 (shell deposition)	0.540‡
Crassostrea gigas (Pacific oysters - adult)	96 hrs	No Effect (shell eposition)	0.310‡
Blue crab (American species) (*Callinenectes sapidus*)		LC50 or EC50	0.700***
American shore crab (*Hemigrapsus*)	96 hrs	LC50 or EC50	1.418***
Grass shrimp (*Palaemonetes pugio*)		LC50 or EC50	0.220***
Shrimp (*Crangon nigricauda*)	96 hrs	LC50 or EC50	0.134***

** = free chlorine, *** = measured as CPO (chlorine produced oxidants i.e. TRO) ‡ = measured as TRB (total residual bromines as hypobromous acid expressed as bromine); LC50 = the concentration at which 50% of test organisms died. EC 50 = the concentration at which 50% of the test organisms exhibited a certain effect or response (examples include: reduced growth rate, increased respiration rates, reduced feeding rates, swimming etc.)

These data indicate that, while some species e.g. macro-crustaceans (lobster, crab and shrimp) appear to be relatively insensitive to free chlorine and TROs, other species e.g. certain zooplankton and the larvae of some oyster species can be very sensitive, particularly to combined residuals (chloramines and bromamines). Other significant findings in the USEPA review are that higher temperatures generally result in higher mortalities at a given chlorine / TRO concentration and that larvae and juveniles tend to be more sensitive, often significantly so than adults.

While eastern oyster larvae (*Crassostrea virginica*) have been shown to be extremely sensitive, the two species grown in Cork Harbour (*Ostrea edulis* and *Crassostrea gigas)* appear to be much less sensitive. Furthermore, combined chlorine (e.g. chloramines / bromamines) are significantly more toxic to most organisms than free chlorine. As toxicants, free chlorine and TROs are generally very fast acting and also show lower acute:chronic concentration ratios than many other toxicants. In other words, concentrations that cause mortalities are in some cases not much higher than concentrations that cause no affect or very minor affects.

Studies elsewhere have shown that both phytoplankton and zooplankton can suffer significant mortalities on passage through chlorinated cooling water systems. In the case of the proposed development and the existing power station, no measurable adverse impact on the local aquatic ecosystem is anticipated, since combined volume of cooling water that will be abstracted is small, i.e. 1.0-1.7%, relative to the volume of each tidal exchange in this part of the harbour.

Fish are known to avoid areas where elevated chlorine is present so that as a group they are unlikely to suffer any significant adverse impacts, especially in open waters such as Cork Harbour. In fact, many fish species are know to be attracted to the thermal discharges of power stations and can show faster growth rates as a result, e.g. bass (*Dicentrarchus labrax*) in the cooling water discharge canal of a British power station (Langford 1987 in Langford 1990). Large numbers of mullet and occasionally bass are seen near the cooling water outlet at Aghada and the same is likely to be the case for the proposed outfall, even though the thermal plume from the latter is likely to dissipate much faster than at the existing site because of better mixing.

The current discharge appears not to be adversely impacting any of the commercial species caught in the study area. Healthy catches of shrimp, crab and lobster are taken in the general vicinity as are mullet and there is no suggestion that oyster growing at Rostellan has ever been adversely impacted by the discharge of chlorinated cooling water from Aghada. Furthermore, because the nearest hatchery is based in the North Channel, the possibility of any impact is even further reduced as larvae are the most sensitive life stage.

In addition, while it is virtually impossible to distinguish between the respective impacts of thermal and biocide-related impacts, particularly in the near-field, there is no evidence of significant adverse impacts from TROs in the intertidal areas around Whitegate Bay or Long Point where the model predicts the highest residual concentrations. It is only close to the CW outfall that definite impacts can be noted, i.e. stunted seaweed and poor barnacle coverage on rocks, but it is not possible to determine the degree to which chlorination of cooling water is contributing to this effect. As with the thermal impacts, some sub-lethal effects would be expected to occur, at least in the near field.

The contribution of the new CW outfall to the overall impact of chlorinated biocides is likely to be very minor due to the deeper water discharge point as greater dilution and dispersion capacity available at that location.

Chlorine Dispersal Model

A chlorine dispersal model was run using inputs of 0.3 mg/l TRO at both the existing and new CW outfalls and decay half-life of 48 hours. These figures are based on a current chlorine-dosing rate of c. 1 mg/l as free chlorine, which regularly results in just 0.1 – 0.15 mg free residual chlorine at the outfall. It is assumed that the TRO is probably slightly higher than the free residual chlorine level, but probably not much higher because of the good quality of the intake water. The decay half-life of 48 hours is based on an overview of several publications, but is considered to be conservative. The model predicts the highest TROs from the combined discharges as occurring within Whitegate Bay and around Long Point at all stages of the tide. In general, lower levels than these are predicted to occur along the shore toward Aghada Pier during high tide and mid-flood tides, whereas during low tide and mid-ebb tide similar levels are predicted along the western and south-western sides of Corkbeg Island passing under the Refinery Jetty in the direction of the Dogsnose .

The USEPA has set ambient water quality criteria for chlorine or CPOs as follows: "…except possibly where a locally important species is very sensitive, saltwater aquatic organisms and their uses should not be affected unacceptably if the four-day average concentration does not exceed 7.5µg/l more than once every four years on average and if the one-hour average concentration does not exceed 13µg/l more than once every three years on the average."

Regulatory agencies in the UK have set a tentative EQS for marine waters of 10 µg/l for TROs derived from bromine. These figures are slightly stricter than the USEPA maximum hourly average of 13µg/l indicated above. The UK authorities have not suggested an annual average TRO concentration for marine waters, almost certainly due to the lack of chronic exposure test results available for these compounds. In the case of both the US and UK criteria, the values chosen are derived from toxicity test data for among the most sensitive species known and include a safety margin in each case, so they probably offer near full protection.

Levels above these concentrations, i.e. within the mixing zone of discharge plumes, would be expected to exercise a degree of stress in receiving waters for the most sensitive species. In the present case most of the predicted local elevation in TROs are derived from the existing discharge in Aghada (Figures 4.25 & 4.26) and the average additional inputs from the new outfall are very much lower due to the rapid dilution of the effluent at the off-shore outfall (Figures 4.27 & 4.28).

To assess the likely impacts of the proposed discharge the current situation in and around Whitegate Bay and Long Point where the model predicts the highest concentrations requires examination. While there is no available toxicity data for the majority of marine species encountered, including polychaet worms, the representation of a range of species groups provides an indication of the impact occurring and what might be expected. For example, based on the present baseline survey and others in the recent past, all the major marine flora and faunal phyla are well represented in the general area including within the Whitegate Bay-Corkbeg-Long Point area.

When an organism is missing from any given area it is difficult to ascribe the reason for its absence to a particular stressor, e.g. CPOs. However, while the possibility that some species are reduced or locally absent as a result of CPOs or a combination of temperature and CPOs cannot be ruled out, it is known that all major macro-algal groups, mollusca (both snails and bivalves), polychaet worms, cnidarians (including hydroids and anemones), echinoderms (starfish), crustaceans (crabs, prawns and mysid shrimps), fish (e.g. mullet, dog fish and sea bass) are present within the area of greatest currently predicted ambient concentrations. It is also known that the over-wintering shore birds that feed on intertidal worms and bivalves during the winter and early spring are continuing to feed and roost in the bay without a downward trend in numbers over two decades. Furthermore, shrimp, crab, lobster and mullet continue to be caught in significant amounts by fishermen in outer Whitegate Bay, along Long Point and off Corkbeg Island toward the Dogsnose and very high numbers of Pacific and Native Oysters are being successfully on grown in the Rostellan area. Overall, therefore, there is no evidence of significant ecosystem impact that can be attributed to the existing CPO regime.

Given the above and the outputs from the model, which suggests that the proposed outfall will contribute virtually no additional TROs to Whitegate Bay itself and only relatively small additional concentrations outside the bay in the 5-10 µg/l range mainly (Figures 4.27 & 4.28), it is reasonable to assume that the impacts of the proposed new CW discharge will not be detectable in the wider harbour and minor or insignificant in the area within or around Whitegate Bay itself.

5.2.8 Mitigation

Dredging

The selected dredging procedure for the pumphouse and outfall pipe will ensure minimal disturbance of bed sediment in order to minimise environmental impact.

Dredging will be timed for the period January-April. This has the greatest benefits as a mitigating measure in that (i) it would avoid the main fishing seasons, (ii) it would be a period of lowest temperatures. ensuring that temperature-related stress on the aquatic community would be at its lowest and (iii) there would be a significant amount of growing time left in the season post-dredging to facilitate recommencement of recolonisation by benthic and other aquatic life.

Chlorination

Chlorination will be kept to the lowest concentration necessary to maintain the efficiency of the condensers at the plant and to prevent fouling in the outfall pipe and the chlorination levels utilised in the existing power station will not be increased

5.2.9 Conclusions

No adverse impacts on shellfish are anticipated. Given the offshore location of the proposed outfall the possibility of thermal impacts on intertidal habitats is limited. Other than in the vicinity of the discharge point, the impact on benthic communities is anticipated to be negligible.

5. 3 TERRESTRIAL HABITATS AND BIRDS

An independent consultant was commissioned by ESBI to provide inputs to the EIS relating to terrestrial habitats, flora and fauna, including wintering waterfowl in the vicinity of Aghada.

5.3.1 Conservation Designations

Cork Harbour Special Protection Area

A total of 1,436 ha of intertidal habitat within Cork Harbour is currently designated as a Special Protection Area (SPA) under the Birds Directive (79/409/EEC). The site was designated in 1994 and comprises a number of discrete areas, one of which is Whitegate Bay. The designation includes Whitegate Bay and Long Point, and excludes Aghada Generating Station as indicated in Figure 5.3.

The extent of the existing SPA in Cork Harbour has been under review by National Parks and Wildlife, Department of the Environment, Heritage and Local Government. It is proposed that the existing designation will be enlarged to include further areas of intertidal habitats and possibly some sub-tidal areas. While most of the additional areas are located in the northern and western areas of Cork Harbour, a change to the area covered by the designation is proposed for Whitegate Bay. This would extend the designated area to include shallow marine waters off Corkbeg Island, between a point 100 m short of the end of the Whitegate jetty, and the northern side of Long Point, where the natural shore meets the Aghada Generating Station rock-armoured embankment. The objective of the extension is to include shallow marine waters that are used by significant numbers of great-crested grebes.

Whitegate Bay (Site Code 1084).

Whitegate Bay is proposed for designation as a Natural Heritage Area (NHA) and is already designated as part of the Cork Harbour SPA. The area covered by the pNHA designation includes the intertidal area of the Bay and Long Point and is the same as the area covered by the existing SPA designation of Cork Harbour (Figure 5.3).

The proposed designation arises from the waterfowl populations that feed, and to a lesser extent roost in it. It forms part of the larger Cork Harbour area, which includes a number of proposed NHA designations.

Cork Harbour is internationally important[4] for wintering waterfowl. Waterfowl numbers vary from year to year and in the 19 years for which data are published the numbers recorded ranged between 28,235 and 56,054 (Smiddy *et al*, 1995; Colhoun 2001). The threshold level for international importance is 20,000.

Black-tailed godwit and redshank both occur in internationally important numbers[5] in Cork Harbour, with shelduck and dunlin exceeding the threshold for international importance in some years (Smiddy *et al*, 1995; Colhoun, 1998). A further 17 waterfowl species occur in nationally important numbers[6]. The diving duck scaup and goldeneye exceed the thresholds for national importance in some years.

4 Internationally agreed criteria based on waterfowl census data are used for assessing the importance of wetland sites for waterfowl, based both on total numbers and on counts of individual species.

5 The threshold for international importance is 1% or more of the world population of a waterfowl species or sub-species.

6 The threshold for national importance is 1% or more of the all-Ireland population of a species or sub-species.

Waterfowl use is concentrated in the northern parts of Cork Harbour, in Lough Mahon, Glounthaune/Killacloyne and Rosslague. Smaller numbers use the western area with waders concentrated in Lough Beg, with wildfowl and waders from Raven to Ringaskiddy; the north east from Ahanesk to Rathcoursey; and the eastern section which includes Whitegate Bay, Aghada, Rostellan/Saleen and Cuskinny.

5.3.2 Receiving Environment

Flora

Field surveys were carried out between late-October 2003 and early-March 2004. A Phase 1 terrestrial habitat survey was carried out on the development site, using Fossitt (2000) to classify the habitats present. Plant species identification follows Webb et al (1996) and nomenclature follows Scannell and Synnott (1987) for common names. Reference was made to Preston et al (2002) with regard to plant species distribution, and to Curtis and McGough (1988) and the Flora Protection Order with regard to rare and protected flora. It should be noted that because of seasonal factors, not all of the plant species present will have been identified.

Habitat Cover in the Proposed Development Site

The habitats present in the development site have developed on stony, coastal reclaimed ground since the late 1970s. Some of the species recorded may have been present on areas of Long Point that lay above high tide level before reclamation took place. An Foras Forbartha (1976) described Long Point as being a spur of rock, linked to the mainland by two shingle ridges with swampy ground enclosed between them. No survey of these habitats was carried out prior to reclamation.

Habitat cover in the development site and immediately adjoining areas is shown in Figure 5.4 and habitats recorded within the proposed development area were as follows:

- Recolonising bare ground ED3
- Dry calcareous and neutral grassland GS1, with areas of wet grassland GS4
- Scrub WS1

Terrestrial habitats located outside but close to the proposed development site are:

- Improved amenity grassland GA2
- Ornamental/non-native shrub WS3
- Mixed broadleaved woodland WD1

The sublittoral habitats of the offshore area, Whitegate Bay and the two on-site lagoons (large eastern and small western) are described elsewhere in this EIS.

Habitats within the Proposed Station Site

Recolonising bare ground ED3

Recolonising bare ground occurs mainly in the eastern part of the site, near the site entrance, on areas of rubble/soil to the east of the eastern lagoon and in the area of the proposed new power station. This habitat incorporates small areas of paved surface used for storage which are virtually unvegetated. Vegetation cover is sparse. Typical species are red fescue, buck's-horn plantain, daisy, mayweed, and common centaury, and in places the flora is dominated by willowherb species and common ragwort. Valerian also occurs in places. Small plants of butterfly bush, *Cotoneaster* (self-sown from ornamental planting around the existing station buildings and entrance), bramble, gorse and grey willow occur within this habitat. Recolonising bare ground vegetation merges into dry calcareous and neutral grassland, in which vegetation cover is higher, and a greater range of species occurs.

This habitat is transitional in nature and includes opportunistic plant species that are initial colonisers of disturbed ground. It would tend to develop to become similar to the grassland and scrub habitats described below in a 'do nothing' scenario.

Dry calcareous and neutral grassland GS1/ wet grassland GS4 mosaic.

The main habitat cover within the proposed station boundary is dry calcareous and neutral grassland, influenced by crushed limestone arising from site development in the 1970s. Vegetation cover within this habitat is quite variable in response to the extent of crushed rock present on the surface. Areas within this habitat are poorly draining and the flora here is more typical of a species poor wet grassland (GS4). Both habitats are best developed near the existing CW outfall, around the western lagoon and between the two lagoons. Rabbits are numerous on site and graze the grassland vegetation.

The vegetation in dry calcareous and neutral grassland is dominated by red fescue grass, ribwort plantain, and bird's-foot trefoil. Other grass species present include common bent, creeping bent, and Yorkshire fog. Species present (occasional to frequent) which indicate calcareous/alkaline substrates are red bartsia, wild carrot and yellow-wort.

Bee orchids are reported to be frequent in the site (P. Smiddy, National Parks and Wildlife, pers. comm). This species is a tuberous perennial of calcareous, well drained soils and occurs in a variety of habitats including industrial waste ground and quarries (Preston et al, 2002). Bee orchids are listed in the Red Data Book for vascular plants (Curtis and McGough, 1988).

Other herbaceous species growing in dry calcareous and neutral grassland include common centaury, lesser hawkbit, common ragwort, ox-eye daisy, mayweed, white clover, self heal, and creeping cinquefoil.

Areas of impeded drainage supporting wet grassland flora occur in a mosaic with the drier calcareous grassland. Sedges and rushes are prominent in the flora in these areas. Typically carnation sedge and glaucous sedge occur with creeping bent-grass. Common sedge, hard rush and jointed rush occur occasionally. Toad rush occurs in wet areas where the cover of other vegetation is sparse. A small area near the existing CW outfall is vegetated with sea club-rush, with some creeping buttercup. Another small area near the eastern lagoon supports a mono-dominant stand of false fox sedge.

Gorse and willow scrub WS1

Gorse and willow scrub has developed near the two lagoons, and in smaller patches within the proposed station site. The main areas of scrub are shown in Figure 5.4, although there are also small patches of scrub throughout the site. European gorse and grey willow are dominant, bramble and occasional plants of broom also occur. Self-sown shrubs of *Cotoneaster* also occur in the eastern part of the site. The ground flora is dominated by ivy.

Habitats Adjoining the Proposed Station Site

Amenity grass and ornamental shrub are established around the existing station entrance, buildings and car parking areas.

Most of the plantation woodland in the overall Aghada site is in the upper area, east of the Midleton-Whitegate road (R630). There are some small areas in the lower site to the west of the road. One area, which is shown in Figure 5.4, is a plantation of ash with some birch and alder on the embankment supporting an internal roadway and bridge over the R630. Alder has self-sown into the area of recolonising bare ground that lies between this plantation and the proposed new station site entrance.

Assessment of Existing Flora within the Proposed Station Site

The existing flora in the proposed station site has developed over the last 25 years since the site was reclaimed. In some areas there is ongoing occasional disturbance where approved waste has been disposed of or plant has been stored. The vegetation cover is therefore quite patchy, but both cover and species diversity generally increase westwards and with distance from the existing station buildings.

The dry calcareous and neutral grassland and wet grassland habitats are the most diverse within the site, but are relatively species poor in comparison with similar habitats developed over a longer timescale in more natural surroundings. Bee orchids are not legally protected but are not common, and merit further attention before construction.

Fauna

Bird counts were carried out for this EIS on five dates between late-October 2003 and early-March 2004. The areas counted were:

- Whitegate Bay and Long Point, the area covered by the existing SPA designation
- The open water to the north of the Aghada site as shown in Figure 5.5, which includes the area where the proposed cooling water outfall will be located 400 m offshore.
- The east and west lagoons within the Aghada site.

Birds using terrestrial habitats within the proposed site were also recorded.

Wintering Waterfowl in Whitegate Bay and on Long Point

Peak counts of waterfowl in Whitegate Bay, including Long Point, are given in Table 5.5, quoting I-WeBS data for the period 1997/98 to 2000/01, and counts carried out for this EIS during the 2003/04 winter season. Four species have occurred in nationally important numbers in Whitegate Bay in at least two recent years: great-crested grebe, shoveler, black-tailed godwit, and redshank. Pintail were recorded in nationally important numbers in 1998/99, but do not occur in Whitegate Bay every year.

Great-crested grebe are consistently present in nationally important numbers in Whitegate Bay. In the context of Cork Harbour, Whitegate Bay often holds up to half the total number of great-crested grebe. These birds feed by diving in shallow water, and feed mainly in the area enclosed by Long Point and Corkbeg Island, although they do feed further out towards the Whitegate Jetty in the area proposed for inclusion in the SPA designation (Figure 5.3). Whitegate Bay also holds most of the pintail and shoveler in Cork Harbour, overall numbers of these species fluctuate between years (see Appendix H).

Black-tailed godwit and redshank both occur in nationally important number in Whitegate Bay, but as a smaller proportion of the Cork Harbour total counts for these species.

Twenty four species of waterfowl were recorded in Whitegate Bay in 2003/04, including three species which had not been recorded in the counts available to date: little egret, light-bellied Brent goose, and knot. However, other species that occur in most years were not present in 2003/04: gadwall, teal, and pintail, and shoveler were present in very low numbers. Some variation between years is to be expected.

