3.2.5 Mitigation Measures

(i) Construction Phase

WWTP

Flora and Habitats

Prior to construction, the amount of hedgerow that will be required to be removed will be determined so that only the amount of hedgerows which is absolutely necessary to be removed will be impacted upon. Under the *Wildlife Acts* (1976 and 2000), restrictions are placed on the removal of scrub (on previously uncultivated land), hedges and ditch clearance, with such works prohibited between 1st March and 31st August. The construction schedule will pay due cognisance to such restrictions, unless authorisation is received from the NPWS for works within this period.

Proposed landscaping works will use native species of local provenance which are commercially available. The details of species to be used in landscaping works will be developed in consultation with an appropriately qualified ecologist.

Fauna-Mammals

The badger sett located near the proposed WWTP will be fenced off during the construction phase of the project. An appropriately qualified ecologist will be engaged at the pre-construction phase of the project to advise on how to protect this sett. NPWS will be consulted regarding the existence of this sett and mitigation measures proposed. Monitoring of the sett will be in accordance with criteria developed in consultation with the NPWS with a view to establishing whether evacuation is necessary.

Collection System

Fauna-Birds

The main conservation interest of the designated areas (Cork Harbour SPA, Monkstown Creek pNHA and Owenboy River pNHA) is wintering birds and the habitats they use. The main mitigation measure required to protect the designated areas will be the careful timing of excavation works in foreshore areas, minimising habitat disturbance and the protection of water quality. These measures are in accordance with the general recommendations of the SWRFB. The mitigation measures required will include the following:

- Excavation works and associated machinery on and near the foreshore will take place during August and September only, unless otherwise agreed with the NPWS, DAFF and SWRFB
- Minimise habitat disturbance in foreshore areas where possible
- Avoid the release of pollutants and sediment into adjoining areas

The appointed contractor will prepare detailed method statements prior to initiating construction works. These method statements will outline how the impacts of the proposed works in and near designated areas will be minimised. The method statement will be developed in consultation with NPWS.

Fauna-Marine animals

Construction of the marine crossing will be timed to avoid sensitive periods for fish such as spawning, nursing and migratory periods, where possible. In the event that particularly invasive techniques will be used during construction of the marine crossing, the methods and programme of construction activities will be developed in consultation with appropriately qualified and experienced marine ecologists, the NPWS, DAFF and SWRFB. The purpose of this consultation will be to determine specific constraints for specific activities in relation to water quality and marine ecology.

Should open cut techniques be used for the River Lee west passage marine crossing a construction environmental management plan (CEMP) and monitoring programme will be developed in consultation with an appropriately qualified ecologist, the NPWS, DAFF and SWRFB to monitor water quality.

Fauna-Invertebrates

Excavation works on the foreshore will ensure that the top layer of sediment/substrate is re-instated. The foreshore macro fauna community in these disturbed areas would be expected to recover quickly following re-instatement of the top layer of substrate.

Water Quality

To prevent chemical pollution, all fuels or chemicals kept on the construction site will be stored in bunded containers. All refuelling and maintenance will be carried out in ramped containment areas away from sensitive environments (i.e. up-gradient of protected habitats or adjacent watercourses). Prior to any construction taking place, local fishing interests should be notified. In the event of any spillage or accident occurring below the high water mark of ordinary or medium tides, or above the high water mark which may impact on the foreshore during the carrying out of the works, or during operations following the completion of these works, the Irish Coast Guard will be notified immediately by telephone.

All stockpiles of soil or fill will be kept 30m from the waters edge and protected by fencing comprised of material known as terram (also known as silt fencing). This fencing will trap any sediment/silt mobilised during periods of high rainfall.

Waste and litter generated during construction will be collected for authorised disposal at suitable facilities. Care and vigilance will be followed to prevent accidental contamination of the site and surrounding environment during construction.

(ii) Operational Phase

WWTP

Flora and Habitats

Any newly planted hedgerows, lawns and treelines will be maintained by a horticulturalist or other suitably qualified contractor to ensure the effectiveness of the management plan. No fertilisers will be used in any habitat pertaining to the proposed development. Litter, grass cuttings and other wastes will be removed from the WWTP site by a suitable contractor for disposal, recovery or recycling in accordance with the requirements of the *Waste Management Acts* 1996-2005 and associated amendments and regulations.

Fauna-Mammals

Monitoring of the badger sett to the east of the WWTP will be in accordance with monitoring guidelines stipulated by the NPWS.

Low level lighting has been selected for external lighting around the treatment plant to reduce any impacts on fauna. Locally directed on-site lighting will be provided for access and maintenance purposes and on the access roads and other locations, as required, for safety and security reasons.

Water Quality

Provision of continuous monitoring and sampling of waste water flow entering and leaving the site will be provided. This will also include monitoring and measuring of the storm water content. This waste water monitoring is critical not only in terms of controlling plant operation but also in terms of complying with the *Urban Waste Water Treatment Regulations* and amendments (2001 & 2004).