Little egrets are recently established as a breeding species in Ireland, with four different breeding sites in Counties Cork and Waterford used since 1997 (Smiddy, 2002). The little egrets recorded during the winter in Whitegate Bay are likely to be part of the resident Irish population. This appears to be expanding rapidly, with 12 nests recorded in 1997 and 55 in 2001. A threshold number for national importance for little egret has not been established yet, but with a peak count of 10 birds in November 2003, Whitegate Bay would be likely to be nationally important for this species.

Table 5.2: Peak Waterfowl Numbers in Whitegate Bay

Species	Peak count 1997/98	Peak count 1998/99	Peak count 1999/00	Peak count 2000/01	Peak count 2003/04*	1% national level	1% inter-national level
Great crested grebe	**125**	**81**	**119**	**92**	**45**	35	
Cormorant	9	18	103	41	37	105	1,200
Grey heron	5	5	8	15	11	105	4,500
Little egret					10		800
Mute swan		2				100	2,400
Light-bellied Brent goose					12	200	200
Shelduck	52	121	29	32	109	125	3,000
Wigeon	68	261	125	209	165	1,000	12,500
Gadwall	2	4		6			
Teal	17	5	2			500	4,000
Mallard	144	362	142	172	81	500	20,000
Pintail	13	**33**	16			20	600
Shoveler	**74**	**91**	**122**	**58**	7	40	400
Red-breasted merganser	12	11	17	24	8	25	1,250
Oystercatcher	72	87	125	105	132	700	9,000
Knot					11	250	3,500
Dunlin	505	382	210	298	225	1,200	14,000
Black-tailed godwit	3	**126**	**128**	15	**151**	80	700
Bar-tailed godwit			27	28	36	175	1,000
Curlew	156	146	111	80	87	1,000	3,500
Redshank	155	241	**286**	183	**299**	250	1,500
Greenshank	3	12	3	7	2	20	3,000
Black-headed gull	450	410	649	260	206		20,000
Common gull	92	178	190	725	55		16,000
Lesser black-backed gull	13	7	27	33	64		4,500
Herring gull	8	46	67	23	10		13,000
Great black-backed gull	29	92	130	54	6		4,800

- Counts that exceed the threshold for national importance are bold-faced.

- Data for 1997/98 to 2000/01 were supplied by the Irish Wetland Bird Survey (I-WeBS), a joint scheme of BirdWatch Ireland, National Parks and Wildlife of the Department of the Environment, Heritage and Local Government, and the Wildfowl and Wetlands Trust.

Some seasonal trends are evident in the data for 2003/04, which also indicates the constancy of presence of the different species in Whitegate Bay during the winter season (Table 5.3).

Table 5.3: Waterfowl Recorded on Five Count Dates in Whitegate Bay (including Long Point) in 2003/04

Date	4.10.03	26.11.03	11.12.03	22.01.04	05.03.04	1% national level	1% inter-national level
Great crested grebe	44	45	41	18	4	35	
Cormorant	37	15	24	19	3	105	1,200
Grey heron	10	9	11	9	4	105	4,500
Little egret	5	10	5	5	2		800
Light-bellied Brent goose		1		12	2	200	200
Shelduck	45	73	109	100	28	125	3,000
Wigeon	31	114	134	165	106	1,000	12,500
Mallard	81	53	19	49	5	500	20,000
Shoveler	2		7			40	400
Red-breasted merganser		8	6	6	7	25	1,250
Oystercatcher	112	116	106	132	52	700	9,000
Ringed plover						100	500
Knot	11	6	5	11		250	3,500
Dunlin	225	1				1,200	14,000
Black-tailed godwit	151	22	21	9	2	80	700
Bar-tailed godwit				36		175	1,000
Curlew	87	42	49	56	32	1,000	3,500
Redshank	299	156	160	195	130	250	1,500
Greenshank	2	1	1	2		20	3,000
Turnstone						100	700
Black-headed gull	23	161	206	81	84		20,000
Common gull		39	31	29	55		16,000
Lesser black-backed gull	1	11	64				4,500
Herring gull		3	10	1	2		13,000
Great black-backed gull	1	4		6			4,800

Birds Recorded in Open Water North of Aghada Generating Station

Waterfowl and seabirds were recorded during each of 5 site visits in the area shown in Figure 5.5. The numbers recorded were very small, as indicated in Table 5.4 below, and include birds flying through the area as well as feeding within it. The numbers of great crested grebe were low, considering the proximity of one of their main sites in Cork Harbour at Whitegate Bay. The seabirds black guillemot, guillemot and razorbill breed in small colonies along the coast west of Cork Harbour, and in east Waterford. Larger colonies are more distant.

Table 5.4: Peak Bird Counts on Five Survey Dates Within the Count Area

Date	**24.10.03**	**26.11.03**	**11.12.03**	**22.01.04**	**05.03.04**
Great crested grebe		2	2	1	
Cormorant	2	4	3	4	5
Herring gull	1			3	
Great black-backed gull		5	3	3	
Black guillemot				2	1
Guillemot				1	
Razorbill			1		

Bird Counts in the East and West Lagoons, Aghada Generating Station.

Six waterfowl species were recorded using the two lagoons on site, with significantly more use of the larger eastern lagoon (Table 5.5). Red-breasted merganser fed within the east lagoon on the rising tide on two count dates. As the threshold number for national importance for this species is 25, the peak count of 7 in the east lagoon is of some significance. Comparison of Tables 5.4 and 5.6 indicates that most or all of the mergansers feeding in Whitegate Bay at low tide can move into the lagoon as the tide rises. Total numbers of mergansers using the lagoon could be higher in some years and could approach national importance.

Little egrets, for which threshold levels for national importance have not yet been established, were recorded in the east lagoon on all count dates, with a peak count of five in January, when five little egrets were recorded at low tide in Whitegate Bay. As with red-breasted mergansers, it is likely that little egrets use the eastern lagoon in association with their use of Whitegate Bay.

The grey herons and little egrets recorded in the lagoons were all roosting on the steep rock armoured side slopes and are likely to be birds that had fed in Whitegate Bay at low tide. These species also roost and feed along the rock armoured embankment facing south to Whitegate Bay; up to five little egrets were recorded feeding and roosting near the existing CW outfall.

Single cormorants were recorded feeding and roosting in the lagoons. Small numbers of oystercatcher, and a single redshank on one date, roosted on the rock armour on the side slopes of the lagoons. Roosting use by waders is likely to be limited by restricted visibility, particularly in the smaller west lagoon.

Table 5.5: Peak Waterfowl Count in the East (large) and West (small) Lagoons

Date	**24.10.03**		**26.11.03**		**11.12.03**		**22.01.04**		**05.03.04**	
	East	**West**	**East**	**West**	**East**	**West**	**East**	**West**	**East**	**West**
Cormorant	1	1	1		1		1			
Grey heron	1	1	2	1	5	1	5		1	
Little egret	1				3				7	1
Red-breasted merganser										
Oystercatcher	4		8	1						
Redshank	1									

Bird Use of Terrestrial Habitats in the Proposed Station Area

Waterfowl were recorded on terrestrial habitats in the proposed station area, mainly in small numbers. A roosting flock of 103 oystercatcher was recorded on one count date, roosting on grassland along the southern side of the west lagoon. Oystercatcher also roost in small numbers (<5) on the embankment top along the shore, as do cormorant. Single curlews were recorded occasionally. Snipe were generally present in grassland mosaic around the west lagoon, with a peak count of 6 birds; this species seems to make mainly roosting use of the site and is considered unlikely to breed in it because of habitat unsuitability.

Passerines recorded in the site were meadow pipit, skylark, wren, robin, blackbird, and reed bunting. Other species are also likely to occur, and all these species are likely to nest in grassland (pipit, skylark) or scrub vegetation within the proposed station site. Additional species likely to occur are wagtails, stonechat and goldfinch. Wheatears have been recorded in the site on passage in spring and autumn. A kestrel was recorded hunting over the site, and on another occasion wood pigeon remains indicated the presence of sparrowhawk or peregrine falcon. Sparrowhawks have been recorded at Aghada previously.

Mammals

Rabbits are numerous within the overall Aghada site, including the proposed station site. There was also evidence of the presence of foxes. There is no habitat suitable for use as bat roosts within the proposed station site.

5.3.3 Impacts and Mitigation Measures

Waterfowl Issues

The proposed development will not impinge physically on the existing SPA in Whitegate Bay or on the proposed extension to the SPA.

All structures will be located on the existing habitats on reclaimed land, with the exception of the proposed 440 m long CW outfall pipe. The pipeline route does not fall within the area of either the existing or proposed extension to the SPA. The thermal plume from the proposed development will not extend into Whitegate Bay and no change in the existing CW discharge to the Bay will arise.

The impacts of the construction of the CW discharge pipeline on marine habitats, and the operational phase CW discharge to marine waters are considered elsewhere in this EIS. The CW outfall area is used by small numbers of waterfowl and seabirds; impacts on them are assessed as neutral.

The proposal will impact on the aquatic area of the eastern lagoon, which will be reduced by c. 25% to accommodate pipework between the new CW intake and the new CCGT station. This is considered to be the maximum extent to which the area of the eastern lagoon can be reduced without impacting on its attractiveness as a feeding site for red-breasted mergansers, which could occur occasionally in numbers approaching national importance during some years. Roosting use by little egrets could also be affected. The extent of infilling has been minimised to limit the potential impact. With a maximum reduction of 25% in the surface area, impacts on waterfowl use of the lagoon are assessed as neutral during the operational phase.

As an additional mitigation measure for waterfowl, landscape/screening tree planting on site will not extend any further west than the western side of the diesel tank compound. The purpose is to retain a section of open flight access to the lagoon areas for birds.

Waterfowl are likely to be partially displaced from the eastern lagoon during the construction phase, particularly when structural fill and pipework is in progress. No adverse impact is anticipated on waterfowl using Whitegate Bay during construction.

Terrestrial Flora and Habitats

Terrestrial habitat cover will be removed from most of the proposed station area during the construction phase, including patches of relatively species poor scrub, dry calcareous and neutral grassland, and wet grassland habitats. Bee orchids are reported to occur within the site; this species is not protected but is uncommon. These impacts are assessed as potentially significant within the context of the overall Aghada site, because of the reported presence of bee orchids on the site.

As a mitigation measure, the proposed site will be surveyed in June/July to assess the occurrence and distribution of bee orchids. Recommendations will then be made about the options available for retaining small areas of vegetation, within the constraints of site layout and requirement for laydown areas during construction. The objective of this measure is to retain a series of small seed banks from which vegetation can recolonise laydown areas after the completion of the construction phase. Recommendations will also be made about the possibility of transplanting bee orchids within the overall Aghada site, with the aim of ensuring the retention of this species at Aghada.

Passerine birds breed in the denser patches of scrub and grassland on site. As a mitigation measure, the clearance of dense vegetation on the site will be carried out from September to and February as far as possible, to avoid loss of nests and young birds during construction. Passerine birds are expected to be largely displaced from the site during construction because of disturbance and habitat loss, populations are likely to recover in the medium to long term as laydown areas become revegetated. Residual impacts on birds are assessed as being imperceptible in the context of the general Whitegate area, because the bird populations on the proposed site are small.

5.3.4 Conclusions

The proposed development will not impinge on the existing SPA in Whitegate Bay, either during the construction or operational phases. No impacts on waterfowl use of Whitegate Bay are expected as a result of the proposed development. Small numbers of waterfowl are expected to be partially displaced from the eastern (larger) lagoon during construction, as installation of structural fill to support pipework will reduce the lagoon area by a maximum of 25%. Waterfowl use of the eastern lagoon is expected to resume during the operational phase.

6. SOILS & GROUNDWATER

6. 1 RECEIVING ENVIRONMENT

6.1.1 Introduction

The site is currently subject to an Integrated Pollution Control licence for which groundwater monitoring is required. The borehole locations have been identified and limits set with respect to certain analytes. The borehole locations are all in or close to the proposed development area.

A ground investigation was undertaken within the environs of the development site in 1997. Groundwater samples have also been recovered from boreholes on the site on six occasions between October 2002 and October 2003.

The assessment of the existing status of the site has been undertaken by reference to published information and through reference to site investigation and monitoring undertaken at the site.

6.1.2 Geology

The Geological Survey of Ireland (GSI) Sheet No. 25, Geology of South Cork, together with the GSI Groundwater Protection Scheme maps for County Cork, indicate that the site is underlain by the Devonian Old Head Sandstone Formation and the Carboniferous Kinsale Formation. The majority of the site is underlain by the Cuskinny Member of the Kinsale Formation, with the Old Head Sandstone Formation being present in the southeast, mainly beneath the location of the existing station buildings. The Castle Slate Member of the Kinsale Formation lies between the Cuskinny Member and the Old Head Sandstone Formation.

The Kinsale Formation Cuskinny Member consists of flaser bedded sandstone and mudstone and the Castle Slate Member comprises grey mudstone. The older Old Head Sandstone Formation consists of flaser bedded sandstone and minor mudstone.

The bedrock at the site is indicated to be faulted by north south trending faults, two of which fully cross the area and form the east and western boundary of the Old Head Sandstone Formation in the vicinity of the site. The third fault only partially penetrates bedrock beneath the site between the other two faults. A syncline on an east west axis is shown to the east of the site and this structure may continue into the bedrock beneath the site.

The Groundwater Protection Scheme indicates that the site is overlain by Made Ground and that bedrock outcrops at locations on the site and more extensively to the east of the site. Further to the east of the site, overburden comprising glacial tills is indicated to be present. It would be anticipated that the Made Ground overburden indicated to be present at the site was deposited as part of the development of the existing electricity generating facility adjacent to the site. It is anticipated that the majority of the Made Ground comprises rock fill, derived from the cutting of the bedrock and deposited for land reclamation to form a construction platform, although some construction and station wastes may also be present.

6.1.3 Hydrogeology

The marine environment of Cork Harbour surrounds the site on three sides and the topography of the site is generally flat. Two lagoons are present within the general development area. It would generally be assumed that groundwater flow would follow the fall of the topography and/or flow towards any major surface water features. The groundwater flow at the site is probably towards the harbour and the direction and rate of flow may be influenced by the tidal fluctuation of the harbour. Locally groundwater flow may be complex and controlled by factors such as rock head topography, fracture orientations, etc.

Because of the saline nature of the water in Cork Harbour, it is likely that some saline waters will have intruded beneath the site. Such saline intrusion is due to salty water having a greater density than fresh water and would have a wedge-like geometry with fresh water lying upon the intruding saline water. Tidal influence on the groundwater level is expected, and would be anticipated to have greatest influence near the shoreline.

Groundwater may be found in bedrock and in any overburden where granular material dominates over fines. The Made Ground rockfill is likely to contain significant volumes of groundwater, but is likely to contain groundwater effected by the salinity of the harbour and would not represent a groundwater resource. Overburden groundwater may allow lateral and vertical migration of contaminants to surface water or underlying bedrock groundwater, particularly where granular materials are present at or near the ground surface.

The GSI has produced a Groundwater Protection Scheme for County Cork that details the potential resource value and vulnerability of groundwater in the county, together with information on the nature of the overburden and existing groundwater abstractions. The GSI scheme predicts that groundwater beneath the site would be extremely vulnerable to potential contaminants passing through the soil (Table 6.1). The vulnerability rating is derived from the anticipated absence of low permeability strata and shallow thickness of more permeable strata.

Table 6.1: GSI's Groundwater Vulnerability Rating Criteria

Vulnerability Rating	**Hydrogeological Requirements Below the Point of Release of Contaminants**				
	Subsoil Permeability and Thickness			Unsaturated Zone	Karst Features
	High Permeability	Moderate Permeability	Low Permeability		
Extreme	0 - 3 m	0 - 3 m	0 - 3 m	0 - 3 m	-
High	>3 m	3 – 10 m	3 - 5 m	>3 m	N/A
Moderate	N/A	>10 m	5 - 10 m	N/A	N/A
Low	N/A	N/A	>10 m	N/A	N/A

N/A = not applicable

The resource status held by the groundwater bedrock in the vicinity of the site is indicated by the GSI Groundwater Protection Scheme to be LI. The classification indicates a minor aquifer that is locally important and productive only in local zones. Therefore, the groundwater protection zone in the vicinity of the station is LI/E; the protection zone classification is present in the matrix presented as Table 6.2.

The GSI Groundwater Protection Scheme indicates that no wells are present within the area around the development. It would be anticipated that groundwater from near the shoreline would be of very limited resource potential due to the saline influence of the harbour.

Table 6.2: Matrix of Groundwater Protection Zones: Aghada

Vulnerability Rating	Source Protection			Resource Protection					
				Regionally Important		Locally Important		Poor Aquifers	
	Site	Inner	Outer	Rk	Rf/Rg	Lm/Lg	Ll	Pl	Pu
Extreme (E)	SS/E	SI/E	SO/E	Rk/E	Rf/E	Lm/E	**Ll/E**	**Pl/E**	Pu/E
High (H)	SS/H	SI/H	SO/H	Rk/H	Rf/H	Lm/H	**Ll/H**	**Pl/H**	Pu/H
Moderate (M)	SS/M	SI/M	SO/M	Rk/M	Rf/M	Lm/M	Ll/M	Pl/M	Pu/M
Low (L)	SS/L	SI/L	SO/L	Rk/L	Rf/L	Lm/L	Ll/L	Pl/L	Pu/L

- Rk = Major Aquifer, Regionally important limestone karst aquifer
- Rg = Major Aquifer, Regionally important fractured bedrock or sand/gravel aquifer
- Lm/Lg = Minor Aquifer, Locally important, moderately productive
- Ll = Minor Aquifer, Locally important, productive only in local zones
- Pl = Poor Aquifer, productive only in local zones
- Pu = Poor Aquifer, unproductive

6.1.4 Fieldwork and Laboratory Testing

A ground investigation within the environs of the development site was carried out by Irish Geotechnical Services Ltd in 1997. The fieldwork comprised the putting down of five boreholes by cable percussive techniques and the recovery of soil samples during cable percussive boring. Groundwater monitoring standpipes were installed in all boreholes.

The borehole locations were targeted to identify any potential contamination on site. Three boreholes were located on the former waste disposal area associated with the existing station and bordering the western lagoon, one borehole was put down to the west of the existing station buildings and one borehole was put down to the north of the existing station buildings. Surface soil samples were recovered from an area of surface oil staining and from the fire fighting training area. The locations of the boreholes are presented as Figure 6.1

Groundwater samples were recovered from four of the five boreholes in 1997; no sample was obtained from Borehole BH5 as it was dry. Groundwater samples have also been recovered from Boreholes BH1 and BH4 on six occasions between October 2002 and October 2003; Borehole BH5 was dry during the monitoring period.

Chemical testing was undertaken on seven soil samples and four groundwater samples recovered as part of the 1997 investigation. These samples were analysed for an extended suite of determinands. The testing of groundwater samples from Borehole BH1 and BH4 in 2002 and 2003 was as prescribed by the existing station's IPC licence.

6.1.5 Ground Conditions

Made Ground was encountered at all exploratory locations, ranging in thickness from 2.5 m in Borehole BH5 to 5 m in Borehole BH3. Made Ground was reported to comprise clayey gravelly fill with cobbles and is taken to represent the rock fill deposited to reclaim the site. The only soil stratum not indicated to be Made Ground was a layer of clayey silt of 0.1 m thickness in Borehole BH3 between the Made Ground and bedrock.

Bedrock was penetrated in all the boreholes to a depth of between 0.4 m in Borehole BH4 and 2 m in Borehole BH2 and was generally described as siltstone/shale. The descriptions are not sufficient to confirm the presence of the Kinsale or Old Head Sandstone Formations.

Groundwater strikes were reported in Boreholes BH1 to BH4. In Boreholes BH1 and BH2 the groundwater strikes were reported within the overburden and in Boreholes BH3 and BH4 the groundwater strikes were within the bedrock close to the bedrock/overburden interface.