To comply with the *Waste Water Discharge (Authorisation) Regulations* of 2007, a Waste Water Discharge licence will be required from the EPA for the Cork Harbour WWTP. The purpose of the licence is to make provision for the protection of human, animal and plant life from harm and nuisance caused by the discharge of dangerous substances to the aquatic environment as well as to ensure compliance with National law.

It is not anticipated that the WWTP will be staffed 24 hrs/day, automatic control of the plant will be undertaken by a computerised control system, with key information and alarms relayed to the relevant Cork County Council office. When the site is unmanned, any critical alarms of the plant will activate an automatic call-out system. It is recommended that the WWTP have a standby generator to ensure operation of the WWTP during any electrical power failure. In such a modern facility, and adhering to the discharge standards proposed, no further mitigation is required.

Collection System

Water Quality

In order to minimise the risk of untreated effluent discharging from pumping stations, an automated control operating system should be put in place to ensure that if a downstream pumping station fails to operate, the upstream pumping station will cease pumping.

3.2.6 Residual Impacts

Residual impacts following the implementation of mitigation measures will include the permanent loss of habitat at the WWTP site which is not considered a significant impact. Improvements in water quality will result in long-term moderate positive impacts for marine flora, estuarine birds, marine invertebrates, mammals and fish species. With moderate benefits for biodiversity following the improvement in water quality, the value of the designated areas would be expected to increase in Cork Lower Harbour.