6.1.6 Contamination Assessment

General

No Irish legislation exists that presents a framework for the assessment of soil contamination. The soil sample test results have been compared to the circular on target values and intervention values for soil remediation released by the Dutch Ministry of Housing, Spatial Planning and the Environment in 2000. The results of soil testing have also been compared to the US EPA Region 6 Human Health Medium Specific Screening Levels (November 2002), abbreviated to HH-MSSL in this report, for industrial outdoor worker. These levels provide a framework for risk to human health from soil contaminants. Where applicable, the results of soil testing are also compared to the typical ranges for analytes in Irish agricultural soils.

The groundwater data has been compared to the EU Directive for drinking water (80/778/EEC) and has incorporated into Irish Statute as SI No. 81 (1988). The groundwater has also been compared to the European Communities (Drinking Water) Regulations 2000 made in accordance with the 1998 Drinking Water Directive; this Regulation came into force in January 2004, superseding SI No. 81 (1988). It should be noted that strictly, these statutes respectively provide levels of analytes for water to be consumed directly by humans, and for which treatment of waters may be required before consumption. Therefore, the statutes represent stringent criteria for the assessment of naturally occurring waters.

The EU Groundwater Directive (80/68/EEC) provides lists of contaminants and has been used in this report to assess the water quality data.

Soil Assessment

The soil samples were generally found to be slightly alkali, with pHs between 7.66 and 8.52, although a higher pH of 9.19 was reported for the Borehole BH3 soil sample.

Limited low level metal contamination was found by the investigation, particularly in the Borehole BH3 sample. Significant arsenic contamination was noted in the Borehole BH4 sample and significant zinc contamination was present in the Borehole BH3 sample. Low level DRO contamination and isolated low level mineral oil and PAH contamination was reported for the soils from the boreholes in the former station waste disposal area (BH1 to BH3). The contamination associated with the borehole soil samples is generally though to relate to the presence of deposited construction and station wastes in the soils, although the source of the elevated arsenic level in the Borehole BH4 soil sample has not been established.

The surface samples were found to be significantly contaminated by Diesel Range Organic (DRO) and mineral oil, and were contaminated to a lesser extent by Polyaromatic Hydrocarbons (PAH). The degree of hydrocarbon contamination in these samples is not unexpected, as these location were targeted due to the presence of surface oil staining and or practices that utilised hydrocarbons, such as fire fighting training. However, the surface samples are only represent areas of very small aerial extent and are extremely unlikely to have influenced the overall status of the soils at the site.

Groundwater Assessment

The groundwater samples were found to have neutral pH ranging from 7.2 to 7.75.

The 1997 groundwater testing indicates that the groundwater would be unsuitable for abstraction for human consumption. The contamination of the groundwater appears to be primarily due to the intrusion of saline waters from Cork Harbour. The presence of limited contamination associated with ammoniacal nitrogen, nickel and DRO may reflect the composition of the harbour waters influencing groundwater quality beneath the site, but the presence of these analytes due to the leaching of any wastes in the fill cannot be fully ruled out.

The monitoring of Boreholes BH1 and BH4 between October 2002 and October 2003 found that conductivity was elevated, indicated a significant seawater influence if not a fully seawater character. The pH of the groundwater generally remained near neutral. DRO and mineral were typically below the analytical limit of detection of 10 µg/l and it was only on one occasion that a detectable level of DRO (342 µg/l) and mineral oil were reported (222 µg/l). Although unlikely to be of significance, the once-off presence of elevated hydrocarbons in the groundwater at Borehole BH4 may indicate a small temporary hydrocarbon loss from the existing station plant or from contamination associated with harbour waters intruding into the groundwater beneath the site.

6. 2 IMPACT OF THE DEVELOPMENT

The soils at the sites have no significant resource value and the proposed development would not have any impacts on the status of the soils. Similarly, the groundwater resource beneath the site is not of suitable quality to represent an abstractable resource for consumption and as such the development is unlikely to have any discernible impact on the value of the groundwater resource. The quality of groundwater beneath the site has been degraded by the intrusion of saline harbour waters and is not attributable to any present or past practices associated with the existing station.

Given the nature and quality of the soils and groundwater identified, the proposed development would be an appropriate end use, which may require limited removal of contaminated soil to facilitate completion.

Limited surface spots of significant hydrocarbon contamination were identified at the site in the past, these may still be found but are unlikely to have had any significant affect on groundwater quality. Limited metal contamination and hydrocarbon contamination were found in soil samples recovered from boreholes, but this contamination does not appear to have influenced groundwater quality. The presence of buried historic construction and station wastes in the site soils is anticipated, but influence from the leaching of these materials to the groundwater was not detected.

It is likely that some contaminated soils would be encountered during the ground works, but the volumes of such material are not anticipated to be extensive based on the site investigation and subsequent soil analyses.

The levels of some contaminants detected in the soils, notably arsenic and individual PAH, may represent a risk to human health if long term exposure were to occur. Workers involved in soil excavation might be exposed to contaminated soils through skin contact or inhalation/ingestion, although other site workers and users of adjacent areas may be exposed where large areas of contaminated soil are exposed and dust is generated.

As the extent of contaminated soils is thought to be limited at the site, contaminated surface water run off is unlikely to be produced and therefore it is unlikely that any discernible impact would occur.

Contaminated groundwater was identified and it is anticipated that the groundwater is fully hydraulically connected to the Cork Harbour, at least in the peripheral shore areas of the site. Therefore, groundwater would have been discharging to the harbour in the past without a discernible impact. It is unlikely that site works and subsequent station activities would lead to any enhancement in this process and therefore would have no discernible impact on the existing water quality of the receiving water body.

In general, there are unlikely to be any discernible impacts with regard to soil and groundwater due to the development and operation of the proposed power station. However, there is a likelihood of encountering contaminated soils particularly in the vicinity of the existing stations former waste disposal area.

6. 3 MITIGATION

It is possible that contaminated soil or other waste materials may be encountered during the ground works at either site. If such material is encountered the contaminated materials will be appropriately segregated and stored at the site prior to appropriate disposal at a licensed facility. The storage of such contaminated materials will consist of placing the material on an appropriate impermeable membrane to prevent downward leaching and covering the material with an impermeable membrane to prevent infiltration and surface water run off.

Where pumping of groundwater from excavations is required, the groundwater shall be discharged to the harbour via a settling pond and oil interceptor; the appropriate discharge consents will be obtained, if and when necessary. Any other treatment required under the discharge consent would be fully implemented.

The contractor appointed to undertake the ground works and construction of the proposed development will be required to assess and manage any risks associated with the handling and management of any contaminated soil, materials and groundwater. The access to the development site would be strictly controlled to ensure that only authorised personnel may enter the site. Other risks and hazards that may potentially be encountered by construction personnel will be dealt with in a comprehensive manner in the Health and Safety Plan, as required by Health and Safety regulations.

The construction and other site workers shall be supplied with appropriate personnel protective equipment (PPE) and training, together with the necessary welfare provisions, to prevent or minimise the potential exposure to contaminated media.

The potential mobilisation of dust shall be monitored through out the ground works phase of the construction and if required dust suppression procedures shall be put in place. The control and suppression of dust arising from the site works would minimise the release of contaminated soil outside of the proposed development area.

The construction mitigation measures described above represent standard good practice for the development of any site where potential contaminated soil or waters may be encountered. Such good practice will be integral to the management of the project from the initial ground works at the site through to operation of the completed development.

6. 4 CONCLUSIONS

The proposed development will not result in significant impacts to soil or groundwater.

7. AIR & CLIMATE

7. 1 RECEIVING ENVIRONMENT

7.1.1 Air Quality Standards

Air quality in the vicinity of the site can be characterised with respect to SO_2 and NO_x by reference to relevant statutory air quality standards, which specify permitted ambient concentrations of various pollutants in air in order to protect human health and the environment.

National air quality standards (NAQS) for ambient SO_2 and NO_2, giving effect to EU Directives 80/779/EEC and 85/203/EEC, are set in the Air Pollution Act, 1987 (Air Quality Standards) Regulations, 1987 (S.I. No. 244 of 1987), remain in force to a limited extent until 31st December 2009 as follows.

Table 7.1: National Air Quality Standards (S.I. No. 244 of 1987)

Parameter	Averaging Period	Standard
NO_2	1 Hour	200 µg/m³ (98 percentile of hourly values)

The future NAQS are contained in the Air Quality Standards Regulations 2002 (SI. No. 271 of 2002) (Table 7.2). These future NAQS are the limit values specified in the 1999 EU Council Directive (1999/30/EC).

Table 7.2 - National Air Quality Standards (SI No 271 of 2002)

Pollutant	Criteria	Limit Value (µg/m³)	Compliance Date
SO_2	Hourly – 99.7% (not to be exceeded more than 24 times per year)	350	1 Jan 2005
	Daily – 99.2% (not to be exceeded more than 3 times per year)	125	1 Jan 2005
	Annual average	20	1 Jan 2001
NO_2	Hourly – 99.8% (not to be exceeded more than 18 times per year)	200	1 Jan 2010
	Annual average	40	1 Jan 2010

7.1.2 Present Status of Ambient Air with Respect to Standards

Introduction

Ambient air quality monitoring has been undertaken by the Electricity Supply Board in recent years at a number of locations to measure ambient concentrations of sulphur dioxide, smoke and nitrogen dioxide. Results clearly show that emissions do not give rise to a significant impact on local air quality.

Sulphur Dioxide and Smoke

Ambient daily average levels of SO_2 and smoke have been monitored at three locations in the area and the average annual levels are shown in Table 7.3 for the period 1996-98. The methodology used at these sites for measuring sulphur dioxide was the 8-day acidimetric method, commonly referred to as the British Standard 1747 method. It is evident that levels of SO_2 and smoke are very low and close to or below the detection level of the sampling method used. The maximum monthly average levels of SO_2 were about 10 µg/m^3 with the corresponding average smoke concentrations below 8 µg/m^3, well below present and future national air quality standards.

Table 7.3 - Annual Average Sulphur Dioxide and Smoke (µg/m^3)

	Sulphur Dioxide			**Smoke**		
Location	1996	1997	1998	1996	1997	1998
Saleen	8	8	8	3	2	2
Aghada Upper	6	7	8	3	2	2
Lugfree	8	6	8	1	1	1

Grid Refs : - Saleen - 188600E, 067850N; Aghada Upper 185750E, 065100N; Lugfree 189310E, 061350N.

Nitrogen Dioxide

Long-term measurements of ambient concentrations of nitrogen dioxide (NO_2) have been undertaken at five locations in the area and a summary of the results for the years 2001 and 2002 are given in Table 7.4. These values were obtained using passive diffusion tube sampling methods. This method is widely used for measuring weekly or monthly levels of nitrogen dioxide in both urban and rural environments in Ireland.

Table 7.4: NO_2 Monitoring Survey 2001-2002 (μg/m^3)

Location	**Average**	**Maximum**	**Minimum**
Saleen	5.1	11	3
Aghada Upper	3.8	8	2
Lugfree	4.0	8	2
Stn Reservoir	5.7	12	3
CW outfall	6.2	12	3

Grid Refs : - Saleen - 188600E, 067850N; Aghada Upper 185750E, 065100N; Lugfree 189310E, 061350N; Stn Reservoir – 18440E, 065000N; CW outfall – 83480E,064650N. The duration of each measurement period was typically 21 days at each location

The results of the air quality survey indicate that the average annual concentrations at the five sites ranged from about 4-6 µg/m^3 with the highest levels reported near the site boundary. The maximum 21-day average levels near the station reservoir and outfall to the west of the main station were about 12 µg/m^3. The ambient concentrations are below 17% of the future annual NAQS value of 40 µg/m^3, which is to be met by 2010. Compared to the existing NAQS hourly NO_2 limit value of 200 µg/m^3, expressed as a 98 percentile of hourly values, the corresponding levels at the monitoring locations would also be very low. The 98 percentile, or 175th highest hourly concentration, is typically about 2.5 times the annual or long-term average value. This gives a 98 percentile of hourly concentrations of about 15 µg/m^3 at the site boundary and 12 µg/m^3 further afield. Such concentrations are less than 8% of the existing NAQS limit value.

The AQS Regulations 2002 specify a more stringent future NAQS hourly value of 200 µg/m^3, expressed as the 99.8 percentile, or 19th highest hourly concentration over a year. This standard is to be met by 2010. It is evident from the low annual concentrations reported at each of the locations in the monitoring network that this limit value will not be exceeded.

Climatology

Wind

There are two meteorological stations in the Cork Harbour area. The nearest is at Roche's Point (4.5 km to the south-west) on a small headland at the mouth of Cork Harbour with the other station at Cork Airport (18 km to the north-west).

Long-term wind observations for Roche's Point over the period 1962-91 indicate that the prevailing wind direction is from the NW direction with a secondary maximum for S-SW winds. The wind direction pattern reflects the influence of the local sea breeze at the mouth of Cork Harbour, especially during the summer period. The lowest frequency is for winds from a direction of 30-90°, i.e. from the NE-E direction. Wind data from Cork Airport indicate the prevailing wind is from SW quadrant (Appendix K) with a similar incidence of winds from the NW. The highest wind speeds are recorded for winds from a westerly direction, which will be most prevalent during the winter months. The incidence of calm wind conditions in the Cork Harbour area is very low with less than 3% of hourly observations recording wind speeds below 1 m/s.

Atmospheric Stability

Atmospheric stability is a measure of turbulence (horizontal and vertical air movement) within the lower layers of the atmosphere. The stability of the lower atmosphere is commonly categorised as unstable, neutral or stable.

Neutral stability is by far the most common type of stability category found in the region with an annual incidence of about 79%. This category occurs when the weather is cloudy, raining or windy and this high occurrence is typical of the prevailing Irish climate. The annual occurrence of unstable conditions is low with data from Roche's Point and Cork Airport indicating an incidence of about 5-6% of the time, which mostly occur during the months of May to September. Under stable conditions the ground level concentrations will be low near the emission source but will be high where the plume impacts on areas of elevated terrain in the area. The long-term incidence of stable conditions in the Cork Harbour area is about 15-20%.

7. 2 IMPACT OF THE DEVELOPMENT

7.2.1 Introduction

The proposed plant will be fired on natural gas. Low sulphur gasoil (0.1% S from 1/1/2008) will be used in the event of gas supply being unavailable. All modelling for gasoil operation was based on use of 0.1%S fuel in all gas turbine plant, i.e. CT11-14, EGC1 & 2 and the new CCGT.

7.2.2 Emission Limit Values (ELVs) and Emission Rates

The proposed plant will utilise state-of-the-art low NOx technology and achieve the ELVs determined by the EU Commission as representing Best Available Technology (BAT) in the EU Large Combustion Plant Directive (2001/80/EC).

Table 7.5 - Emission Limit Values (2001/80/EC)

Parameter*	**Natural Gas**	**Gasoil**
NO_x	**75 mg/Nm^3	120 mg/Nm^3
SO_2	35 mg/Nm^3	***

* dry flue gas conditions at 15% O_2 .

** gas turbines in combined cycle plant having average annual electrical efficiency greater than 55%, 50 mg/Nm³ for electrical efficiencies less than 55%

*** No ELV is defined for gasoil use. Instead there is a product standard for gasoil limiting S content to 0.1% from 1/1/2008. This is equivalent to 55 mg/Nm³ at 15% O_2 dry.

Emission rates in practice will vary depending on the manufacturer and model of CCGT offered to ESB in its procurement process. At present it is expected that up to four offers will be considered. Each plant is unique in design and, although all meet the above ELVs, they will differ in relation to actual electrical output and cycle efficiency. These differ to the largest extent in relation to output and efficiency when firing gasoil.

The estimates of emissions used for modelling were based on a mid-range CCGT design. In practice, this means that there is a deviation of +1.5% to – 0.2% in NOx emission rates for gas firing compared to the nominal values used for modelling work (and +6% to -15% for NOx values for gasoil firing). In no case has this any implications for the validity of the modelling conclusions.

Based on use of gasoil as stand-by for 5% of the year and a very conservative assumption of a 100% overall load factor, the estimated annual air emissions from the plant are as follows for the highest emitting CCGT tendered.

Table 7.6 - Annual Air Emissions

Emissions	**Tonnes per Annum**
SO_2	61 (1)
NO_2 (expressed as NO_2 but 90% NO)	1,530 (2)
CO_2	1,332,000

(1) Based on the S limit of 0.2% for gasoil.

(2) NOx emissions are based on the assumption that the NO_2 ELV on gasoil is 120 mg/Nm³

7.2.3 Air Dispersion Modelling

The impact of the proposed plant on ambient air quality for SO_2 and NO_2 was modelled using the Atmospheric Dispersion Modelling System version 3.1.10, 2003 (ADMS3) model. The ADMS3 is a third generation prediction model for air pollution studies model developed by CERC (Cambridge Environmental Research Consultants) that is used worldwide. It has been approved by the Environmental Protection Agency for modelling studies supporting IPCL applications and is used by Regulatory Authorities and the Environment Agency in the United Kingdom. Details of the model are outlined in the report presented in Appendix I.

Meteorological data for Cork Airport was used to model the Aghada emissions. Due to lack of cloud data for Roche’s Point in recent years it would not have been possible to use recent climatological data from there for that purpose. A sensitivity check was made using both Cork Airport and Roches Pt. climatological data for earlier years. This showed no significant difference in the modelled results for the two weather data sets. Thus, Cork Airport with its available cloud cover data has been used for all air dispersion modelling.

Initial screening model runs determined that a minimum chimney height of 65 m avoided building wake effects and this was used in modelling dispersion of emissions.

If a bypass stack is provided, it will be possible to operate the plant in combined cycle mode or in open cycle mode. The maximum mass emission rate from the proposed development will be the same regardless of the mode of operation. However, the thermal buoyancy and therefore the dispersion of the flue gas emission is enhanced for open cycle operation due to the higher discharge temperature of the exhaust gases. On this basis, all modelling was conducted using parameters applicable to combined cycle mode of operation which represents the worst case.

The principal pollutants emitted in the exhaust stack when natural gas is burnt will be nitrogen oxides (NOx) and comprising ~95% nitric oxide (NO) and ~5% nitrogen dioxide (NO_2).

The proposed new ELVs for NO_2 apply to operation at greater than 70% load and exclude start up and shut down periods. Emission concentration will normally rise at some point below this load level – typically at 50% load. Owing to the very high efficiency of this type of plant it will normally operate at full load with very infrequent occurrence of start-up and shut-down. Operation at reduced load will be confined to starting and stopping transitions. Since these periods are infrequent and are of short duration they are not relevant to the modelling of air quality impacts.

Input parameters to the model are detailed in Appendix K.

The sulphur content of natural gas is negligible (maximum concentration about 15 ppm as H_2S by volume) and so sulphur dioxide emissions will only be significant when gasoil is used as stand-by fuel. The highest permitted sulphur content for this grade of oil is currently 0.2%. However, from 1st January 2008 the maximum sulphur content for gasoil will reduce to 0.1%, resulting from the implementation of EU Council Directive (1999/32/EC, relating to a reduction in the sulphur content of certain liquid fuels). SO_2 emissions are estimated to be about 37 g/s, when the CCGT plant is operating at full load. A summary of the emission characteristics of the proposed CCGT plant is given in Table 7.7.

Table 7.7: Emission Characteristics for the CCGT Exhaust Stack

Operating Mode	**Ht (m)**	**Diam (m)**	**T (°C)**	**Exit Vol (Nm^3/s)**	**Exit Vel (m/s)**	**NO_x (a) mg/Nm^3**	**NO_x g/s**	**SO_2 (a) mg/Nm^3**	**SO_2 g/s**
Natural Gas	65	5.5	95	531	30.1	75	45.1	8	4.9
Gasoil	65	5.5	135	523	33.4	120	80.0	55	37.0

Note: *(a) at 15% dry O_2 reference level.*

Emissions of particulates are considered to be negligible for natural gas and gasoil because of the efficient burnout and low ash content in the CCGT turbine. The maximum emission rate for PM_{10} would be in the order of 1-2 g/s (4-8 kg/hr) when operating on natural gas and 5 g/s (19 kg/h) when the plant is burning gasoil. These emission rates are very low and would include the condensable particulate fraction in the exhaust gas. In addition, emissions of carbon monoxide and hydrocarbons are also normally very low with significant levels emitted only during periods of incomplete combustion / low-temperature operation at start-up. Nearly all the fuel carbon (>99.5%) is converted to CO_2 during the combustion process when gas or gasoil is burnt and so the amount of carbon monoxide formed is very low.

An auxiliary steam boiler, with a rating of about 7 t of steam/hr, will be used for start-up of the main boiler and this unit will have a single stack located near the southern corner of the HRSG building. Operation of the auxiliary boiler will be restricted to about 1-2 hours and this is unlikely to occur more than once per month during normal plant operation. This boiler will operate on either natural gas or gasoil, with a firing rate of about 500 kg/hr for gas and 550 kg/hr for oil. Emissions of NOx and SO2 are estimated to be very low and under 0.5 g/s. These rates are below 2% of the emissions from the CCGT boiler exhaust stack. Furthermore, due to the limited period of operation of the auxiliary boiler during the year, the emissions will be insignificant in terms of those arising during operation of the CCGT. Note that the auxiliary boiler does not operate while the CCGT is on load.

7.2.4 Results of Air Dispersion Modelling

The air quality impact of emissions from the proposed CCGT plant was carried out using the air quality dispersion model to evaluate the potential contribution to ambient levels of NO_2 and SO_2 in the surrounding area. The combined effect of emissions from the CCGT exhaust stack and those from the existing main 270 MW exhaust stack, three open cycle gas turbine units and the two 'Twinpac' Emergency gas turbines was also examined.

For modelling the impact of NOx emissions from the various generating plant exhaust stacks at Aghada Power Station, a constant conversion ratio for NO_2/NO_x of 0.6 was used. This ratio was applied to the calculated NO_x value, irrespective of distance downwind, in calculating the corresponding equivalent NO_2 concentration at each of the receptor locations. This is a conservative approach to modelling power plant emissions, as the actual levels of NO_2 at a specific receptor downwind of the emission point are likely to be substantially lower, especially close to the emission point. Therefore, the results from the modelling study present a 'worst-case' air quality impact.

The results of the modelling studies are shown as ground level concentration contour plots for each CCGT emission scenario. Predicted ground level concentrations are also presented for the combined impact of emissions from the CCGT plant and the existing 270 MW Unit 1, three 85 MW open cycle combustion turbines and the twin emergency generation capacity (EGC) gas turbines.

The modelled concentrations are compared with the existing and future National Air Quality Standards (NAQS). In the case of NO2, a limit value in the now-replaced 1987 legislation remains in force and sets a 98 percentile limit on hourly concentrations, i.e. 175^{th} highest value of the year. This existing NO_2 hourly Standard remains in place until 31 December 2009.

7.2.5 Impacts - Nitrogen Dioxide

CCGT on Natural Gas

Hourly

The predicted 99.8 percentiles of hourly ground level NO_2 concentrations are shown in Appendix **I,** based on the CCGT plant operating at maximum generating load, with the gas turbine fired on natural gas. The maximum hourly NO_2 concentration is predicted to be 102 $\mu g/m^3$ with a 99.8 percentile value of 82 $\mu g/m^3$. The highest 99.8 percentile of hourly concentrations is predicted to occur near the shoreline, immediately to the west of the site of the CCGT. To the east, the highest 99.8 percentile concentrations are predicted to be about 60 $\mu g/m^3$, near the power station boundary. Beyond about 1 km from the boundary, the maximum 99.8 percentile of hourly concentrations is predicted to be less than 20 $\mu g/m^3$, with a level of below 10 $\mu g/m^3$ beyond 2 km downwind. The predicted 99.8 percentile is predicted to be about 15-20 µg/m^3 near the communities of Aghada Upper and Whitegate village.

The corresponding predicted 98 percentile of hourly concentrations give substantially lower ground level concentrations with the highest levels within the area of about 40 µg/m^3. The highest predicted concentrations occur near the shoreline immediately to the west of the CCGT site. To the east, the 98 percentile concentrations are predicted to be less than 20 µg/m^3, with levels of less than 10 µg/m^3 beyond 1 km from the power station site boundary.

Compared to the future NO_2 hourly NAQS value of 200 µg/m^3, the maximum predicted levels are less than 40% of this limit near the power station boundary. Over most of the area around the power station, the predicted concentrations are less than 10% of this value. The maximum predicted 98 percentile concentrations to the east of the power station boundary are less than 20% of the current NAQS hourly value.

Annual

The maximum predicted annual average NO_2 concentration, based on the CCGT operating on continuous full load for the whole year, is about 1.7 µg/m^3. This average concentration is predicted to occur near the north-eastern site boundary. Predicted levels to the east of the power station boundary are generally below1 µg/m^3. These long-term average concentrations are very low and less than 5% of the future NAQS annual value of 40 µg/m^3.

CCGT on Gasoil

It is planned that the CCGT can operate for a limited number of hours per year, not exceeding 5% of the time, using gasoil during emergency periods due to a disruption to the normal supply of natural gas. Based on the modelled results for this scenario, the maximum 99.8 percentile of hourly concentrations is predicted to be 131 µg/m^3. This concentration is about 66% of the future NAQS hourly value. The areas where the highest concentrations are predicted to occur are similar to those based on firing on natural gas, with the highest levels found immediately to the west of the proposed CCGT plant site, near the shoreline. At Aghada Upper and Whitegate village, the 99.8 percentile of hourly NO_2 concentrations is predicted to be about 20 µg/m^3 or about 10% of the future NAQS.

The maximum 98 percentile of NO_2 is predicted to be 47 µg/m^3, which is 24% of the current NAQS. Over land, the highest 98 percentile of hourly levels are predicted to be below 20 µg/m^3 or less than 10% of the current NAQS limit value.

7.2.6 Impacts - Sulphur Dioxide Concentrations

CCGT on Gasoil

Hourly

The predicted 99.7 percentile of hourly SO_2 concentrations indicates that the highest levels occur near the shoreline, to the west of the CCGT site. The maximum predicted concentration is 100 µg/m^3, which is 29% of the future hourly NAQS value. There is a secondary peak of about 80 µg/m^3 near the north-east site boundary. Beyond about 1 km downwind of the power station boundary, the 99.7 percentile of hourly concentration of SO_2 is predicted to be below 25 µg/m^3. The predicted 99.7 percentile levels are indicated to be 10-20 µg/m^3 in the vicinity of Aghada Upper and Whitegate village.

Daily

The predicted 99.2 percentile of daily SO_2 concentrations shows maximum levels of 30-40 µg/m^3 near the shoreline. This concentration is 33% the future daily NAQS. Predicted levels over land are substantially lower with a maximum 99.2 percentile of about 20 µg/m^3 near the north-east boundary and below 10 µg/m^3 beyond about 1 km to the east of the power station. These predicted levels to the east of the power station are about 16% of the future NAQS daily limit value.

7.2.7 Combined Impact of CCGT with Existing Plant

Nitrogen Dioxide Concentrations - Hourly

The combined impact of NO_x emissions from the existing plant coupled with those from the CCGT main exhaust stack were modelled with the CCGT operating on natural gas and gasoil. With the inclusion of the NOx emissions from the existing generating plant stacks, the combined impact on ground level concentrations near the power station boundary is much higher than when emissions from the CCGT are modelled separately. In both cases the existing Unit 1 is operating on natural gas but the open cycle GT plant, CT1-4 and EGC1 & 2 are operated on gasoil to produce a worst case scenario.

For the case in which the CCGT operates on gas the highest levels occur close to the shoreline, with a maximum 99.8 percentile of hourly NO_2 concentrations of 134 µg/m^3. This maximum value is 67% of the future hourly NAQS. Near the eastern site boundary, the 99.8% percentile of NO_2 level is about 50-60 µg/m^3, with the highest levels occurring near Aghada Upper. A maximum 99.8% level of 95 µg/m^3 is predicted just to the west of Aghada Upper and this reflects the effect of elevated terrain on the dispersion of the emission plumes from the power station site. Beyond this area, predicted levels decrease rapidly to less than 60 µg/m^3 within about 3 km. The corresponding maximum 98 percentile hourly NO_2 concentration is 47 µg/m^3, which is 24% of the current NAQS.

When the combined impact of the existing generating plant emissions is combined with the NO_x emissions from the CCGT operating on gasoil, the maximum 99.8 percentile of hourly concentrations increases to 181 µg/m^3. This concentration is about 90% of the future NAQS and it is predicted to occur near the shoreline to the west of the CCGT plant. These results are based on the assumption of a 60% conversion rate of NO_x to NO_2 in all of the emission plumes, irrespective of travel distance before the plume impacts at ground level. However, given the very short distance of less than 1 km between the CCGT stack and the area where the highest levels are predicted, this will result in a substantial over prediction in NO_2 concentrations. A maximum 99.8 percentile concentration of about 100-110 µg/m^3 is predicted near Aghada Upper, with levels of about 60 µg/m^3 near Whitegate village.

Nitrogen Dioxide Concentrations - Annual

The predicted annual average NO_2 ground level concentration contour pattern shows maximum annual average levels of about 3 µg/m^3. The highest annual average NO_2 levels are predicted to occur near to the shoreline to the north-east of the station boundary. On the elevated terrain near Aghada Upper, the annual average is predicted to be about 2-2.5 μg/m^3. These predicted concentrations are very low and below 8% of the future annual NAQS.

Sulphur Dioxide Concentrations - Hourly

The combined impact of SO_2 emissions from the CCGT plant operating at full load on gasoil coupled with emissions from the three gas turbines and the emergency generating plant shows the maximum predicted 99.7 percentile of hourly concentration is 119 µg/m³. This is 34% of the future hourly NAQS value of 350 µg/m³ and this occurs near the shoreline. Beyond the power station boundary, the level is generally below 60 µg/m³ or 17% of the future hourly NAQS. On the high ground near Aghada Upper, the predicted 99.7 percentile of hourly concentrations is predicted to be about 40 µg/m³. At Whitegate village, the predicted hourly 99.7 percentile value is about 20 µg/m³, which is 10% of the future NAQS.

Sulphur Dioxide Concentrations - Daily

The predicted 99.2 percentile of daily SO_2 concentrations shows highest levels of about 45 µg/m³ near the shoreline to the west of the station. This predicted maximum value is 37% the future daily NAQS value. Predicted levels to the east of the station boundary are substantially lower with a maximum 99.2 percentile of about 20-25 µg/m³ near the north-east boundary and below 10 µg/m³ beyond about 1 km. At Aghada Upper, the predicted 99.2% percentile is about 10 µg/m³, with a similar level predicted for Whitegate village. These predicted levels are below 10% of the future daily NAQS value.

7.2.8 Mitigation

The following mitigation measures will be employed:

- The 65m. stack height chosen will ensure good dispersion
- The proposal will employ the latest stage of development of low NOx burners for this class of plant. ELVs on gas are likely to be significantly better than the 75 mg/Nm³ legal ELV standard.
- Actual NOx ELVs on gas firing are expected to be substantially below the values modelled by up to 40%.
- Low sulphur gasoil will be used as back up only in the event that natural gas is unavailable.
- Water injection will be used for NOx control when gasoil fuel is used.
- Operation of the CCGT on gasoil will be very limited if at all. The parallel operation of the existing plant will be at lower load factors than heretofore and not at the 100% value used in the modelling. Operation of the existing plant post-2007 is expected to be at load factors of less than 30% on Unit 1 and less than 5% on CT11-14.
- Modelling of NOx emissions assumes a conversion rate of 60% from NO to NO_2. In practice, this will be substantially less at points of maximum Impact due to the short travel distance and time available for NO_2 formation. .

7.2.9 Conclusion

Ambient air quality in the vicinity of the site complies with current and future air quality standards for SO_2 and NO_2.

The proposed plant will utilise state of the art low NO_x technology and achieve the emission limit values required by the EU Large Combustion Plant Directive (2001/80/EC).

Based on full load continuous operation on natural gas, NO_x emissions from the plant are estimated at 1,530 t per annum. Annual SO_2 emissions will be 61 t.

The results of the air dispersion modelling study show that the ground level concentrations for both NO_2 and SO_2 due to emissions from the planned future operation of Aghada power station will be below the current and future NAQS. No adverse impact on air quality is predicted in the surrounding area due to the operation of the proposed CCGT generating plant.

7. 3 TRANSBOUNDARY AIR IMPACTS

7.3.1 Existing Environment

SO_2 and NO_x emissions, which arise in the main from fossil fuel combustion in the transport and energy sectors, are transported over long distances and undergo chemical transformations in the atmosphere. In Europe, the long range atmospheric transport of SO_2 and NO_x contributes to regional problems of acidification and eutrophication of soils and waters (acid rain, dry deposition) and also to air pollution (SO_2 and NO_2 levels, secondary particulate formation) over a wide area.

The Government has entered into agreements at EU and international level to control national emissions of SO_2 and NO_x. These agreements specify obligations to reduce total emissions of these gases. The obligations were agreed having regard to the economic costs that will be imposed and their impact on national social and economic development. The electricity sector has been assigned specific emissions targets by Government and is currently required to control annual NO_x and SO_2 emissions at 42 kt and 82 kt respectively. Further progressive reduction in sectoral emissions will be required to assist national compliance with reduced emissions ceiling for SO_2 and NO_x agreed for 2010 under the Gothenburg Protocol and the EU National Emissions Ceilings (NEC) Directive[7].

In 2001, national emissions of SO_2 were 126.15 kt[8]. Of this 76.72 kt was emitted by the electricity sector with the existing plant at Aghada emitting 0.063kt. Under the EU NEC Directive national emissions of SO_2 must be maintained below 42 kt per annum from 2010 onwards.

In 2001, national emissions of NO_x were 134.95 kt. Of this 41.16 kt was emitted by the electricity sector with the existing plant at Aghada emitting 1.64 kt. Under the EU NEC Directive annual national emissions of NO_x must be maintained below 65 kt from 2010 onwards.

A Government programme to ensure compliance with the EU NEC Directive limits is under development. In July 2003 the Department issued a discussion paper on a strategy to achieve the emissions targets.

Construction and utilisation of base load high efficiency low NOx emitting CCGT plant complying with the ELVs set in the EU Large Combustion Plant Directive for such plant, thereby displacing electricity production from higher NOx emitting plants is assumed in projections contained in the Government consultation document.

The proposed plant is compatible with any future strategy to limit national NOx emissions in a cost effective manner.

7.3.2 Impact of the Development

Combustion of natural gas and gasoil at the proposed plant at Aghada will give rise to SO_2 and NOx emissions. Assuming the largest size of plant likely to be constructed (425 MW), high

---

[7] DIRECTIVE 2001/81/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2001 on national emission ceilings for certain atmospheric pollutants

[8] STRATEGY TO REDUCE EMISSIONS OF TRANSBOUNDARY POLLUTION BY 2010 TO COMPLY WITH NATIONAL EMISSION CEILINGS (Discussion paper issued by the Department of Environment, Heritage and Local Government, July 2003)

operating hours at full load per annum (equivalent to 95% Load Factor) and a limited amount of gasoil use (432 hours), maximum additional SO_2 and NO_x emissions per annum are 61 t and 1,530 t respectively.

The NOx figure assumes emissions at the ELVs stipulated in the EU Large Combustion Plant Directive (viz. 75 mg/Nm³ when firing natural gas and 120 mg/Nm³ when firing gasoil).

SO_2 and NOx emissions from the plant will mix and disperse in the atmosphere. In addition to other national SO_2 and NOx emissions arising from fossil fuel combustion in transport and energy production, these emissions will be transported over long distances and undergo chemical transformations in the atmosphere. In Europe, the long-range atmospheric transport of SO_2 and NO_x contributes to regional problems of acidification and eutrophication of soils and waters (acid rain, dry deposition) and also to air pollution (SO_2 and NO_2 levels, secondary particulate formation) over a wide area.

In the context of reducing national ceilings for SO_2 and NOx emissions, the emissions to atmosphere from the proposed plant will not cause an increase in the impacts described above. In the initial years of operation the proposed plant will displace older higher NOx emitting plants and contribute to an overall reduction in NOx emissions from the electricity sector.

While relatively significant in a national context, NOx emissions from the proposed plant are a small fraction of Europe wide emissions and will not give rise to a significant environmental impact in Europe.

7.3.3 Mitigation

The proposed plant will utilised Best Available Techniques (BAT) as required by the EU Integrated Pollution Prevention and Control Directive and will meet the ELVs specified in the EU Large Combustion Plant Directive considered to represent BAT for the class of installation involved. No further mitigation is proposed.

7.3.4 Conclusion

The proposed plant will not give rise to significant transboundary environmental impact.

It will assist in the achievement of national obligations regarding limiting transboundary air pollution and sectoral targets that will be established in this regard in the future

7. 4 CLIMATE

7.4.1 Existing Environment

Without the earth's atmosphere, the average global temperature would be - 18 °C approximately. However, due to the effect of this atmosphere, which selectively absorbs and re-radiates solar energy, the earth's temperature is typically 33°C warmer. This natural "Greenhouse Effect", which is vital to life on earth, is determined by the concentration of the so-called greenhouse gases (GHG) in the atmosphere. Greenhouse gases include water vapour (H_2O), carbon dioxide (CO_2), ozone (O_3), methane (CH_4), nitrous oxide (N_2O) and also industrial gases such as sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). CO_2 is the most significant greenhouse gas from the perspective of anthropogenic emissions to air.

Greenhouse gases, with the exception of the industrial gases, occur naturally as part of the carbon and nitrogen cycles in the environment. It has been determined that the atmospheric concentration of greenhouse gases is increasing. Atmospheric CO_2 concentrations have risen from about 280 ppm prior to the industrial revolution to approximately 375 ppm at present and levels continue to increase. Fossil fuel combustion for energy use is the primary reason for human induced increased CO_2 concentrations.

Scientific concern regarding the potential impact of an enhanced greenhouse effect on the Earth's climate system has led to an intensive research effort on the issue. Despite many remaining uncertainties, United Nations (UN) scientists are now of the view that *"In the light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations."* [9]

In response to concerns, a UN Framework Convention on Climate Change was adopted in 1992. This has led to international negotiation on reducing greenhouse gas emissions, in particular CO_2 from developed countries. Under the 1997 Kyoto Protocol to the UN Framework Convention on Climate Change, and a subsequent European Union burden sharing agreement, Ireland is committed to limiting annual national emissions of a basket of six greenhouse gases[10] to 113% of 1990 levels on average for the period 2008 to 2012.

In 1990, national emissions of greenhouse gases amounted to 53.4 Mt CO_2 equivalent[11]. Greenhouse gas emissions in 2001 amounted to 70.0 Mt CO_2 equivalent. The national Kyoto Protocol target of 113% of 1990 levels is 60.4 Mt CO_2 equivalent.

As part of an EU wide strategy to facilitate achievement of the EU's commitments under the Kyoto Protocol an EU Emissions Trading Directive[12] was finalised in October 2003. This requires mandatory participation by large combustion plant such as that proposed at Aghada in an EU-wide CO_2 emissions trading scheme from 1st January 2005 onwards. Inter alia it requires that Member States develop plans to allocate CO_2 emission allowances to mandatory participants in the scheme prior to 2005.

In July 2004 the EU Commission approved a National Allocation Plan for Ireland. Under this plan Government is committed to allocating approximately 14.4 Mt per annum in CO_2 allowances to the energy sector for the period 2005 – 2007 and 0.34 Mt per annum to a New Entrant Reserve (NER), to be allocated to installations covered by the Directive which commence operation after the first of January 2005. It is anticipated that the proposed new plant at Aghada will obtain an allocation of allowances from the NER and purchase any further allowances required.