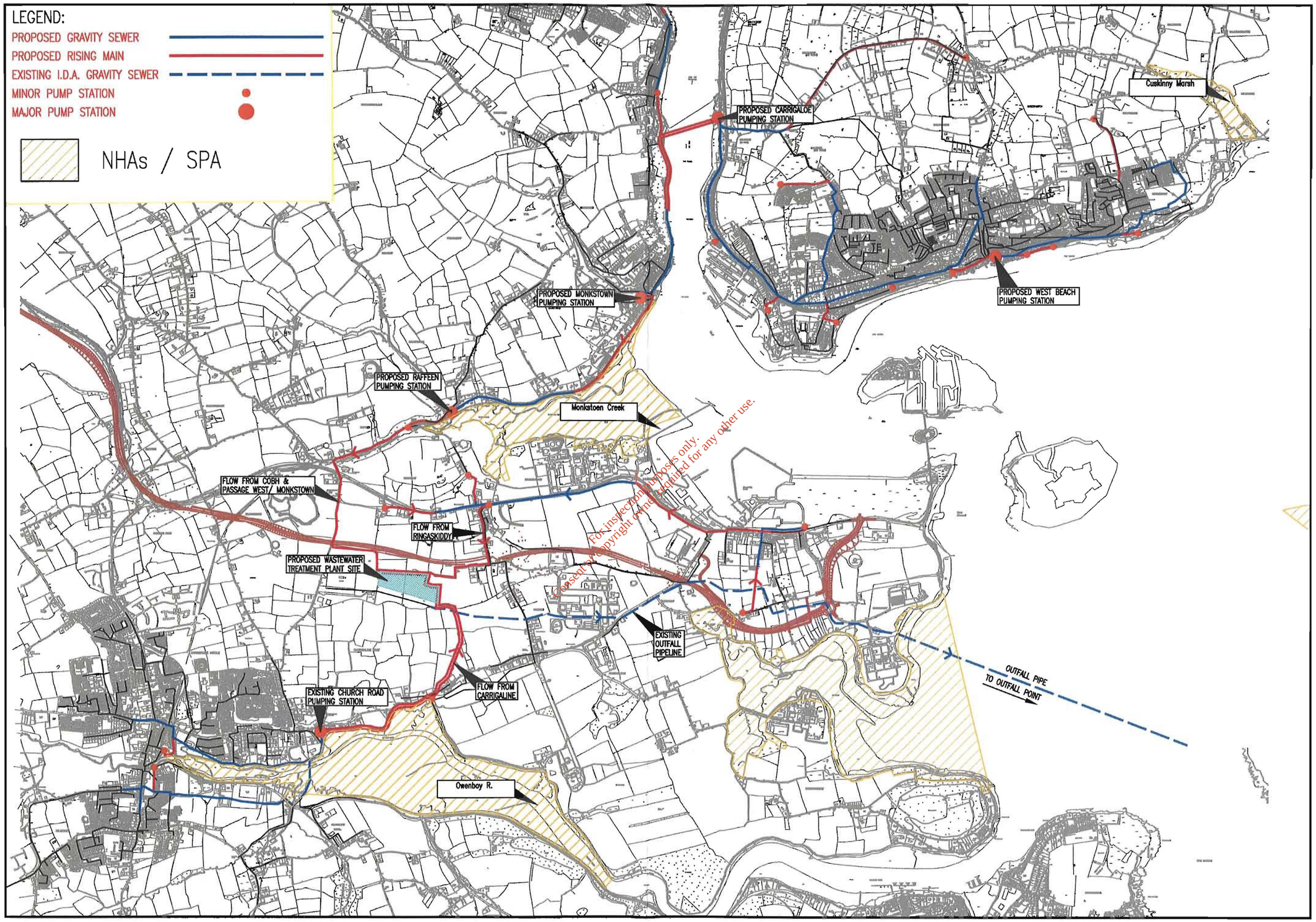

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FIGURE 3.2.1 CONSERVATION DESIGNATED SITES IN THE STUDY AREA

CORK HARBOUR MAIN DRAINAGE SCHEME
JOB NR. 234541
DRG NR. 5670FG125

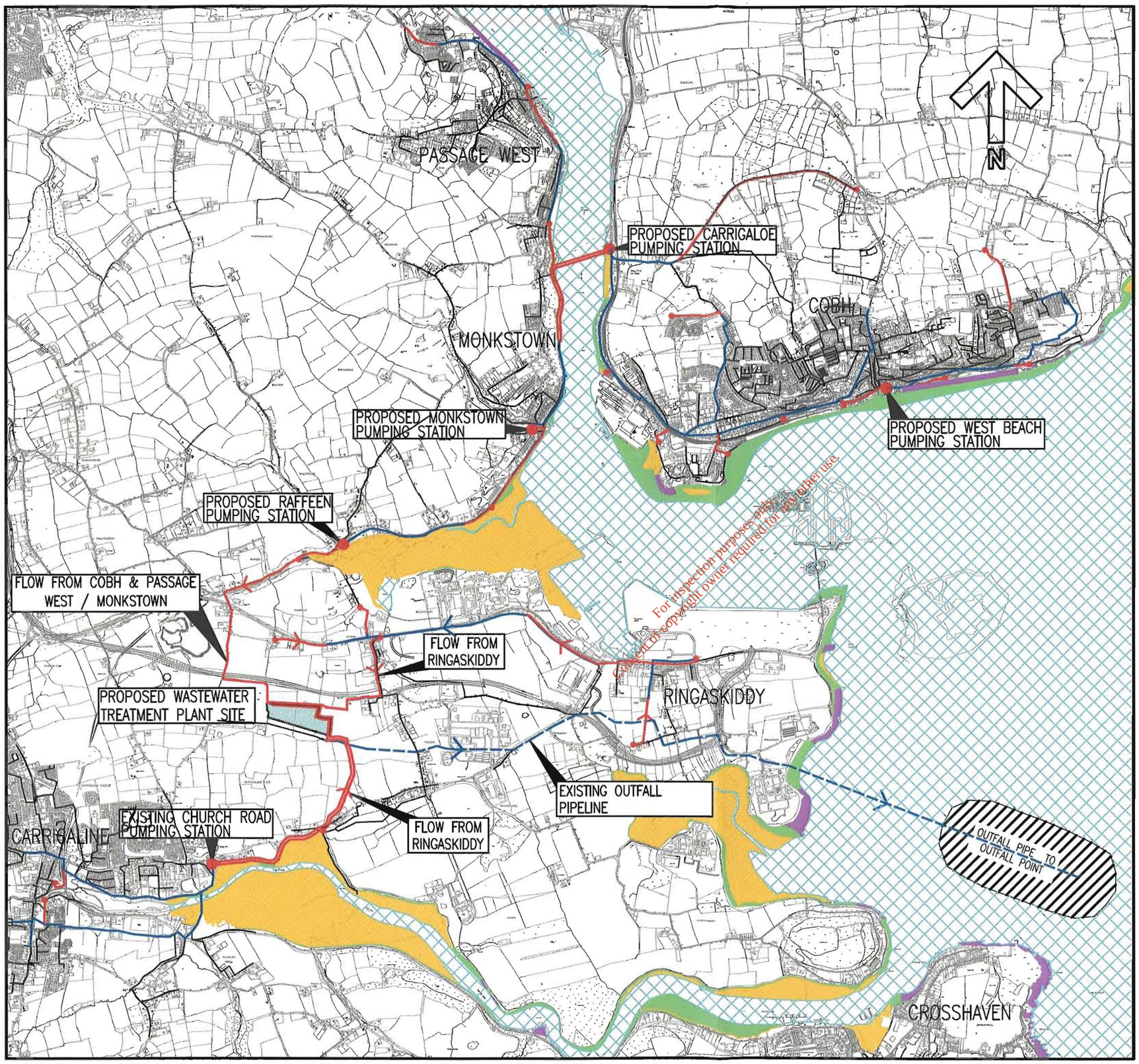

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FIGURE 3.2.2 – HABITAT MAP OF SELECTED MARINE HABITATS

CORK HARBOUR MAIN DRAINAGE SCHEME
ENVIRONMENTAL IMPACT STATEMENT
JOB NR. 234541
DRG NR. 5670FG108

PROPOSED SITE

PROPOSED BYPASS ROUTE

Badger sett

SITE BOUNDARY

ACCESS TO SITE

OVERHEAD ESB POWER CABLE

BORD GAIS SUBSTATION

CARRIGALINE EAST

Sports Ground

Club House

School

Church (Cath)