In light of the EU emissions trading scheme which caps national emissions[13] from the sectors covered from 2005 onwards, the future operation of the proposed new plant at Aghada will not cause an increase in global CO_2 emissions.

---

[9] Third Assessment Report of Working Group I of the Intergovernmental Panel on Climate Change, Jan 2001

[10] The six gases are: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

[11] The total CO_2 equivalent figure is calculated by converting emission quantities of the non-CO_2 ghgs to CO_2 equivalent tonnes based on the global warming potential of each gas relative to that of CO_2.

[12] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC

[13] Emissions trading require that emissions in excess of a target be offset by reductions elsewhere within the emissions trading area.

7.4.2 Impact of the Development

Combustion of natural gas and gasoil at the proposed plant at Aghada will give rise to CO_2 emissions. Assuming the largest size of plant likely to be constructed (425 MW), high operating hours at full load per annum (equivalent to 95% Load Factor) and a limited amount of gas oil use (432 hours) it is calculated that CO_2 emissions will be at maximum be 1.332 Mt per annum.

Based on annual electricity production of 3.73 x 10^6 MWh and total CO_2 emissions of 1.332 Mt the proposed plant will emit 0.357 t of CO_2 per MWh of electricity produced. This is considerably lower that the average figure for CO_2 emitted in electricity supply nationally (0.771[14] t per MWh in 2002).

In the initial years of operation the proposed new plant will displace generation from higher CO_2 emitting plant and cause a net reduction in system CO_2 emissions. As the plant will participate in the EU Emission Trading Scheme (ETS) it will not result in an increase in global GHG emissions and thereby not contribute to any additional impact on climate over the situation at present.

In light of the quantities of CO_2 associated with the global carbon cycle and the quantities emitted from fossil fuel combustion on a global basis (circa 22 billion t of CO_2 in 1990) it is apparent that the quantum of emissions from the proposed plant will not give rise to a significant impact on the global climate system.

7.4.3 Mitigation

The proposed plant will utilise high efficiency state of the art technology and participate in the forthcoming EU emissions trading scheme. No further mitigation is proposed.

7.4.4 Conclusion

Emissions arising from the proposed plant will not be significant in the context of global climate.

[14] Energy in Ireland 1990 – 2002, Sustainable Energy Ireland, May 2004

8. NOISE

8. 1 RECEIVING ENVIRONMENT

8.1.1 Introduction

The site is located within a designated strategic industrial area with the nearest residences being 600 m from the site boundary.

The site is currently subject to an Integrated Pollution Control licence for which noise sensitive locations (NSLs) have been identified and noise limits set. The two noise sensitive locations are the nearest house to the Aghada side at 600 m from the site (NSL 1) and the nearest house to the Whitegate side (NSL 2), also at 600 m from the site.

Existing plant on the site comprises a 270 MW steam generation unit (Unit 1), three 85 MW open cycle gas turbines (CT11, CT 12 and CT 14) and two emergency 26MW open cycle gas turbines units. Unit 1 operates continuously all year round, the three CTs are used for peaking purposes only and operate mainly by day. The small emergency units are operated only for peaking purposes.

The noise regime has been surveyed for the original IPCL application in 2000 and subsequently in 2003. Reports of these measurements are presented as Appendix J and Appendix K.

A further assessment including noise monitoring was undertaken in April 2004 in relation to the provision of the CCGT plant at the site.

Since commissioning of the existing plant in 1981 there has been very few complaints relating to noise at the station. In the last five years for instance there have been four complaints, all related to steam blows of short duration during forced start-ups at night and no complaints in relation to normal operation.

Road traffic is the main contributor to noise in the vicinity of the site. The Whitegate Oil Refinery is approximately 1 km south of the station on the R630 and contributes to the noise climate of the local area.

8.1.2 April 2004 Noise Survey

The noise survey results are presented in terms of the following three parameters:

L_{Aeq} is the equivalent continuous sound level. It is an energy based average and is used to describe fluctuating noise levels usually over a defined sample period.

L_{A10} is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise.

L_{A90} is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.

Measurements were conducted close to NSL1 and NSL2 over the course of the following survey periods:

Daytime 11:05 – 18:01hrs on 28/04/2004

Night-time 00:02 – 03:28hrs on 28-29/04/2004

Continuous monitoring was from 9:46hrs on 27/04/2004 to 03:46hrs on 28/04/2004

The weather throughout the survey periods was dry with a moderate breeze. Average wind speeds in the range 2 - 4 m/s were recorded during the measurement period with occasional gusts in the order of 7 m/s, temperatures were in the range 4 - 15ºC. During the survey, the oil refinery was shut down for a major overhaul, which may have reduced the background noise levels in the area.

The results are presented in Appendix L and are summarised as follows:

NSL 1: During the daytime the dominant sources of noise were passing road traffic, wind induced noise from nearby foliage and the sea. Noise levels were in the range 48 - 59dB L_{Aeq} with background noise levels in the range 37 - 53dB L_{A90}. During the night-time the dominant source of noise was road traffic. Noise levels were in the range 33 - 53dB L_{Aeq} with background noise levels in the range 23 - 39dB L_{A90}.

NSL 2: During the daytime the dominant sources of noise were passing road traffic and activity on the Aghada Generating Station site. Noise levels were in the range 52 - 60dB L_{Aeq} with background noise levels in the range 39 - 47dB L_{A90}. During the night-time the dominant sources of noise were road traffic and plant noise from the Aghada Generating Station site. Noise levels were in the range 33 - 47dB L_{Aeq} with background noise levels in the range 30 t- 42dB (A) L_{A90}.

In addition to the surveys at the NSLs, attended noise surveys were carried out at two further locations to provide a full suite of baseline information. , as follows.

- South west corner of Aghada Generating Station site The results are summarised in Table 8.1
- On R630 south of Aghada station towards Whitegate just east of junction to Corkbeg Island in the vicinity of a number of residential dwellings. The results are summarised in Table 8.2.

Table 8.1: Summary of Results(dB re. 2x10^{-5} Pa) for South West Corner of Site

Period		L_{Aeq}	L_{A10}	L_{A90}
Daytime	11:04 – 11:19	52	55	48
	11:19 – 11:34	55	57	51
Night-time	00:02 – 00:17	50	51	47
	00:18 – 00:33	56	59	49

During the daytime the dominant sources of noise were plant noise associated with the Generating Station and water and wave noise. Noise levels were in the range 52 to 55dB L_{Aeq} with background noise levels in the range 48 to 51dB L_{A90}. During the night-time the dominant sources of noise were again plant noise associated with the Generating Station and water and wave noise. Noise levels were in the range 50 to 56dB L_{Aeq} with background noise levels in the range 47 to 49dB L_{A90}.

Table 8.2: Summary of Results for Location East of Junction with Corkbeg Island

Measured Noise Levels (dB re. 2x10^{-5} Pa)								
L_{Aeq}	L_{A10}	L_{A90}	L_{Aeq}	L_{A10}	L_{A90}	L_{Aeq}	L_{A10}	L_{A90}
Daytime								
11:47 – 12:02			12:53 – 13:08			13:57 – 14:12		
59	59	53	61	64	52	57	59	51

15:02 – 15:17			16:07 – 16:22			17:07 – 17:22		
56	57	47	60	58	50	56	57	49
Night-time								
01:20 – 01:35			02:18 – 02:33			02:33 – 02:48		
40	42	35	37	39	34	39	42	34

During the daytime the dominant sources of noise were road traffic along the Whitegate Road and wind induced noise from nearby foliage. Noise levels were in the range 56 to 61dB L_{Aeq} with background noise levels in the range 49 to 53dB L_{A90}. During the night-time the dominant sources of noise was road traffic along the Whitegate Road. Noise levels were in the range 37 to 40dB L_{Aeq} with background noise levels in the range 34 to 35dB L_{A90}.

8.1.3 Historic Noise Monitoring

The 2000 survey was undertaken whilst Unit 1 was operation. The 2003 noise monitoring survey was undertaken during a high activity period at the station as all the generators were operating throughout the noise monitoring period of the daytime noise monitoring survey. During the night time survey Unit 1 was the only unit in operation.

The 2003 survey results confirmed that the operation of the gas turbines have no significant effect on the L_{A90} levels. This survey showed that the contribution from the station, represented by L_{A90} levels was between 39.5 – 41.0 dB (A) daytime and 29.0 - 34.5 dB (A) night-time. These levels are below the EPA criteria for the site.

All three surveys show that, for both NSLs, the noise levels (Leq) are dominated by traffic noise and do not meet EPA criteria. However, all three surveys show that the noise levels attributable to the existing power station are at or below EPA criteria as evidenced by the L_{A90} results.

Table 8.3: Summary Results of 2000, 2003 and 2004 Surveys

Period	***Day***						***Night***					
Location	**NSL 1**			**NSL 2**			**NSL 1**			**NSL 2**		
Value	L_{aeq}	L_{A10}	L_{A90}	L_{aeq}	L_{A10}	L_{A90}	L_{aeq}	L_{A10}	L_{A90}	L_{aeq}	L_{A10}	L_{A90}
2000 survey - (15 min ref. Period)	64.5	66.7	46.1	63.1	65.2	45.4	56.6	53.9	45.1	54.2	51.5	43.7
2003 survey - (30 min ref. period)	68.6	71.5	39.5	66.2	70.0	41.0	31.7	33.0	29.0	58.6*	40.0	34.5
2004 survey - (15 min & 60 min ref. periods)	48 – 59	46 - 60	37 - 53	52 – 60	55 - 63	39 - 47	33 - 53	29 - 57	23 - 39	33 - 47	33 - 58	30 - 42

*see note in report (levels attributable to heavy traffic)

The L_{A90} levels from the 2003 and 2004 surveys are of a similar order of magnitude and are lower than the 2000 survey. This may partially reflect different microphone locations in the 2004 survey compared to earlier surveys.

8. 2 IMPACT OF THE DEVELOPMENT

8.2.1 Construction Noise

The main impacts of on-site construction are expected to be noise from plant and on-site construction traffic. Calculations of construction noise were made following the procedures set out in BS 5228 with calculations made for each construction activity. The results are expressed as LA_{eq} (12 hour) dB equivalent continuous noise levels, which is a standard unit used to express construction noise. While no formal limits exist for construction noise, standards that have been applied to large civil engineering projects tend to fall in the range of 70-75 dB LA_{eq} (12 hour) for daytime construction activities.

Details of typical construction plant noise levels and the percentage of the working day that the plant would typically be operating are as follows:

Table 8. 8: Typical Construction Plant Noise Characteristics (dB re 10^{-12} watts)

Item of Plant	Sound Power Levels	Percentage On-time	Item of Plant	Sound Power Levels (dB re 10^{-12} watts)	Percentage On-time
Compressors	102	100%	Earth Moving	113	50%
Welding Generators	70	70%	Supply Vehicles	108	50%
Pneumatic Breakers	109	30%	Piling	115	60%
Cranes	102	50%	Concrete Mixer	108	50%
Wheeled Loaders	104	65%	Poker Vibrators	112	75%

Noise levels at selected receiver distances were calculated from the sound power data assuming the plant would be operating at the nearest point to the sensitive receivers.

It is not envisaged that foundations for the main buildings and structures of the proposed plant will require piling. Piling is likely to be confined to the provision of a small number of permanent piles for the cooling water outfall access/maintenance platform and temporary sheet piling for construction of the new cooling water pumphouse. Piling and works involving earth moving and concreting tend to be the noisiest activities during construction.

The likely noise levels from these activities, at various distances from the site, are calculated below. It is to be noted that these activities are not coincidental so the noise is not additive.

Table 8.9: Noise Levels of Construction Activities

Distance From Site	10 m	50 m	100 m	200 m	500 m	1,000 m
Activity	**LA_{eq} (12 hour) dB**					
Earth Moving	82	68	62	56	48	42
Piling	85	71	65	59	51	45
Concreting	84	70	64	58	50	44

Construction noise levels at sensitive locations which are 500 m or more in distance from the site boundary, will remain below both the existing ambient daytime noise levels and typical noise limits appropriate to such activities. Any possibility of local disturbance will be further limited by restricting piling work to daytime hours.

During the construction phase of the project there may be some small impact on nearby residential properties during the day as a result of noise emissions from construction traffic. At peak construction activity, the estimated number of daily vehicle movements is 500. This represents an increase of approximately 20% in existing vehicle movements.

8.2.2 Operational Noise

The exact layout and configuration of the plant will only be finalised after the techno-economic evaluation of tenders. However, preliminary layouts indicate that the main potential sources of noise will be located at the centre of the development area.

Commissioning of the plant will involve a steam blow through the boilers and pipework to purge them, with the steam being exhausted to atmosphere. This is a once-off occurrence and can lead to high noise levels if not silenced. ESB has used silencers for many years to minimise noise from such boiler blow outs and one will be used in this case. The blow out activities will be scheduled to occur during daytime hours only.

The operational noise will be governed by the noise level limits set down in the station's IPCL, i.e. Daytime (08:00 - 22:00hrs) 55dB $L_{Aeq,}$(30 min) and Night-time (22:00 to 08:00hrs) 45dB $L_{Aeq,}$(30 min)

The resultant noise level at the nearest noise sensitive location attributable to the proposed plant in operation will be designed to be less than LA_{eq} (30 mins) 45dB night time and 55dB day time and will not have significant tonal or impulsive character.

Noise Impact Modelling

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, Brüel & Kjær Type 7810 *Predictor*, calculates noise levels in accordance with ISO9613: *Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation*, 1996. The model input data is presented in Appendix N.

The predicted noise levels at the noise sensitive locations and at the location east of junction with Corkbeg Island are set out in Table 8.10 below.

Table 8.10: Predicted Noise Levels at the Facade of the Nearest Noise-Sensitive Locations

Identification	Octave Band Centre Frequency (Hz)								dB(A)
	63	125	250	500	1k	2k	4k	8k	
NSL1	29	27	26	28	30	26	5	–	36
NSL2	28	27	23	22	22	15	–	–	33
R630/Corkbeg Isl. Junction.	23	17	17	17	19	15	–	–	27

The predicted noise levels at the receiver locations are in the range of 27 - 36dB L_{Aeq}. These noise levels are within the noise limits applicable to the site.

8. 3 MITIGATION

8.3.1 Construction

During construction the recommendations of BS5228: Noise and vibration control on construction and open sites, Part 1: Code of practice for basic information and procedures for noise and vibration control, 1997 and the European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations 1988 will be complied with.

This will ensure that:

- No plant used on site will cause an ongoing public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be of the 'sound reduced' models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machines, which are used intermittently, will be shut down or throttled back to a minimum during periods when they are not in use.
- Any plant, such as generators or pumps, which are required to work outside of the hours 07:00 – 19:00, will be surrounded by an acoustic enclosure.
- Piling will be restricted to daytime hours.

8.3.2 Operation

Noise control at major CCGT plants is well understood and implemented in practice. The gas turbine is the major potential source of noise. A silencer will be used on the air intake to suppress the predominantly pure tone noise radiation from this source. Broadband noise from the gas turbine exhaust is controlled by specially tuned absorptive/reactive silencers. In addition, the boiler provides additional attenuation to this noise source. Noise emissions from the body of this plant will be reduced by use of acoustic enclosures. Sound insulation will also be provided to enclosures housing items of plant liable to be sources of noise.

Where unavoidably high noise levels exist within the plant these locations are identified by survey and marked with warning signs. Hearing protection equipment is provided to all workers and its use is mandatory for work in such areas.

A noise analysis of all major plant components will be carried out during commissioning of the plant to ensure compliance with the specification and guaranteed performance.

Thereafter, in order to ensure compliance with specified limits, noise measurements during plant operation will be carried out at regular intervals.

8. 4 CONCLUSIONS

The general noise environment is dominated by traffic.

Noise levels (Leq) are dominated by traffic noise and do not meet EPA criteria. However, the noise levels attributable to the existing power station are at or below EPA criteria as evidenced by the L_{A90} results.

Local disturbance during construction will be minimal, except for a small increase in noise level from construction traffic.

Silencing measures will ensure that the operation of the CCGT plant will be undetectable at noise sensitive locations nearby and will not add significantly to the existing noise environment.

The proposed development will not result in significant adverse environmental impacts.

9. LANDSCAPE

9. 1 RECEIVING ENVIRONMENT

9.1.1 Landscape Character

The site for the proposed CCGT power plant is just west of the existing power station on a large area of reclaimed land (Plate 1).

Cork Harbour is one of the world's largest natural harbours. It consists of several limestone basins separated from each other and from the sea by ridges of Old Red Sandstone. The harbour is influenced by tidal changes and the estuaries of the River Lee and Ballynacorra River, which effectively shape the landform of the surroundings of Cork Harbour. Several villages and many scattered properties can be found along the shoreline facing the waterfront. The most important settlement on the harbour is Cobh on the northern shore, which was an important Naval Base and trading port from the 18^{th} Century to the early 20^{th} century and still is a popular tourist attraction for its colourful terraced Victorian houses and cathedral.

In many areas, the coastline around Cork Harbour steeply rises to heights up to 70-90 m OD. Further inland the landform is undulating, at elevations of 50 - 80 mOD and landuse is largely agricultural (Plate 11, 12 and 14). The landuse surrounding Ringaskiddy at the western shore of Cork Harbour and to the south of Whitegate is characterised by several industrial developments (Plate 8).

There are several tourist attractions, viewing points and scenic roads around Cork Harbour that highlight the attractive landscape and seafront in this area.

9.1.2 Site Characteristics

The application site consists of a level area of reclaimed land, mostly bare with scattered groups of gorse (Plate 1). The total land area measures approximately 11 hectares (27 acres).

The site is open to the south, west and north, where it juts out into Cork Harbour. The existing Aghada Generating Station lies directly to the east. The R630 is separated from the existing Power Station and the proposed site by a mature dense hedgerow and some trees (Plate 2).

The only open view of the site from the R630 is from the entrance road to the existing Power Station (Plate 3). The land directly to the east of the R630 is part of the existing Power Station.

Plate 7 shows the lands surrounding the site, with mature woodland immediately to the east of the site (right hand side of picture) and Great Island rising in the background more than 2 km to the north of the site.

The site will be accessed via an existing entrance off the R630, approximately 250 m to the northeast of the entrance to the existing power station.

9.1.3 Site Visibility - General

Visibility of the site is primarily determined by its location on the shore of Cork Harbour. Views from the north and west are generally very open but are mostly distant views over water. There are closer open views of the site from many locations on the shore of Whitegate Bay. Views from further south and east are partly to fully screened by local topography and vegetation.

Figure 9.3 shows the location of the application site within the existing landscape and indicates the Principal Visual Zone from which the site, and therefore the proposed development, could potentially be seen, also see plates 1-21. Note that the site may not be visible from some residences and roads within this area, owing to localised screening topography and vegetation. The seasonal effects of hedgerow and trees in winter will also affect the visibility of the site.

Figure 9.4 indicates the locations of those private properties that may experience visual impact arising from the proposed development. The main group affected will be residents of properties located to the immediate south of the proposed development site along Whitegate Bay (refer to Plates 7-9).

Potential Short Distance Views Towards the Site Lands

There are potential short distance views from:

- most properties facing Whitegate Bay to the immediate south of the proposed development site (see Plates 7-9).
- the R630 from approximately 500 m to the northeast of the site to just southeast of the site (see Plates 3 and 4).

Potential Longer Distance views of the Site

There are potential longer distance views of the site from:

- several properties along the waterfront east of Marloag Point.
- those properties on Great Island, including Cobh, which are facing the waterfront (Plates 14-18).
- several properties and stretches of road to the west of Cork Harbour (Plates 19-21).

Distant views from the south and east:

The site is almost fully screened by intervening vegetation and landform from locations to the south and east other than along Whitegate Bay (see Plates 5, 6 and 10-13).