Car Park

Shanbally Cross Roads

Marian Terrace

Factory

Coolbawn

110Kv

220Kv

N

LEGEND

- PROPOSED SITE
- Hedgerow (WL1)
- Improved Agricultural Grassland (GA1)
- Recolonising bare ground (ED3)
- Building & artifical surface (BL3)

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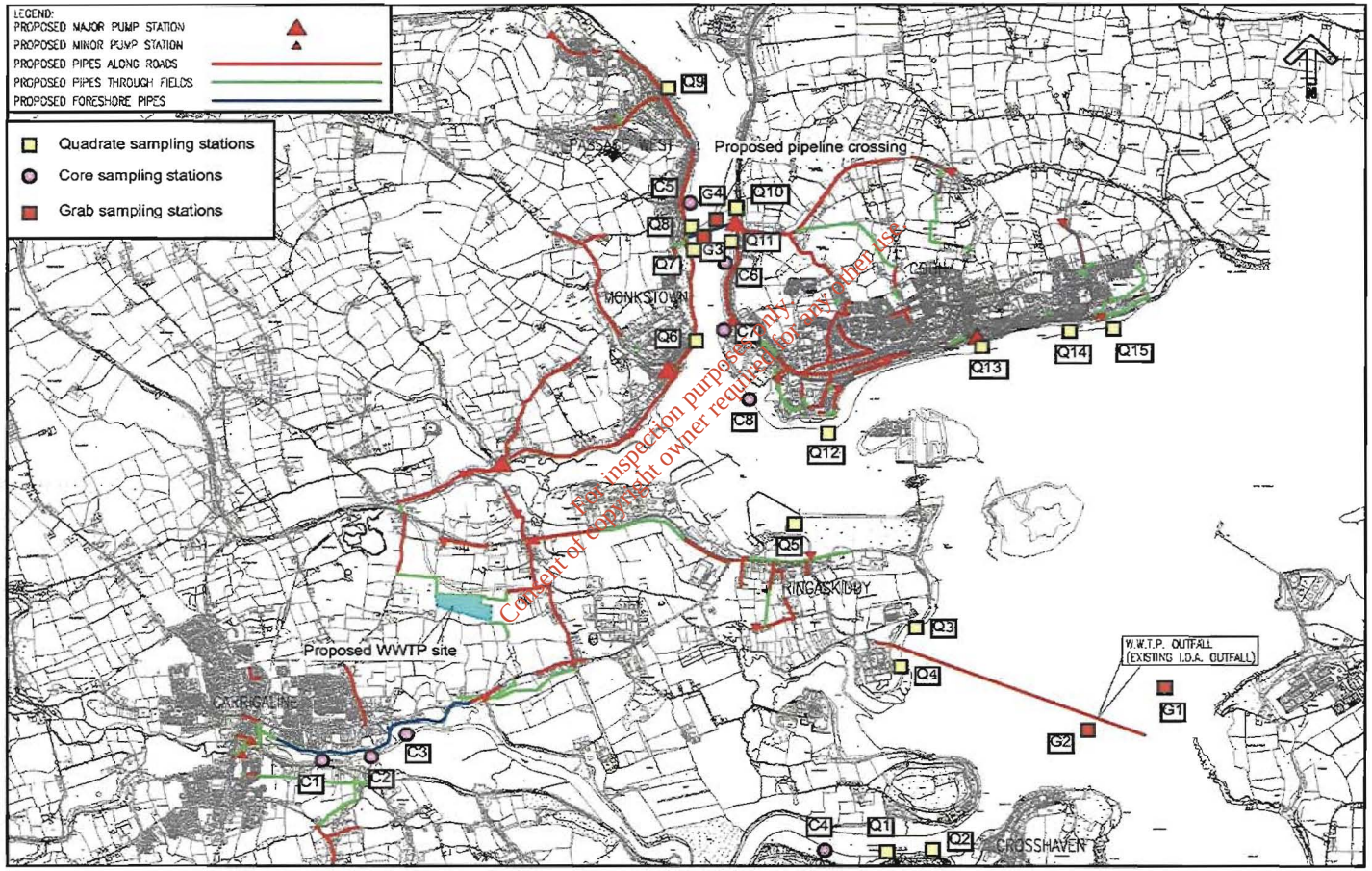
FIGURE 3.2.3 HABITAT MAP OF WWTP SITE