9.1.4 Sensitivity of Existing Views

Existing views are on the whole important. Views towards the site at the moment represent a scenic rural environment, albeit containing large industrial developments. There is an increase in building development in and around Whitegate but topography screens many potential views from these new residential areas (Plate 6).

The views described above range from low to high sensitivity to development of the type proposed i.e. extension to the existing power station on large scale. This will be dependent on where the development is viewed from, as the proposed buildings will blend in with the existing ones from certain locations and will be more obvious and intrusive from others.

9.1.5 Significance

The word significance as used in this report relates to the level of intrusion of a proposed development upon designated views, designated landscapes and designated amenity areas. Impacts on visual character of designated site are dealt with in section 9.2.

Scenic Landscape

A large area around Cork Harbour is listed as scenic landscape in the Cork County Development Plan 2003. See Figure 9.1 for extent.

Proposed Natural Heritage Areas

The following are listed in the Cork County Development Plan 2003:

Within a 4 km radius from the site:

1084 - Whitegate Bay: There will be open views of the proposed development from this designated area. These views will be similar to the views from properties facing Whitegate Bay.

1076 - Rostellan Lough, Aghada Shore and Puolnabibe Inlet: There will be no views of the proposed development from most parts of this NHA but there may be some distant views from the most north-western section.

1987 - Cuskinny Marsh: This site is located 2.5 km east of Cobh on the shores of Cork Harbour. There will be distant views of the proposed development from this NHA (Plate 6).

Between 4 and 8 km radius from site:

1058 - Great Island Channel: There will be no views of the proposed development from any part of this NHA.

1046 - Douglas River Estuary: There will be no views of the proposed development from any part of this NHA.

1979 - Monkstown Creek: There will be distant views of the proposed development from this NHA (Plate19).

1066 - Lough Beg (Cork): There will be distant views of the proposed development from this NHA.

1990 - Owenboy River: There will be no views of the proposed development from any part of this NHA.

Items Listed as Special Areas of Conservation

The following are listed in the Cork County Development Plan 2003:

Within a 4 km radius from the site:

There are no listed SACs within a 4 km radius of the site

Between 4 km and 8 km radius from the site:

1058 - Great Island Channel

See NHAs above

Items Listed as Special Protection Areas

SPA030 – Cork Harbour

There will be open views of the proposed development from that part of the SPA located at Whitegate Bay. Views from the SPA at Lough Beg south of Ringaskiddy will be distant and partly screened. There will be no views from the SPA north of Great Island.

Scenic Routes

Two scenic routes are listed in the Cork County Development Plan 2003 within a radius of 4 km of the site:

- A50: Road between Inch and Aghada
- A51: Road from Ballynacorra via East Ferry to Whitegate and Roche's Point

Five scenic routes are listed in the Cork County Development Plan 2003 within a radius of 4-10 km of the site:

- A52: Road at N.E. Great Island
- A53: Road between Cobh and Belvelly
- A54: Road between Passage West and Ringaskiddy
- A56: Road from Carrigaline to Crosshaven
- A57: Roads between Crosshaven and Myrtleville, Church Bay, Camden, Weavers Point and Fountainstown

There will be open short distance views of the proposed development from scenic route A51 (refer to Plates 3, 4, 7, 9 and 12). There will be open and glimpsed distant views from sections of scenic routes A53, A54 and A56 (refer to Plates 17, 19 and 21).

There are no known views of the site lands from the remainder of these routes.

9.1.6 The Historical and Man-Made Landscape

Cork Harbour, being one of the world's largest natural harbours, has been used as a trading port, ferry port and naval base for many years. It houses oil refineries and many other types of industries. Towns and villages have grown around the several little harbours all around the bay. The further growth of these towns, villages and industries is restricted by the existing topography with the land steeply rising from the shore of Cork Harbour in many areas.

The area of the development site and its immediate surrounds is located on an in-filled site that was enlarged by excavated material from the hillside opposite. At the moment the site is made up of bare soil with some sparse groups of gorse.

Proposed development will entail removal of very little existing planting and continue the process of industrial development in the Whitegate and Aghada area.

9. 2 IMPACT OF THE DEVELOPMENT

9.2.1 Characteristics of the Proposed Development

The proposed development will comprise of a complex of buildings including one chimney stack (70 m high), a bypass stack (50 m high) and a much smaller auxiliary stack (48 m high), immediately to the west of the existing power station. There will also be other buildings (e.g. workshops) and a number of tanks (e.g. oil tanks, raw water and treated water tanks) spread out over the development site. It is also proposed to fill in a small area of each of the two existing lagoons on site. This section assesses two options for the layout and mass of the main group of buildings (single and multi-shaft layout). Two sets of photomontages were prepared to illustrate the impact of the two different options from 8 locations within a 6 km radius of the site (see Photomontages 4, 7, 11, 12, 15, 17, 18, 21-single and multi-shaft options)

In the single shaft option the main building complex covers an area of approximately 5,400 m^2, whereas the multi shaft option covers an area of approximately 6,700 m^2. The remaining buildings and tanks have the same shape and height in both options. The only difference being that some of them are in slightly different position in both options.

During construction the development will be accessed via an existing entrance off the R630, approximately 250 m to the northeast of the entrance to the existing station. On completion, the new power station will be accessed via the existing station entrance.

A landscape plan (Figure 9.5) has been prepared, which includes native tree planting to the south of the proposed development along Whitegate Bay and along the R630, which will help mitigate some of the potentially negative visual impacts.

9.2.2 Scope of the Impact

The development will impact on the visual and landscape character of the surrounding area. These impacts will be likely to arise from factors including the following:

Construction Works/Site Development: Disturbances will largely arise from vehicle movement, and will create a temporary and moderate negative visual impact in the area, with intermittent significant visual impact.

Removal of Existing Vegetation: The only planting to be removed are the small groups of gorse on site. This will have a negligible visual impact.

New Development/Changes in Land Use: Permanent visual impact will occur on completion of the developments.

- Impact on views from properties and roads facing the site in and around Whitegate will range from moderate to significant.
- Impact on views from properties and roads facing the site, from the north and west over Cork Harbour, will range from low to moderate.

Any alteration to the landscape as a result of the change of land use associated with the proposals will have a corresponding impact on the character of the landscape. The extent of the impact depends on the degree of change of land use. The proposed development site is situated on in-filled land that lies bare at the moment and is zoned as an established area of industry (Cork County Development Plan 2003). The impact on landscape character as a result of the development is considered moderate, long term and negative.

Increases in Traffic: During the construction period the number of vehicles on the R630 and entering the site will increase. This number will return to normal on completion, as staff numbers will not significantly be increased. This will result in a short term negative visual impact.

9.2.3 Zone of Visual Impact

Figure 9.2 indicates the Zone of Visual Influence. The ZVI map was prepared for the visibility of the proposed stack. It was based over a 8.5 km radius and was used to check visibility from surrounding areas.

The map represents visibility within a lunar landscape and so depicts a `worst case' scenario with none of the screening benefits of vegetation and the built environment being taken into account. Its limitations, such as accuracy with a 10 km radius, are also acknowledged. Hence the ZVI map was used as a general guide to visibility, and visibility ‘on the ground’ was recorded separately. These results are presented in the Visual Impact Map, Figure 9.3, which shows the principal views and sections of roads where there are open or intermittent/glanced views of the proposed development.

This map indicates areas where the stack is visible and how much of the stack is visible; top 17.5 m, top 35 m, top 52.5 m, all of the stack. Depending on how much of the stack is visible it can be gauged whether or not any of the proposed buildings will be visible. The highest building would be 45 m high. Therefore if only the top 17.5 m of the stack will be visible none of the buildings will be visible. If the top 35 m is visible, a maximum of 10 m of the highest building are visible, and so on.

9.2.4 Impact on Visual Character

As a whole, the development will give rise to short term visual intrusion arising from the construction phase, and permanent visual intrusion arising from completion of the development. Completion, including proposed tree planting combined with correct maintenance of proposed and existing vegetation, will help to ameliorate impact on views**.**

Given the location of the site, the proposed development will be seen from a number of viewpoints. The principle views are described below:

Open short distance views from the south and southwest:

R630 and Whitegate (Plates 3, 4 and 7-9)

The proposed new power station will be openly visible from numerous properties facing the bay in Whitegate. It will also be visible from several locations along the R630 in and around Whitegate. Please note that there will also be many locations within Whitegate where local topography and vegetation will partly or fully screen the proposed development**.**

Plate 3 shows the view along the entrance road to the existing Aghada Generating Station. The proposed development will be visible in the background to the right of the entrance road but will only be visible for a short moment as one drives by. Therefore this view will experience negligible to slight visual intrusion both during construction and upon completion.

Plate 4 (also Photomontage 4) shows a view of the existing power station as one approaches from a north-easterly direction along the R630. The top part of the proposed oil tanks as well as a great part of the proposed station, including the proposed stacks, will be visible along this section of the road. There are no existing views into the wider landscape owing to the hedgerow planting along the road. At the moment the dominant structure within views from along this stretch of the road is the existing stack. As shown in Photomontage 4, the existing stack will still be the dominant feature even after completion of the new power station.

Therefore, the construction of and the completed proposed station will result in a moderate and negative visual impact on views along this part of the road.

Plate 7 (also Photomontage 7) gives an example of a view from a property along Whitegate Bay. Many properties in this area will have similar views. The proposed development will be openly and clearly visible in these views owing to the short distance. Nevertheless, plate 7 also indicates that the buildings will only take up a small part of the view when looking at the wider landscape of Cork Harbour. The existing view towards Great Island will experience some visual intrusion as shown in Photomontage 7.

Views from properties and roads along Whitegate Bay, as shown in Plate 7**,** will experience a moderate to significant and negative visual impact as a result of the proposed development. This impact may be reduced somewhat by the planting of trees on the perimeter of the site.

Plates 8 and 9 are examples of open short distance views of the development site from locations further inland. There are a number of properties close to the location of Plate 8 with similar views. The proposed development will be visible to the left of the existing power station in both Plate 8 and 9 and will result in a moderate and negative visual impact on these views.

Glimpsed short distance and longer distance views from the south and southeast:

Parts of Whitegate, Aghada and private properties and roads to the south and east (Plates 5, 6 and 10-13)

There are several locations within the above-mentioned area with glimpsed views of the proposed development and/or views where only the top part of the proposed stack and buildings will be visible. Some examples are:

Plate 5 is a view from a road within Aghada, approximately 1 km to the northeast of the proposed power station. There are similar views throughout Aghada. Only the top part of the existing power station and the existing stack are visible in these views. Considering the location of the proposed development (behind the existing station from this viewpoint) and the height of the proposed buildings and stack as well as the screening effects of local vegetation, only glimpsed parts of the proposed power station will be visible in views from Aghada. The visual impact on these views will be imperceptible.

Plate 6 shows a view of the existing Power Station from within a new housing estate at the northern edge of Whitegate. Owing to the screening effects of vegetation and topography, there will be no visual impact as a result of the development.

Plate 10 is a view from a small housing estate located to the southeast of Whitegate. In the existing view only the existing stack and none of the existing buildings at Aghada Generating Station are visible. Considering that all of the proposed buildings are lower than any of the existing ones, none of them will be visible from this location. It is possible that the very top part of the proposed stack will be visible beside the existing one but it will result in imperceptible to slight and neutral visual impact on this view.

Plate 11 (also Photomontage 11) is a view from beside a private property along the third class road between Aghada Upper and Inch. Local topography at this point of the road allows a view of the existing stack. As with Plate 10, only the top part of the proposed stack will be visible in this view (refer to Photomontage 11). This will result in an imperceptible visual impact.

Plate 12 (also Photomontage 12) shows a view from the third class road between Whitegate and Roche's Point at Glanagow. Several private properties along this stretch of the road as well as the entrance to Trabolgan Holiday Park have similar views. As seen in Photomontage 12, parts of the proposed buildings and stacks will be visible in this view. Nevertheless, the existing stack at Aghada Generating Station remains the tallest structure in view.

There are also a number of stacks belonging to the oil refineries south of Whitegate Bay visible in this view and therefore this view will experience an imperceptible to slight impact as a result of the proposed development.

Plate 13 shows a view southwest from Aghada Pier. As with Plate 10 and 11, only the existing stack at Aghada Generating Station is visible and therefore only the top part of the proposed stack will be visible if at all, resulting in imperceptible visual impact on views from Aghada Pier.

Open long distance views from the north:

Private Properties and roads on Great Island and east of same (Plates 14-18)

There are numerous locations on Great Island, and within the area directly to the east of the island, facing the waterfront with open distant views of the proposed development. Some examples are listed below:

Plate 14 is an example of views from a private property facing the waterfront in the eastern part of Great Island. There are several properties in this area with similar views. The proposed extension will be clearly visible to the right of the existing power station but owing to distance it will not become dominant within the view and will therefore have a slight to moderate and negative visual impact.

Plate 15 (also Photomontage 15) shows a view from the main road through Ballymore on Great Island. There will be glimpsed views of the proposed development from this road and open views from the private properties along the road. As with Plate 14 and as visible on Photomontage 15, the proposed extension will be clearly visible in the distance and views will experience a slight to moderate negative visual impact.

Plate 16 is a view from the third class road along the waterfront at Cuskinny Bay on Great Island. Cuskinny Marsh is one of the listed NHAs within a 6 km radius of the proposed development**.** The proposed development will be openly visible from this location. It will be located in front of the existing power station and the elevated landscape surrounding Whitegate and will therefore visually recede into its background to a certain degree. Because of this and considering the distance of the proposed power station from this location there will be a slight to moderate and negative visual impact on this view.

Plates 17 and 18 (also Photomontages 17 and 18) were both taken in Cobh. Plate 17 was taken close to the waterfront just off the R624, and Plate 18 from outside St. Colman's Cathedral at an elevation of 50 m OD. As with Plate 16, the proposed development will appear to be located in front of the existing Power Station and will visually recede into the general landscape, to a certain degree. The two stations, existing and proposed, will read as a single development from this viewpoint.

It helps to reduce potential visual impact that the buildings do not break the natural ridgeline in views from this location (although the proposed stack does appear higher than the ridgeline). Views from Cobh therefore, looking south-west, will experience slight to moderate and negative visual intrusion (refer to Photomontages 17 and 18).

Glimpsed long distant views from the west:

<u>Roads and Properties along the western shore of Cork Harbour, Monkstown, Ringaskiddy and Crosshaven (Plates 19-21)</u>

The development is partially screened from the western shore of Cork Harbour by intervening islands within the Harbour. All below viewpoints are a minimum of 4 km away from Aghada Generating Station. Refer to the examples below:

Plate 19 is a view east from the R610 just outside Monkstown. Haulbowline Island and Spike Island block views of Aghada Generating Station, so that only the existing stack is visible in the distance. Considering the former, and that both the proposed buildings and stack will be lower than the existing structures it can be said that the visual impact on views from this section of the R610 will be imperceptible.

Haulbowline Island is still used by the Irish Navy as their Base and Spike Island is a former military fortification now used as a prison. There will be open distant views from these Islands of the proposed development, similar to the ones of Plates 17 and 18 described**.**

Plate 20 shows a view northeast from the Pfizer factory, approximately 1 km south of Ringaskiddy. There will be no views of the proposed development from within Ringaskiddy owing to topography. Views only open up when getting close to the western shore of Cork Harbour as seen in Plate 20**.** The proposed development will be partly visible and appear to be located in front of the existing power station. Considering this and the presence of other industrial structures in this view (Corkbeg Island with its many oil tanks) the visual impact of the proposed development will be imperceptible to slight.

Plate 21 (also Photomontage 21) was taken from Crosshaven Harbour. As seen in Photomontage 21, the proposed development will barely be visible behind the existing oil tanks on Corkbeg Island. Visual impact would be imperceptible.

9.2.5 Impact on Landscape Character

As described above, the development will have a degree of impact on the landscape setting of the eastern shore of Cork Harbour, with the loss of a large open space, albeit an area of reclaimed land.

Impact on landscape character is dependent partly on the vulnerability of the affected landscape, i.e. by its ability to accommodate change without loss of perceived character. The ability of the landscape to accommodate change such as the proposed development is moderate.

The proposed development site is located in an area zoned as an established area of industry. There are several areas around Whitegate and Aghada zoned as new areas for industry and enterprise and there are areas undergoing development at present (e.g. in the area south of Whitegate Bay). Therefore, even though the wider landscape appears visually to be generally rural in nature, there is a substantial amount of large industrial development, particularly in the Whitegate area.

The Development Plan notes that where particular zoned lands have a scenic landscape designation or adjoin a scenic landscape designation, there is still a presumption in favour of development for the specific land use, but special attention should be paid to design, siting and landscaping depending on the individual area and the type of development.

The proposed development is a large complex of buildings and will have a moderate to significant visual impact on properties along Whitegate Bay. It will be a new and large-scale introduction into the landscape, and will be visible from areas around Cork Harbour. Nevertheless, it is felt that the proposed development does not have overly high significance within the wider landscape and development context and that it will not profoundly alter the character of the wider landscape.

It can be said that the development's proximity to the existing power station will result in less impact on landscape character than if the proposed plant were to be built on a separate site.

9. 3 MITIGATION

Mitigation measures were designed to ameliorate visual impact of the proposed development, mainly using the parameters of building massing/scale, siting, colour treatment and landscaping.

9.3.1 Location and Scale

The location for the proposed development within the site has been selected partly to reduce impact on views into the development.

The CCGT technology allows a facility which has a reduced visual mass when compared to the existing station.

The proposed station's proximity to the existing power station will result in less visual impact than if the station were to be built on a separate site, due to the visual benefits of clustering large scale developments in the landscape.

9.3.2 Layout Design

The process of design and layout of the CCGT elements included the assessment of various different options, some of which are described below.

- The final location of the oil tanks adjacent to the R630 was chosen over the original location closer to the water, to reduce visual impact on views of the site.
- Several colour options for the proposed buildings were assessed at an early stage and the colours as seen in Photomontages 4, 7, 11, 12, 15, 17, 18 and 21 were chosen. It is felt that the grey (RAL9002), chosen as the main building colour, reduces potential visibility of the development, because the buildings will mostly be viewed against a backdrop of sky or water.
- In order to provide architectural continuity, a row of windows is proposed to imitate the windows of the existing boiler house and turbine hall.
- High quality materials will be used in the construction of the buildings, in order to limit the impacts of weathering.

9.3.3 Landscaping

A landscape plan (Figure 9.5) has been prepared for the site to help reduce potential visual impacts. The features of the plan are listed below.

- A row of native trees along the southern boundary/Whitegate Bay will partly screen views from Whitegate.
- A row of trees along the R630 will screen some of the development from this road.
- Tree species proposed include Pine, Field Maple and Ash
- Landscape monitoring will occur for at least the first 18 months post-development completion by a Landscape Architect.

9. 4 CONCLUSIONS

The development site is openly visible from the north and west due to its location on the eastern shore of cork harbour.

There are open short distance views from the south, along Whitegate Bay. From further south and the east there are no known long distance views into the site.

Visual impact will range from imperceptible to slight to moderate, relating to many views from longer distances. A limited number of properties and roads within 2 km of the development, in particular to the south of the site, will experience moderate to significant visual impact. The principal visual zone is relatively large owing to the open views from the north and west but is restricted to those areas facing the waterfront and includes many distant views.

The main views of the development will be from areas in Whitegate, Cobh and Ballymore. Views from further inland are limited owing to topography and vegetation.

It is felt that impact on landscape character will be moderate, since the development takes up a small part of the wider landscape from many viewpoints within the study area, and considering that the site is close to existing large-scale industrial developments.

10. MATERIAL ASSETS

10. 1 INFRASTRUCTURE

10.1.1 Receiving Environment

The Cork County Development Plan 2003 strategic aims for Whitegate-Aghada support the consolidation of their industrial and harbour related roles within their sensitive scenic and coastal setting.

The development complies with the provisions of the Cork County Development Plan and represents a continuation of the existing use of the site.

The general area of the proposed development is already well serviced by the public road network, gas pipeline, electricity and water supply as follows:

Road Network: Access to the site is from the R630 Midleton - Whitegate Regional Road. The N25 National Primary Road links Midleton to Cork City and to Waterford City.

Foul Sewer: The existing station has its own sewage treatment works, from which treated effluent is discharged to Cork Harbour. The station is not connected to the public sewer.

Gas Pipeline: The gas distribution network passes close to the site. There is a gas connection to the existing plant on site via an above ground installation located on the upper eastern side of the site.

Electricity: The site already houses a high voltage substation and there is a connection to the site at lower voltage.

Water: Demand for water at the existing Aghada Generating Station is approximately 2,000 cum/week. Townswater is supplied from the public watermain. There is a water storage reservoir on the site.

10.1.2 Impact of the development

Road Network: Large components of the gas turbine will be delivered to site as completed items ready for installation. Delivery will mainly be by road. There is also a possibility of unloading from sea-going vessels at the existing unloading facility on site. There will be no adverse environmental impact.

Foul Sewer: Sewage from the new plant will be treated on site and discharged via the cooling water channel to Cork Harbour. Therefore there will no discharge to the public sewer.

Gas Pipeline: The proposed development would be fuelled by natural gas from the existing BGE network. A new connection from the distribution network will be provided on site. The gas will be fed to the plant via an on-site above ground pipe installation. There will be no adverse environmental impact.

Electricity: Export of power from the proposed plant will be via an underground cable to new bay in the existing 220 kV switchyard, which connects to the existing 200 kV and 110 kV lines.

Completion of the planned Aghada-Raffeen 220 kV line, including switchgear and additional cable connections to the existing 220 kV switchyard, will enable export of power from the proposed plant and the existing generating units at Aghada via the new line in addition to the existing lines.

No adverse impacts will arise from construction or operation of the additional switchgear required. Until this line is available operation of existing capacity at the site may be limited.

Water: Average water demand for the CCGT will be 20 m^3/hr**.** A towns water storage tank will be provided and connected to the station reservoir to ensure that station demand will not cause peaks in local demand and impact on other users. The storage will also serve as the supply for fire-fighting purposes.

10.1.3 Mitigation

The main infrastructural demands of the project will be supplies of gas and water. Otherwise, no mitigation is necessary.

10.1.4 Conclusions

No new public infrastructure requirements, other than those already provided for, will be necessary, either for construction or operation.

10. 2 TRAFFIC

10.2.1 Receiving Environment

Access to the site is from the R630 Midleton - Whitegate Regional Road.

Two pre-selected sites were surveyed on Tuesday 16th March and Saturday 20th March 2004. The sites were:

- Site 1: N25 / R630 Midleton Roundabout
- Site 2: R630 / Aghada Generating Station Access

The survey period was 07:00 to 19:00 hours for both days. Full turning counts were recorded and data was collected in 15 minute intervals. The traffic survey report is presented in Appendix M.

A 4-fold classification was used, namely Cars (CAR), Light Goods Vehicles (LGV), Heavy Goods Vehicles (HGV) and Pedal Cycles (PCL).

Survey Results

On Tuesday 16th March the survey showed that 5,684 vehicles entered onto the R630 from the N25/R630 Midleton roundabout. Of these 4,495 were cars, 724 were LGV and 463 were HGVs. In the same period 1,455 cars passed the entrance to Aghada Generating Station. Therefore, a full 75% of vehicles coming off the roundabout onto the R630 did not journey as far as the power station and Whitegate. The survey confirmed that traffic on the R630 is much less than the total using the Midleton/N25 Roundabout and that the R630 is largely used by the local community for domestic and agricultural purposes.

There was a reduction of approximately 15% in overall vehicle numbers going onto the R630 from Midleton roundabout on Saturday 20th March. The onward percentage of vehicles on the R630 was similar to that on the Tuesday survey. However, the numbers of HGVs and LGVs were considerably reduced in comparison with the Tuesday figures.

Daily traffic movements recorded at the R630/station entrance are summarised in Table 10.1.

The maximum number of LGVs and HGVs each way on the R630 per hour were approximately 25 and 20 respectively.

Table 10.1 Summary of Traffic Survey Results

	Car	LGV	HGV	PCL	Total
Tuesday 16th March 2004					
R630 towards Midleton	1000	166	209	0	1375
R630 from Midleton	1111	183	196	3	1493
To Aghada Station	86	17	8	0	111
From Aghada Station	85	14	9	0	108
R630 to Whitegate	1076	184	192	3	1455
R630 from Whitegate	966	170	204	0	1340
Saturday 20th March 2004					
R630 towards Midleton	930	81	46	1	1058
R630 from Midleton	924	100	39	1	1064
To Aghada Station	36	4	2	0	42
From Aghada Station	41	2	0	0	43
R630 to Whitegate	917	97	37	1	1052
R630 from Whitegate	918	80	46	1	1045

ESB Station

Traffic to and from the existing Aghada Generating Station relates to staff movements, maintenance and service activities and intermittent deliveries of gasoil for the GTs and emergency plant. In general between 7 - 15 tanker deliveries can be received on site per day. This typically represents approximately 7% of existing HGV traffic on the R630.

10.2.2 Impact of the Development

Construction

The total number of movements of HGVs on and off the site will be approximately 30,000 over the full duration of the period of construction. For a 27-month construction period and construction restricted to week-days, the average number of daily HGV vehicle movements traffic will be approximately 55. With a doubling of this to allow for peak construction period, this represents a total of 110 HGV movements/day, 55 to the site and 55 from the site. This represents 28% (55/196) of the existing HGV traffic volumes on the R630 from Midleton direction and a similar percentage on the R630 towards Midleton.

However, for most of the construction period the number of truck movements per day will be considerably less than the maximum assessed above.

Peak numbers employed during construction will be 500. In the worst scenario, this would mean 500 additional car movements to and from the site. This represents approximately 50% of car traffic each way on the R630. However, for most of the construction period the numbers employed will be considerably less than the maximum assessed above, typically 100/day. This would represent approximately 10% of existing car numbers each way on the R630.

Construction impacts will be short term and peaks in activity will be for short durations only.

Operation

Traffic will be associated with a relatively small number of station personnel and maintenance and servicing requirements. The estimated daily maximum is 80 vehicle movements (40 each way). This is a minimal increase on existing vehicle numbers each way (approximately 3%) on the R630.

The only case where additional traffic will arise is related to deliveries of back-up gasoil supplies to the site. The plant would be permitted to run on gasoil for a maximum of 5% of the year (18 days) and there will be a requirement for the new development to have a strategic reserve on site of 5 days continuous gasoil supply. To meet the latter requirement, two new tanks (2 x 4500 t) will be provided. In the event that this is used the oil supply in the tanks would have to be replaced. If this supply was to be replaced over 5 days, this would represent 60 ton/hr x 120 hr (5 days) 240 deliveries assuming 30 ton tankers. Assuming deliveries evenly spread over the 5 days this gives 240/5 = 48 deliveries per day (max), representing 25% of existing HGV numbers.

This level of HGV numbers would be for only a few days a year.

10.2.3 Mitigation

ESB will liase with Cork County Council in regard to traffic management during construction and adhere to all their requirements. During construction liaison will be maintained with the residents along the R630. They will be advised of any particularly busy periods and, where possible, their suggestions and comments will be taken on board. If deliveries involve unusually large loads, they will be undertaken at times that minimise the impact on other road users.

Otherwise, no mitigation of impacts is foreseen.

The increase in traffic during the operational phase will be slight in comparison with existing traffic in the general area. No mitigation of traffic impacts is required.

10.2.4 Conclusions

Short-term effects will arise during the 27 month construction period, but the effects thereafter will be minimal. In general, the increase in traffic during the operational phase will be imperceptible in comparison with existing traffic in the general area.

10. 3 ENERGY SUPPLY

10.3.1 Receiving Environment

Electricity Supplies and Economy

Demand for electricity is a key indicator of performance and growth in the national economy, with growth in demand for electricity actually surpassing national economic growth. Sustained economic growth requires that additional electricity generating capacity be installed on a continuing basis.

The last 20 years have seen significant growth in demand for electricity. Between 1990 and 1998 demand grew by 48% and further significant growth, an increase of 65% compared with 1998, is anticipated to 2010.

Reliable high efficiency plant operating at base load in addition to renewable and alternative forms of electricity production is required to meet this demand, in line with Government strategy.

10.3.2 Impact of the Development

Electricity Supplies and Economy

The proposal will contribute to ensuring that adequate electricity supplies are available to support economic activity and growth in a manner fully compatible with Government energy and environmental policies. It will ensure that national economic development is not constrained by shortfalls in the availability of electric power.

The anticipated total capital cost of the project is of the order of €300 M. This expenditure will result in economic benefit to the national economy.

10.3.3 Mitigation

No mitigation of impacts is required.

10.3.4 Conclusions

The proposed development will have positive effects and will not result in significant adverse environmental impacts.

10. 4 MARINE NAVIGATION

10.4.1 Receiving Environment

Cork Harbour is one of the largest sea inlets in the country with considerable throughput of traffic associated with Port of Cork, private commercial facilities and recreational activities.

Cork is the second port in the Republic and it is one of two Irish ports which handle all five shipping modes i.e. lift-on lift-off, roll-on-roll-off, dry bulk, liquid bulk and break bulk. There is a ferry crossing to Britain and mainland Europe.

Most of the port’s car ferry and roll-on roll-off freight services are operated from the Ringaskiddy Ferry Terminal, although the port’s deep-sea Ro-Ro services are operated from the adjoining deepwater terminal. Cruise liners are handled primarily at the Cobh Cruise Terminal but also at Cork city, Ringaskiddy and Whitegate.

The Port of Cork regularly carries out maintenance dredging in the channel and transports the dredged spoil to the dredge disposal site outside the harbour.

Apart from the deepwater quay at Cobh, there are a number of private facilities in the lower Harbour. Ireland’s only oil refinery is situated at Whitegate while other private marine facilities are located at Haulbowline, Ringaskiddy, Rushbrooke, Marino Point and Passage West.

Cargo handled in the harbour includes freight units, tourist cars, trade cars, mineral fuels (crude and refined oil), lubricants and related materials.

The Port of Cork is responsible for pilotage in the Harbour. Pilotage is compulsory for all vessels in the area between the Spit Lighthouse in the Lower Harbour and the quays at Cork.

The Commissioners of Irish Lights (CIL) are responsible for the superintendence and management of all aids to marine navigation around the coast of Ireland and its adjacent waters.

10.4.2 Impact of the Development

As previously stated, the cooling water system will involve the construction of a 440 m long submerged cooling water outfall pipe with a reinforced concrete diffuser structure constructed at the point of outfall, approximate co-ordinates, E183270 N65320. An elevated piled platform will be constructed at the point of discharge into Cork Harbour. This will contain a light beacon and the structure will be approximately 12 m x 12 m in plan with a deck level of 7.0 mOD (Poolbeg Datum).

Dredging will be required for the intake structure and the outfall pipe. It is proposed to dispose of the silt portion of the dredged material at the existing Port of Cork dredge disposal site outside Cork Harbour (Refer section 4.2.4 for location).

During construction, the estimated number of trips to the dredge disposal site would be 40 trips in total, over a period of 10-20 days to allow for poor weather. Only one to two barges would be involved. The impact on marine traffic volumes will be minimal and will be over a very limited period.

The cooling water pipe will be submerged and anchoring will be prohibited along its length. This will not affect navigation in the area.

The proposed elevated piled platform at the point of discharge to the east of the harbour is outside the main navigation channel in an area which is relatively less utilised than the west of the Harbour. The platform will form a new permanent structure in Cork Harbour and will in effect be a new marker and navigation aid for vessels using the Harbour.

Consultations took place with Port of Cork during preparation of the EIS and it indicated that it was unlikely that the proposed development would have adverse consequences for the safety of marine navigation in the Harbour.

The Marine Survey Office of the Department of Communications, Marine and Natural Resources (DCMNR) was also consulted and it indicated that it was unlikely that the proposed development would have adverse consequences for the safety of marine navigation, provided it complies with specified requirements in relation to provision of navigational aids and markings.

10.4.3 Mitigation

All requirements of the Marine Survey Office of the Department of Communications, Marine and Natural Resources, the Commissioners of Irish Lights (CIL) and Port of Cork will be implemented in full in relation to sanction of new navigational aids/buoys and compliance with marking requirements

Signs will be erected on shore on both sides of the proposed outfall pipe prohibiting anchoring.

10.4.4 Conclusions

There is considerable throughput of marine traffic in Cork Harbour associated with Port of Cork operations, private commercial facilities and recreational activities.

During construction, the only barge movements will be associated with deliveries of plant to the site and movement of dredge spoil to the dredge disposal site outside Cork Harbour. The impact on marine traffic volumes will be minimal and will be over a very limited period.

The cooling water pipe will be submerged and anchoring will be prohibited along its length.

The proposed elevated piled platform at the point of discharge to the east of the harbour is outside the main navigation channel in an area which is relatively less utilised than the west of the Harbour. The platform will form a new permanent structure in Cork Harbour. This will benefit navigation by providing a new marker and navigation aid for vessels using the Harbour.

10. 5 AIR NAVIGATION

10.5.1 Receiving Environment

The development site is low-lying reclaimed land with ground level of 6.7 mOD (Poolbeg datum). The existing stack on site is 152 m high.

10.5.2 Impact of the Development

In general building heights will not exceed 45 m. The height of the exhaust stack will be 70 m which is considerably less than the existing stack.

The Irish Aviation Authority was contacted in the course of the consultation process and it indicated that it was unlikely that the proposed development would have adverse consequences for the safety of air navigation, provided it complies with any aeronautical lighting and positional data requirement specified by the Authority at the planning stage.

10.5.3 Mitigation

All requirements of the Irish Aviation Authority and the Department of Defence will be implemented in full.

10.5.4 Conclusions

The proposed development will not result in significant adverse impacts.

11. CULTURAL HERITAGE

11. 1 INTRODUCTION

Cultural heritage in respect of a project is assumed to include all humanly created features on the landscape, including portable artefacts which might reflect the prehistoric, historic, architectural, engineering and/or social history of the area.

The Department of the Environment, Heritage and Local Government (DoEHLG) was contacted in the course of the consultation process and it specified its requirements in terms of archaeological assessment. The assessments undertaken have been carried out in accordance with these requirements.

Geophysical surveys carried out on behalf of Port of Cork have indicated that there is nothing of archaeological value in the offshore dredge disposal site at which material from dredging works associated with the project will be disposed. The disposal site is therefore not considered further.

Both terrestrial and underwater archaeology were subject to assessment and these studies involved a documentary/cartographic search and field inspection of the area, while the historical study involved a documentary search.

11.1.1 Paper Survey

As part of a documentary/cartographic search, the following principal sources were examined from which a list of sites and areas of cultural heritage interest/potential was compiled:

- Sites and Monuments Record – County Cork.
- Records of the National Museum of Ireland.
- Excavations 1970-2001; Summary Accounts of Archaeological Excavations in Ireland.
- Stereoscopic photographic coverage carried out by the Geological Survey of Ireland.
- Documentary and cartographic sources in Cork County Library and Midleton Branch Library
- Cork County Development Plan 2003.

11.1.2 Field Inspection

From the preceding paper survey, a list of cultural heritage sites/sites of cultural heritage potential was compiled for inspection. The development area and an area within 200 m of its boundaries was assessed for the presence of archaeological monuments by reference to map and aerial photographic sources. A field survey of this entire area, where possible, was undertaken in early February 2004. This field survey consisted of a walk-over of the site and an inspection of the surfaces of recently disturbed ground.

An attempt was also made to identify previously unrecorded sites of cultural heritage potential within, and in the immediate environs of, the proposed development area.

Sites of cultural heritage potential identified on the basis of the paper survey were inspected in an attempt to confirm their locations on the ground and to determine, if possible, their likely extent. Where access to properties adjacent to the site boundaries was problematic, a visual inspection from such boundaries was made.

Methodology – Underwater Archaeology

Examination of desktop information including marine geophysical data was carried out in advance of site work to identify any anomalies of archaeological potential.

Visual inspection and magnetometry survey by hand-held metal-detection was employed to assess the archaeological potential of the seabed surrounding each of the impacts. A side-scan sonar survey was undertaken prior to the dive survey to identify any anomalies in advance. Dive operations were run from a 'live boat' set-up to allow maximum seabed coverage. A 400 m baseline was laid from the shore in a direct line with the proposed pipeline route. A similar set-up was used to assess the new pump-house location. A sizeable buffer zone was incorporated into the underwater survey, and the assessment extended 20 m either side of the proposed impacts.

11. 2 TERRESTRIAL ARCHAEOLOGY

11.2.1 Receiving Environment

This present Aghada Generating Station comprises two separate parts divided by the Midleton – Whitegate road (R630) and linked by a bridge. The lands to the west of the road were reclaimed in the 1970s during the construction of the station with much of the fill for the reclamation works coming from excavation works associated with the area located on the eastern side of the road, where in excess of 500,000 m³ of material was excavated from the hillside.

Prior to the site reclamation, the area consisted of a spit of land extending into Cork Harbour. Pre-development photographs of the area indicate that, at low-tide, the spit, known as Long Point generally consisted of exposed rock, shale and sand with a grassy area located above the high-tide level. There was a small triangular-shaped pond situated in the western half of the grassy area. The entire grassy area, including the pond, was incorporated into the area of reclamation works. However, the westernmost section of Long Point can still be seen, particularly at low-tide when the surface is exposed.

The site is located in the townlands of Ballincarroonig and Aghada (O.S. 6" sheet No. 88).

The area under assessment is part of a landscape which is rich in historical and archaeological material. The general region has attracted settlement from early times as evidenced by the presence of monuments dating back to the prehistoric period. Continuity of settlement is illustrated by artefacts dating to the Mesolithic Period and by identified monuments ranging from Neolithic to Medieval and Post-Medieval remains.

The siting preferences of particular monument types are well documented. Broadly speaking, the general landscape of the proposed development area offers a potential setting for the discovery of archaeological sites and remains, as follows:

- Mesolithic people were hunters, fishers and gatherers, living on the coastline and along rivers and lakes. They used flint and other stones to manufacture sharp tools. While the greatest source of flint in Ireland is in the north-east, it has also been sourced from areas along the southern seaboard where it has been washed up on beaches. The manufacture of flint artefacts generally took place close to the source of the raw material and the subsequent waste debris (known as Flint Scatters) has been identified in a number of areas along the Cork coast, particularly to the immediate east of Cork Harbour.
- The subject lands and surrounding landscape offer many opportunities for the location of Fulachta Fiadh (prehistoric cooking sites). These sites are location specific, generally located close to rivers and streams or in wet marshy areas, and sometimes occur in groups.

One recorded archaeological site was identified, on the basis of the paper survey, within the defined study area as follows (see Figures 11.1 & 11.2 for location):

Table 11.1 Recorded Archaeological Site Details

Reference	Townland	Classification	SMR No.	Protection
CH-1	Ballincarroonig	Burial ground	088:029	RMP

The 1902 and 1935 O.S. 6" maps indicate a *'Burial Ground (site of)* to the immediate west of the former pond on Long Point. However, it is not marked on any earlier maps. In addition, there is no tradition in the area of a burial ground at this location.

The custom of setting apart a special place for the burial of very young or unbaptised children appears to have been common practice in Ireland from at least the 18^{th} century (Cuppage, 1986, 347). It resulted largely from the refusal by church authorities to allow such burials in consecrated graveyards. As well as infants, suicides and unidentified bodies (such as drownings along the coastline) were also interred at these places (Power, 1994, 179). According to Ó Súilleabháin (1939, 143-51), the locations of such burial grounds includes such places as haggards and fields, cliff-clefts and on the sea shore.

The recorded monument is located within the area subjected to reclamation works during the 1970s. There was no archaeological involvement associated with the project during the 1970s and it is unclear if any topsoil stripping was undertaken in advance of the commencement of reclamation works. An examination of the Geotechnical / Site Investigations Report (Geotech, 2004) and associated logs and record photographs indicates that the levels in this area of the subject lands may have been raised by between 1.15 – 1.80 m.