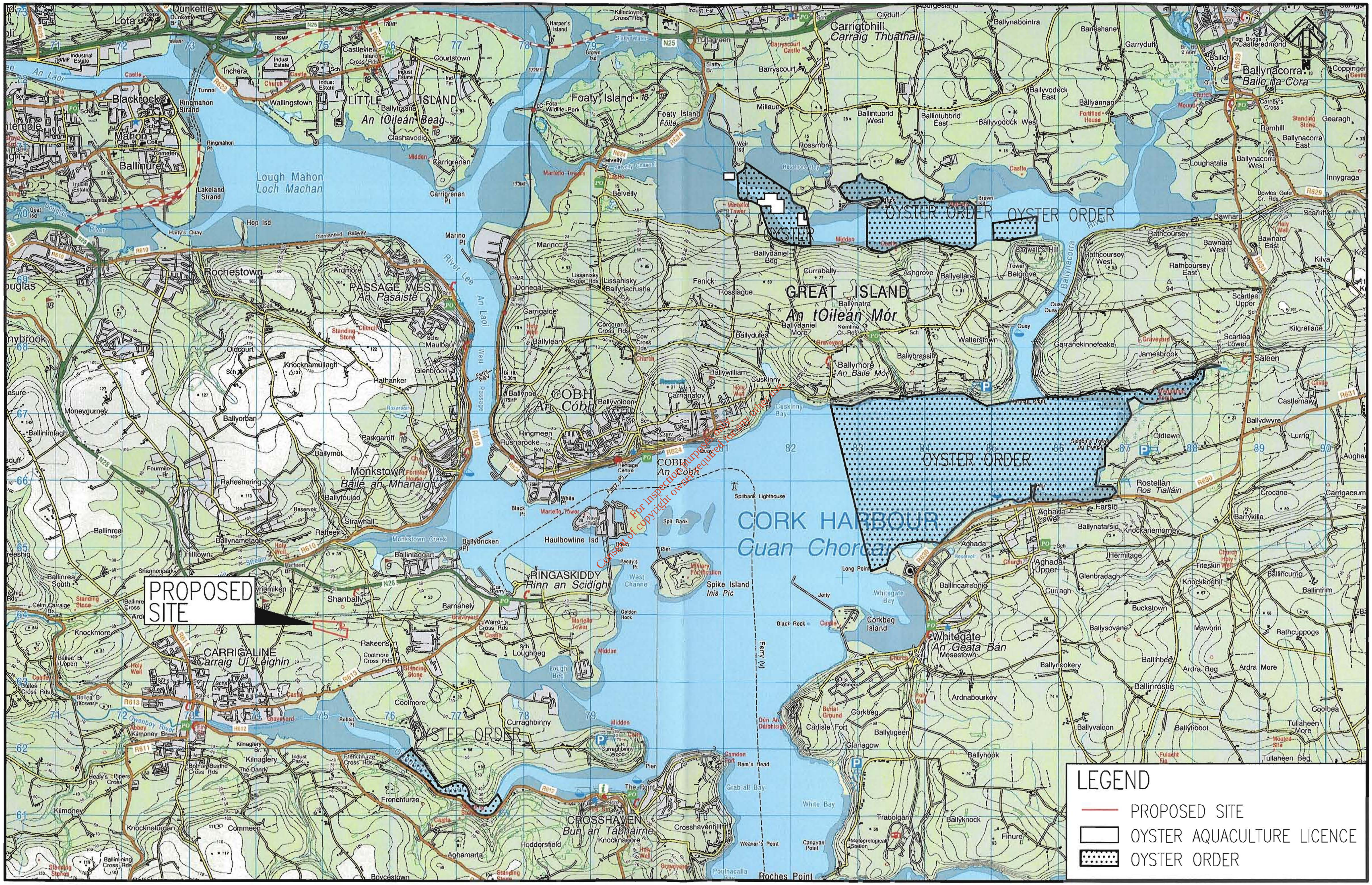
SCALE 1:5,000

EXTRACT FROM O.S. MAPS CORK 6471-D & 6510-B

CORK HARBOUR MAIN DRAINAGE SCHEME
JOB NR. 234541
DRG NR. 5670FG124

Figure 3.2.4: Location of Marine/ Estuarine Sampling Sites.





INFORMATION COURTESY OF BORD IASCAIGH MHARA

SOURCE: ORDNANCE SURVEY DISCOVERY SERIES OS 1806 & OS 1606

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FIGURE 3.2.5 SITES WITH OYSTER AQUACULTURE LICENCES & OYSTER ORDER SITES IN CORK HARBOUR SCALE 1:75,000

CORK HARBOUR MAIN DRAINAGE SCHEME
ENVIRONMENTAL IMPACT STATEMENT
JOB NR. A234541
DRG NR. 5670FG106

3.3 Water Quality

3.3.1 Introduction

The subject of water quality in this section encompasses existing water quality (chemical and biological) and models future water quality based on the development of the proposed WWTP and Collection System. University College Cork (UCC) were commissioned by MMP to conduct a detailed hydrodynamic and water quality modelling study of the proposed WWTP discharge, thereby assessing the likely impacts of the development on water quality.

3.3.2 Methodology

A literature review was conducted to assess the baseline information available for water quality in Cork Harbour. Sources of information included:

- Cork County Council
- Cork City Council
- Environmental Protection Agency
- Directive 2006/7/EC Concerning the management of bathing water quality and repealing Directive 76/160/EEC
- European Communities (Quality of Shellfish Waters) Regulations 2006, S.I. No. 268 of 2006
- Urban Waste Water Treatment Directive 91/271/EEC (amended by 98/15/EC): Urban Waste Water Treatment Regulations 2001 (S.I. No 254 of 2001) and Amendment (S.I. No. 440 of 2004)

A hydrodynamic study for Cork Lower Harbour was conducted by University College Cork (UCC), the findings of which are presented in this section. A computer model, called the 'OH_2' model covering an area from the Old Head of Kinsale to the Waterworks weir in Cork City was developed. This model simulates the release, transport and decay of various micro-organisms in Cork Lower Harbour and the surrounding area due to discharges of untreated and treated waste. In order to determine the improvement in water quality the OH_2 model was configured in two different ways. Firstly it was configured to simulate the release of untreated waste from the towns of Cobh, Passage West, Monkstown, Glenbrook, Ringaskiddy, Crosshaven and Carrigaline and secondly it was configured to simulate the release of treated waste water from the proposed WWTP at Carrigaline. By comparing the results of these two cases the improvement in water quality as a result of the proposed WWTP can be estimated. A proper comparison requires the same population is used in both cases and in this study the projected population loadings for 2010 were used. The detailed methodology is outlined in the full report which is presented in *Volume III, Appendix 3A*.

The impact assessment for this section of the report is based on the *Guidelines on the Information to be contained in Environmental Impact Statements* and the *Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements)* published by the EPA in March 2002 and September 2003 respectively. The criteria used include the quality, magnitude and duration of impacts.

Criteria for assessing impact quality, magnitude and duration are described in Tables 3.3.1 *Criteria for assessing the quality of impacts*, 3.3.2 *Criteria for assessing impact magnitude* and 3.3.3. *Criteria for assessing impact duration.*

Table 3.3.1: Criteria for assessing the quality of impacts

Impact type	Criteria
Positive impact	A change is likely to improve the quality of the environment.
Neutral	No effect.
Negative impact	The change is likely to adversely affect the quality of the environment.

Table 3.3.2: Criteria for assessing impact magnitude

Impact Magnitude	Definition
No change	No discernible effect on human beings.
Imperceptible Impact	An impact capable of measurement but without noticeable consequences.
Slight Impact	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Impact	An impact that alters the character of the environment in a manner that is consistent with existing and emerging trends.
Significant Impact	An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Profound Impact	An impact which obliterates sensitive characteristics.

Table 3.3.3: Criteria for assessing impact duration

Temporary Impact	≤ 1 year
Short-term Impact	1 – 7 years
Medium-term Impact	7 – 15 years
Long-term Impact	15 – 60 years
Permanent Impact	≥ 60 years

3.3.3 Existing Environment

(i) Background

Cork Harbour is the second largest natural Harbour in the world. It consists of two main sections: the Upper Harbour including the Lee Estuary and Lough Mahon and the Lower Harbour. The Outer and Lower Harbours are connected by an east channel and west channel. The west channel is the larger of the two and the majority of the tidal exchange volume occurs through the west channel. Salinity within the Harbour varies greatly. The Upper Harbour is characterised by estuarine salinities and the Lower Harbour by salinities characteristic of coastal marine waters.

When considering the receiving environment, it should be noted that a number of types of geographic areas are generally regarded as being particularly sensitive and significant in an environmental context. Many of these geographic areas are officially designated for protection. One such geographic area type is the coastal zone (EPA, 2002 – EIS Guidelines). Another geographic area type is that which is classified or protected under legislation, including Special areas of Conservation (SAC) with protected species or habitats designated under the *Habitats Directive 92/43/EEC* and Special Protection areas (SPA) for birds designated under the *Birds Directive (79/409/EEC)*.

Within the Lower Harbour area there are a number of protected conservation areas namely, Cork Harbour SPA and the Great Island Channel SAC. Two nationally important designated sites are also present, Monkstown Creek Natural Heritage area (pNHA) and Owenboy River pNHA. The west passage of the River Lee is designated a sensitive water under the Urban Waste Water Treatment (UWWT) Directive, however, the Lower Harbour area is not designated as a sensitive water under the UWWT Directive.

There are no designated bathing areas within the study area, however, Fountainstown beach is a designated bathing area and is located 5.25km from the existing IDA outfall, which is proposed as the sole outfall for discharges from the WWTP. The EPA report for bathing water in Ireland (EPA, 2006) categorised Fountainstown as being compliant with EU mandatory and guide values and within the National limit values. The *Quality of Bathing Waters Regulations* (1992) *(S.I. No. 155 of 1992)* and subsequent amendments set EU mandatory and guide values for parameters related to bathing water quality (see Table 3.3.4 *Quality Requirements for Bathing Waters*). Bacterial parameters included total coliforms and faecal coliforms. However, the EC Directive concerning the quality of bathing waters (76/160/EEC) has now been superseded by the *Directive 2006/7/EC Concerning the management of bathing water quality* and repeals Directive 76/160/EEC. The new Bathing Water Directive specifies standards for intestinal enterococci and *Escherichia coli* however, this Directive has not yet been transposed into Irish law.