A number of geotechnical trial pits were excavated in the region of the monument in December 2003 and January 2004. These were subsequently backfilled but the areas of spoil deposition and backfilled pits was still readily identifiable during early-March 2004 when fieldwork was undertaken. These areas were raked over and visually examined in order to determine if any fragments of bone, or other artefacts, might be recovered. However, nothing of archaeological or historical interest was noted. In addition, there is no definitive evidence for any buried topsoil horizon indicated in the photographic records of the excavated trial pits. Consequently, the level of pre-reclamation disturbance, if any, is unclear and, therefore, the possibility of undisturbed burials cannot be determined.

No additional features or sites of archaeological potential were identified during the course of aerial photographic research or during the process of fieldwalking.

11.2.2 Impact of the Development

Construction Phase

Excavation works have the ability to uncover and disturb hitherto unrecorded sub-surface features, deposits, structures and finds of archaeological interest and potential. However, in this case, the greater part of the subject lands has been reclaimed from the harbour area and it is not considered that these areas are of archaeological potential.

The only evidence of a possible burial ground is a cartographic source and the nature or extent of the site, or indeed level of disturbance, if any, caused to it during previous reclamation/ construction works, is unclear. Without specific mitigation measures, such a burial ground, if it exists, could be impacted upon by the development.

In general, where subsurface archaeological remains are suspected within the boundaries of a proposed development area, it is normal to undertake a programme of archaeological investigation (geophysical survey and/or test trenching) to determine the nature and extent of such remains (DAHGI, 1999). However, in this case, the area of archaeological potential has been the subject of reclamation and ground levels have been raised. The fill material is identical to the geological subsoil of the subject area compounding the difficulty of determining the interface between the two layers, in the absence of a buried topsoil horizon. Consequently, the use of geophysical survey was not considered. Furthermore, the exact location of any burials is unclear. It may be that there is only one burial located at the site and it is possible that it would not be uncovered by any programme of archaeological testing. In this case, the only definitive way of determining the presence, or indeed absence, of archaeological remains would be to excavate the entire 'footprint' extent of the proposed structures within the immediate environs of Site CH-1. However, given the scale and requirements of such, this is not a feasible pre-development option. Consequently, a mitigation strategy, requiring monitoring of excavations by an archaeologist is proposed. This strategy has been discussed and agreed with the National Monuments Section, Heritage and Planning Division, Department of Environment, Heritage and Local Government.

Operational Phase

Potential adverse impacts with respect to the archaeological heritage are not anticipated once the development is completed.

11.2.3 Mitigation

Construction Phase

The following general mitigation measures are proposed:

- All general surface ground reductions down onto the surface of the underlying geological subsoils should be monitored by an archaeologist. Such monitoring should be limited only to area of the former 'grassy area', as indicated in Figure 11.2.
- In the event of archaeological features being uncovered during the course of such ground reductions, works in the immediate area of such features will be suspended pending the advice of the Department of Environment, Heritage and Local Government (National Monuments Section) with regard to additional mitigation works that might be required. Likewise, should archaeological artifactual material be uncovered/recovered during such works, the requirements of the National Museum of Ireland with regard to such items will be implemented.
- The developer will bear all costs associated with all archaeological mitigation measures, including monitoring, testing (if required), excavation (if required) and any post-excavation costs that might be required (e.g. specialist analysis, reporting, conservation, dating, etc.).

Operational Phase

Potential adverse impacts with respect to the archaeological heritage of the development site area are not anticipated once the development has been constructed. Therefore no remedial measures are deemed necessary.

11. 3 ARCHITECTURAL HERITAGE

11.3.1 Receiving Environment

There are no protected structures within the meaning of the Planning and Development Act, 2000 situated either within the boundaries of the proposed development lands or the defined study area.

However, there are a number of structures located within the immediate environs of the development area. These are all associated with the existing power station and date from the 1970s onwards. These are not considered to be of interest from an architectural heritage perspective.

11.3.2 Potential Impact of the Proposal

The development will have no impact on architectural heritage.

11.3.3 Mitigation

No mitigation of impacts is required.

11. 4 UNDERWATER ARCHAEOL0GY

11.4.1 Receiving Environment

Desktop Study

While various moorings are indicated on Admiralty Chart 1773, there is no suggestion of known wreck sites or other features of archaeological interest in the immediate vicinity of the proposed works area.

Examination of the Shipwreck Inventory in the DoEHLG's archive reveals the potential for wreckage to the southwest at Corkbeg, and to the Northwest, on the far side of the Fairway in the vicinity of Spike Island (Table 11.2). The *Elfin,* a small yacht, was lost at her moorings in Corkbeg in 1896, but it is unlikely that materials related to this instance would have survived, given the presence today of the Whitegate terminal in this area. In contrast, the loss of HMS *La Suffisante* in 1803 between the Spit and Spike Island does appear to retain an underwater potential. Dredging in 1980 recovered pieces of wreckage that are believed to be from this naval sloop and it is clear that the fuller remains survive at depth. However, this location is on the far side of the Fairway navigation channel, and it is unlikely that its wreckage extended as far east as the power station. It should be noted that the Inventory does not claim to record shipwrecking instances in any detail before c. 1750, because it was only after this that anything approaching systematic records were kept. It therefore remains possible that earlier wreckings and other sea-related instances occurred but have left no historical record.

Table 11.2: Instances of Shipwrecking Recording in the General Area, Based on the DoEHLG Shipwreck Inventory

Vessel Name	Date	Location	Description
Anonymous	c. 1900	Near Spike	Coasting steamer sank in the fairway near Spike, following a collision. She was later refloated.
Bacchus	3/09/1814	Back of Spike Island	Vessel went ashore

Vessel Name	Date	Location	Description
Bredah/ Breda	12/10/1690	Off Spike Island	72-gun 3rd rate gunship, built by Betts at Harwich, 1679. Ship blew up at anchor following gunpowder explosion aboard.
Crompton	c.1900	Off Spike	4-masted barque went aground while at anchor, but was patched and towed away.
Elfin	8/10/1896	Corkbeg Island	1-tne wooden yacht, 9 years old from Cork. Lost at her moorings.
HMS La Suffisante	25 -27/12/1803	Between the Spit and Spike Island	14-16 gun naval sloop captured in 1795 under sail from Cove she dragged anchors in a 'hurricane' and struck Spike Island and went to pieces. Dredging on the Bar and channel around the Spit in 1980 has recovered several items.

Marine Geophysical Data Review

A marine geophysical survey was carried out by Irish Hydrodata Ltd. The sources for assessment included:

- Side-scan Sonar Data Files on CD-ROM with Klein SonarPro 7.5 operating system
- Magnetometer Profiles booklet
- Project Drawing 928_4_03: Magnetometer and Sidescan Sonar Survey Tracks and Targets

The record is comprehensive. No anomalies of obvious archaeological significance were observed.

Intertidal/Foreshore Assessment

The foreshore area is dominated by substantial rock-armouring along the limits of the reclaimed land that has effectively replaced any pre-existing intertidal foreshore. No archaeologically significant features or sites were observed in the vicinity.

Seabed Topography

A flat featureless fine sand/ silt bottom, with a depth range of 0.10 m – 0.20 m, characterises the seabed within the eastern channel of Cork Harbour. A sand/gravel/shell bottom mixture was observed below this silt layer. These bottom types provide for a good archaeological holding content. The intertidal elements of each of the impact areas are covered by large limestone rock armouring (0.40 m x 0.40 m).

A large amount of oyster shells were located approximately 30 m offshore from the rock-armour. These were buried within the silt in a c.15 m band (stretching eastward and westward of the pipeline route) roughly parallel to the shoreline. Inspection of the oyster shells revealed that they were from a native, semi-extinct, species. It is likely that the shells represent the residue a sizeable oyster bed of reasonable antiquity (last 100 years). Also, a large amount of sealife was observed in the form of spider crabs, starfish and sea anemones.

Magnetometer Survey

A hand-held metal detector was used to supplement the visual survey. A large amount of metal-detection targets were encountered close to the rock-armour shoreline and decreased relative to the distance from the shore. The target hits, where visible, were all of modern origin and represent construction debris.

Visual Inspection & Assessment

Investigation of two sidescan sonar targets located within the impact area of the new pump-house proved to be modern iron mooring piles.

Conclusion

No material of archaeological significance was observed. Further in-water or foreshore archaeological assessment ahead of works commencing should not be required. However, taking into consideration the survey locale (Cork Harbour) and the relatively good archaeological holding content observed it is feasible that archaeological material may be located within the seabed surrounding the proposed impacts.

11.4.2 Impact of the Development

It is not anticipated that material of archaeological significance will be uncovered during the construction. There will be no impact on marine archaeology associated with operation of the plant.

11.4.3 Mitigation

As a precaution, the following mitigation measures are proposed:

- Archaeological monitoring licensed to the Department of the Environment, Heritage and Local Government will be carried out during seabed disturbances associated with the construction the outfall pipeline and pump-house structure. No monitoring of any intertidal impacts is deemed necessary.
- An archaeologist will be retained for the duration of the relevant works.
- In the event of archaeological features or material being uncovered during the construction phase, machine work will be halted in the immediate area to allow the archaeologist/s to inspect any such material.
- Once the presence of archaeologically significant material is established, full archaeological recording of such material will be carried out. If it is not possible for the construction works to avoid the material, excavation will be carried out as necessary. The extent and duration of excavation would be decided upon in consultation between the developer and the licensing authorities.

11. 5 CONCLUSIONS

The proposed development will not result in significant environmental impacts

12. INTERACTION OF IMPACTS

The interaction of potential significance between the various matters addressed are between the following:

- Cooling water and air emissions

The choice of cooling water system has an impact on the overall efficiency of the plant and thus indirectly on air emissions. This has been addressed in Section 2.7 of the EIS dealing with Alternatives.

- Water and fisheries, flora and fauna

Impacts on water quality potentially has an impact on fisheries, flora and fauna. This potential interaction of these impacts has been addressed in Part 4 of the EIS dealing with Water.

APPENDIX A. GLOSSARY OF TERMS

Annual Load Factor	This is the total energy produced per year divided by the plant rated energy and by the number of hours in a year.
Base Load	This is the maximum load output at which the gas turbine may be operated on a continuous basis.
BAT	Best Available Technology
BATNEEC	Best Available Technology Not Entailing Excessive Costs
BOD (Biological Oxygen Demand)	The BOD of water is that depletion of water brought about in the breaking down of anaerobic bacteria. The standard test measures the demand after five days at 20 ^{o}C; hence the term BOD_5.
CCGT	Combined Cycle Gas Turbine
CHP	Combined Heat and Power
Combustion (Gas) Turbine	A combustion (gas) turbine is one in which the working substance is a gas rather than a condensable vapour as in a steam turbine. The cycle employed, in the simplest case, is the constant pressure cycle referred to as the Brayton cycle.
Combined Cycle	This is where the gas turbine and steam turbine are both in operation.
Condenser	A condenser is used to cool the exhaust steam from the steam turbine and condense it to water for reuse.
CO_2	Carbon dioxide
CW	Cooling water
dB(A)	For planning purposes, noise is measured in dBA, i.e. decibels on the 'A' scale. This scale simulates the response of human hearing to sound and the "A" filter is specified for use in assessing noise levels by International Standards.
DED	District Electoral Division
Dissolved Oxygen	Dissolved oxygen (DO) refers to the amount of oxygen dissolved in water. It is used up in the decomposition of organic wastes and by animal respiration. And is essential to all normal forms of aquatic life. The minimum DO required to support a balanced population of desirable aquatic flora and fauna is widely considered to be 5 mg/l. The saturation DO levels at 15 ^{o}C and 25 ^{o}C in freshwater are 10.2 mg/l and 8.4 mg/l respectively.
EIS	Environmental Impact Statement
ELV	Emission limit value
EPA	Environmental Protection Agency
EQO	Environmental Quality Objective
EU	European Union

Gasoil	This is often referred to as diesel or distillate and has by law a maximum sulphur content of 0.2%.
GSI	Geological Survey of Ireland
Ha	Hectare (100 m x 100 m)
HRSG	A Heat Recovery Steam Generator (boiler) generates steam using the energy in the hot exhaust gases of the combustion (gas) turbine.
HW	High water.
km	Kilometre (One thousand metres)
kt	kilotonne (One thousand tonnes)
kV	Kilovolt (One thousand volts)
LW	Low water
mg/l	In the measurement of water quality parameters such as dissolved oxygen, the metric expression milligrams per litre (mg/l) is equivalent in volumetric terms to ppm.
MMcfd	Millions of standard cubic feet per day of natural gas
mOD	Metres above Ordinance Datum.
m^3/s	Cubic metres per second.
Mt	Megatonne (One million tonnes)
MW	Megawatt (One million Watts)
MWth	Megawatt thermal
Neap Tide	The range of the tide, i.e. between high water and low water, varies throughout each month. This range is at its lowest during neap tides.
NOx	Oxides of nitrogen, including nitric oxide (NO) and nitrogen dioxide (NO_2)
Peak Load	This is the maximum load which may be allowed for short periods, on certain makes of gas turbine.
ppm	Parts per million
rpm	Revolutions per minute
Salmonid Waters	The EC Directive on the quality of freshwater in order to support fish life' states that salmonid waters are those which support or become capable of supporting fish belonging to species such as salmon, trout, grayling and white fish.
Simple (Open) Cycle	This is where only the gas turbine is in operation.
SO_2	Sulphur dioxide
Spring Tide	The range of the tide, i.e. between high water and low water, varies throughout each month. This range is at its highest during spring tides.
Steam Turbine	A steam turbine is one in which the working substance is steam. High

	pressure high temperature steam is expanded through a steam turbine which it causes to rotate at high speed, thereby producing mechanical energy.
^{o}C	Degree Centigrade
€M	Million Euro

APPENDIX B. BIBLIOGRAPHY

A Companion Guide to Architecture in Ireland, 1837-1921; J Williams; 1994.

A Guide to Habitats in Ireland; J Fossitt, The Heritage Council, Kilkenny; 2000

A Topographical Dictionary of Ireland, 2 vols; S Lewis; 1837.

Advice Note on current practice (in the preparation of Environmental Impact Statements) – Environmental Protection Agency, 1995

An Foras Forbartha (1976). Aghada Power Station, Co. Cork. Environmental Impact Assessment.

Atlas of the Irish Rural Landscape; F Aalen, K Whelan & M Stout;.1997.

Colhoun, K (1998). I-WeBS Report 1996-97. BirdWatch Ireland.

Colhoun, K (2001). I-WeBS Report 1998-99. BirdWatch Ireland.

County Development Plan 2003; Cork County Council

Curtis, T.G.F., and H.N. McGough (1988). The Irish Red Data Book. 1. Vascular Plants. Stationery Office, Dublin.

Fossitt, J. A. (2000). A Guide to Habitats in Ireland. The Heritage Council.

Green Paper on Sustainable Energy; Department of Public Enterprise,1999

Guide to the National Monuments in the Republic of Ireland; P Harbison; 1975 – 2nd ed. 1982.

Inventory of Outstanding Landscapes in Ireland; An Foras Forbartha, 1977

Irish Place Names; D Flanagan & L Flanagan; 1994.

Irish Red Data Book 2, Vertebrates; A Whilde, 1993.

Maintenance Dredging Management Plan 2003 to 2007, Port of Cork, July 2002.

National Climate Change Strategy; Department of the Environment and Local Government, 2000

Preston, C.D., D.A. Pearman and T.D. Dines (2002). New Atlas of the British and Irish Flora. Published for the Department for Environment, Food and Rural Affairs. Oxford University Press.

Proposed Natural Heritage Areas, proposed Candidate Special Areas of Conservation, and designated Special Protection Areas in County Carlow - listings and maps; National Parks & Wildlife, Dúchas the Heritage Service.

Scannell, M.J.P., and D. M. Synnott (1987). Census catalogue of the flora of Ireland. Stationery Office, Dublin.

Smiddy, P (2002). Breeding of the little egret Egretta garzetta in Ireland, 1997-2001. Irish Birds 7 (1): 57-60.

Smiddy, P., J. O'Halloran, J. Coveney, J.A. Leonard, P. G. and M Shorten (1995). Winter waterfowl populations of Cork Harbour: an update. Irish Birds 5: 285-294.

The Architecture of Ireland from the Earliest Times to 1800; M Craig; 1982

The Irish Red Data Book. 1, Vascular Plants; T Curtis & H McGough, 1988.

The New Atlas of Breeding Birds in Britain and Ireland: 1988-1991; D Gibbons, J Reid & R Chapman, 1993

The Shell Guide to Ireland; Lord Killanin & M Duignan; 1989.

Webb, D.A., J. Parnell, and D. Doogue (1996). An Irish Flora. Dundalgan Press (W. Tempest) Ltd., Dundalk.

APPENDIX C. SCOPING & CONSULTATION

Consultations took place with Cork County Council, the Environmental Protection Agency and the Department of Communications, Marine and Natural Resources during the preparation of the EIS. The cooling water discharge was the subject of a presentation to the Marine Licence Vetting Committee of the Department of Communication, Marine and Natural Resources.

Organisations

The scope of the EIS was the subject of a written report (Report No. P04M024A-R1) submitted to Cork County Council, the Environmental Protection Agency and the Department of Communications, Marine and Natural Resources in March 2004.

In addition, the Consultation Report was issued to the following organisations who were invited to comment as part of the consultation process:

Organisation	Response	
	Yes	No
Cork County Council	✔	
Environmental Protection Agency		✔
The Commission for Electricity Regulation		✔
The National Authority for Occupational Safety and Health		✔
Cork Harbour Commissioners		✔
Minister for Arts, Heritage, Gaeltacht and the Islands	✔	
Department of Communications, Marine and Natural Resources	✔	
Marine Institute	✔	
South Western Regional Fisheries Board	✔	
Central Fisheries Board		✔
An Taisce - The National Trust for Ireland		✔
The Heritage Council		✔
Department of Environment, Heritage and Local Government – Development Applications Unit	✔	
Department of Enterprise, Trade and Employment		✔
BirdWatch Ireland		✔
Irish Wildbird Conservancy		✔
Irish Aviation Authority	✔	
Geological Survey of Ireland	✔	
Port of Cork		✔
Marine Surveyors Office		✔

Organisation	Response	
	Yes	No
Marine Licence Vetting Committee		✔
Radiological Protection Institute of Ireland	✔	
Bord Iascaigh Mhara	✔	
National Roads Authority	✔	
Bord Failte Eireann		✔
Atlantic Fisheries Ltd.,	✔	

Information Day

An Information Day was held at Midleton Park Hotel on 19th April 2004. The Information Day was publicised in advance locally by circular and the placing of public notices at various locations in the area.

THERMAL PLUME SURVEYS

HYDROGRAPHIC FIELD SURVEY

APPENDIX D. COOLING WATER HYDRODYNAMIC AND DISPERSION STUDY

APPENDIX E. GENERAL REVIEW OF FINFISH RESOURCE

APPENDIX F. LITERATURE REVIEW - ENVIRONMENTAL ISSUES AT THERMAL ELECTRICITY GENERATING STATIONS AT COASTAL, ESTUARINE AND INLAND SITES

APPENDIX G. AQUATIC FLORA AND FAUNA

APPENDIX H. WATERFOWL NUMBERS IN CORK HARBOUR & TERRESTRIAL PLANT SPECIES LIST

APPENDIX I. AIR QUALITY IMPACT OF PROPOSED CCGT PLANT FOR AGHADA POWER STATION

APPENDIX J. MAY 2000 NOISE REPORT

APPENDIX K. JUNE 2003-ANNUAL ENVIRONMENTAL NOISE MONITORING

APPENDIX L. NOISE MONITORING 2004

APPENDIX M. TRAFFIC SURVEY REPORT, MARCH 2004