Table 3.3.4: Quality Requirements for Bathing Water

	EC Directive 76/160/EEC – Bathing Water Quality		National Limit Values (S.I. No. 155 of 1992)
Parameters[5]	Guide values	Mandatory values	
Microbiological			
Total Coliforms (number/100ml)	≤ 500[1]	≤ 10,000[3]	≤ 5,000[1] ≤ 10,000[3]
Faecal Coliforms (Number/100ml)	≤ 100[1]	≤ 2,000[3]	≤ 1,000[1] ≤ 2,000[3]
Faecal Strep (Number/100ml) [4]	≤ 100[2]		≤ 300[3]
Salmonella (Number/Litre) [4]		0[3]	0[3]
Enteric viruses (PFU/10Litres) [4]		0[3]	0[3]
Physiochemical:			
pH[4]		6 – 9[3]	≥ 6 and ≤ 9[3]
Colour		No abnormal change in colour[3]	No abnormal change in colour[3]
Mineral Oils (mg/L)	≤ 0.3[2]	No film visible on the surface of the water and no odour[3]	No film visible on the surface of the water and no odour[3]
Surface active substances (mg/L)	≤ 0.3[2]	No lasting foam[3]	No lasting foam[3]
Phenol (mg/L as C_4H_3OH)	≤ 0.005[2]	No specific odour ≤ 0.05[3]	≤ 0.05 and no specific odour[3]
Transparency (m)	≥ 2[2]	≥ 1[3]	≥ 1[3]
DO (% saturation O2) [4]	80 to 120[2]		≥ 70 and ≤ 120[3]
Tarry residues and floating material	Absence		No offensive presence[3]

1: ≥ 80% of samples; 2: ≥ 90% of samples; 3: ≥ 95% of samples; 4: to be sampled where investigations show or where there are other grounds for believing that water quality has deteriorated in respect of this parameter;
5: Additional parameters (Ammonia, Nitrogen (Kjeldahal), pesticides, heavy metals, cyanides

Cork Lower Harbour is not designated as a sensitive water under the *Quality of Shellfish Waters Regulations* (2006), however several oyster beds are present in the north channel of Cork Harbour. Refer to Figure 3.2.5 *Sites with Oyster Aquaculture Licences and Oyster Order Sites in Cork Harbour* which illustrates the location of aquaculture sites in Cork Lower Harbour. The *Quality of Shellfish Waters Regulations* stipulates a Guide value for faecal coliforms of ≤300 MPN/100mls in the shellfish flesh or intervalvular liquid.

(ii) Existing Water Quality in Cork Lower Harbour

Nutrient Enrichment, Accelerated Growth and Undesirable Disturbance

Water quality in Cork Harbour is monitored by the EPA. In order to assess the trophic status of Ireland's estuaries and bays the Assessment of Trophic Status of Estuaries and Bays in Ireland (ATSEBI) system was established. To investigate the eutrophic status of estuarine and coastal waters, three criteria are assessed, namely nutrient enrichment, accelerated growth of algae and other higher plants and undesirable disturbance to the balance of organisms present and to the quality of the water concerned.

Nutrient enrichment is quantified by Dissolved Inorganic Nitrogen (DIN) and Molybdate Reactive Phosphorous (MRP). DIN is the sum of oxidised nitrogen (nitrate and nitrite) and ammonium and is considered to represent available nitrogen for uptake by plants. Phosphorous is present in natural waters in various forms of phosphate. Orthophosphate is the predominant form and regarded as the main form of biologically available phosphorous. However, other forms of phosphate may also occur and phosphate concentrations are quantified as MRP as this incorporates the more reactive portions of other forms of phosphate in addition to orthophosphate and represents the biologically available phosphorous in water. Accelerated growth of algae and other higher plants is quantified by chlorophyll concentration. Undesirable disturbance is quantified by the percentage saturation of dissolved oxygen (DO) in the water.

Based on criteria levels of nutrient enrichment (DIN and MRP), chlorophyll levels and percentage saturation of DO, the trophic status of the water can be classified into eutrophic, potentially eutrophic, intermediate and unpolluted based on the following:

- Eutrophic waterbodies – criteria breached for each parameter
- Potentially eutrophic – criteria breached for two parameters and the third falls within 15% of the criterion value
- Intermediate – criteria for one/two of the parameters breached
- Unpolluted – no breach of criteria levels for each of the three parameters.

Data published by the EPA for the sampling periods 1995-1999 and 1999-2003 (EPA, 2005) demonstrated that the Lough Mahon area of Cork Harbour remained eutrophic; the north channel (Great Island) had improved from eutrophic to intermediate; the Owenacurra estuary had disimproved from potentially eutrophic to eutrophic; Cork Harbour disimproved from unpolluted to intermediate and the Lee estuary remained at intermediate.

Water quality data from Cork City Council for 2005-2007 in Table 3.3.5 *Water quality results 2005-2007* illustrates that DIN during the summer period has decreased and is below the criterion value in Cork Harbour, with the exception of Blackrock Castle. MRP levels are below the criteria in both summer and winter periods. The median chlorophyll concentration was higher than the criterion value at Blackrock Castle and Mid Lough Mahon, however chlorophyll concentrations have decreased compared to previous years. Levels of percentage saturation of dissolved oxygen were above the critical values, with the exception of Blackrock Castle where the 5 percentile value was lower than the critical value. The Lower Harbour exceeded the criteria for winter DIN and this was the only parameter breached during 2005-2007. In comparison with published data for Cork Harbour over the period 1999-2005 (EPA, 2005), water quality within Cork Harbour has exhibited an improvement over the last two years. Carrigrennan WWTP, which treats waste water from Cork City, commenced

operation in 2005 and from the results presented in Table 3.3.5 *Water quality results 2005-2007* an improvement in water quality has been observed within this time period.

Table 3.3.5: Water quality results 2005-2007 (Cork City Council)

Water Body	DIN (mg/l N) median		MRP (µg/l P) median		Chlorophyll (µg/l) median	Chlorophyll (µg/l) 90%ile	D.O. % Saturation 5%ile	D.O. % Saturation 95%ile
	W	*S*	*W*	*S*	*S*	*S*	*S*	*S*
Waterworks	**3.840 (2.6)**	2.335 (2.6)	34 (60)	26 (60)	3.5 (15)	4.2 (30)	85[a] (70)	129[a] (130)
Tivoli	2.375 (2.6)	1.018 (2.6)	45 (60)	39 (60)	13.6 (15)	28.1 (30)	71[a] (70)	111[a] (130)
Blackrock Castle	**1.732 (0.697)**	**0.722 (0.697)**	46 (48)	31 (48)	**13.5 (11.9)**	23.4 (23.9)	**75 (76)**	113 (124)
Mid L Mahon	**1.570 (0.633)**	0.34 (0.633)	43 (47)	21 (47)	11.5 (11.7)	**26.7 (23.3)**	79 (77)	115 (123)
End L Mahon	**1.366 (0.569)**	0.289 (0.569)	40 (46)	15 (46)	10.6 (11.4)	17.7 (22.8)	81 (77)	120 (123)
Hawbowline	**0.974 (0.442)**	0.163 (0.442)	35 (43)	8 (43)	6.4 (10.8)	11.4 (21.7)	83 (78)	114 (122)
Lower Harbour	**0.509 (0.378)**	0.038 (0.378)	25 (42)	5 (42)	3.8 (10.6)	7.1 (21.1)	81 (79)	117 (121)
End Harbour	**0.364 (0.314)**	0.038 (0.314)	21 (41)	5 (41)	3.9 (10.3)	5.3 (20.6)	80 (79)	115 (121)
[a] some samples were tested in laboratory				note: data in brackets is criteria value				

DIN – dissolved inorganic nitrogen and considered to represent bio-available Nitrogen; MRP – Molybdate Reactive Phosphorous and considered to represent bio-available dissolved inorganic phosphorous; Chlorophyll – Chlorophyll concentration; D.O. % Saturation – Dissolved oxygen relative to normal for ambient temperature and pressure; W – Winter sampling; S – Summer sampling.

At present, water quality in the Lower Harbour area is classed as 'intermediate' and from the data presented in Table 3.3.5 *Water quality results 2005-2007*, the only parameter which exceeded the criterion value was winter levels of DIN.

Bacteria

The Lower Harbour area is not designated as a sensitive bathing or shellfish water and therefore there are no criteria set for levels of faecal coliforms in the Lower Harbour area. Faecal coliforms are present in waste (human and animal) and levels of faecal coliforms in water are proof of faecal contamination and indicate that pathogenic organisms may be present in water. Data from Cork City Council for the period 2005-2007 was assessed to identify levels of faecal coliforms in Cork Lower Harbour. Figures 3.3.1 *Faecal coliform concentrations in Cork Lower Harbour at High Tide (May 2005-January 2007)*.and 3.3.2 *Faecal coliform concentration in Cork Lower Harbour at Low Tide (May 2005-January 2007)* illustrate levels of faecal coliforms in the Lower Harbour over the period May 2005 to January 2007 during high and low tide. No sampling data was available for the months of January 2006 and May 2006 for low tide sampling and for June 2005, January 2006, May 2006 and December 2006 for high tide sampling. There are no published data on *E. coli* or intestinal enterococci in Cork Lower Harbour at present.

Norovirus

There is no published data on concentrations of *Norovirus* in Cork Lower Harbour to date and there are no legislative requirements to monitor *Norovirus* in Ireland at present. *Norovirus* was included as part of this study in order to determine the impact of the proposed discharge from the WWTP on the oyster farms and water-contact recreational areas in Cork Lower Harbour.

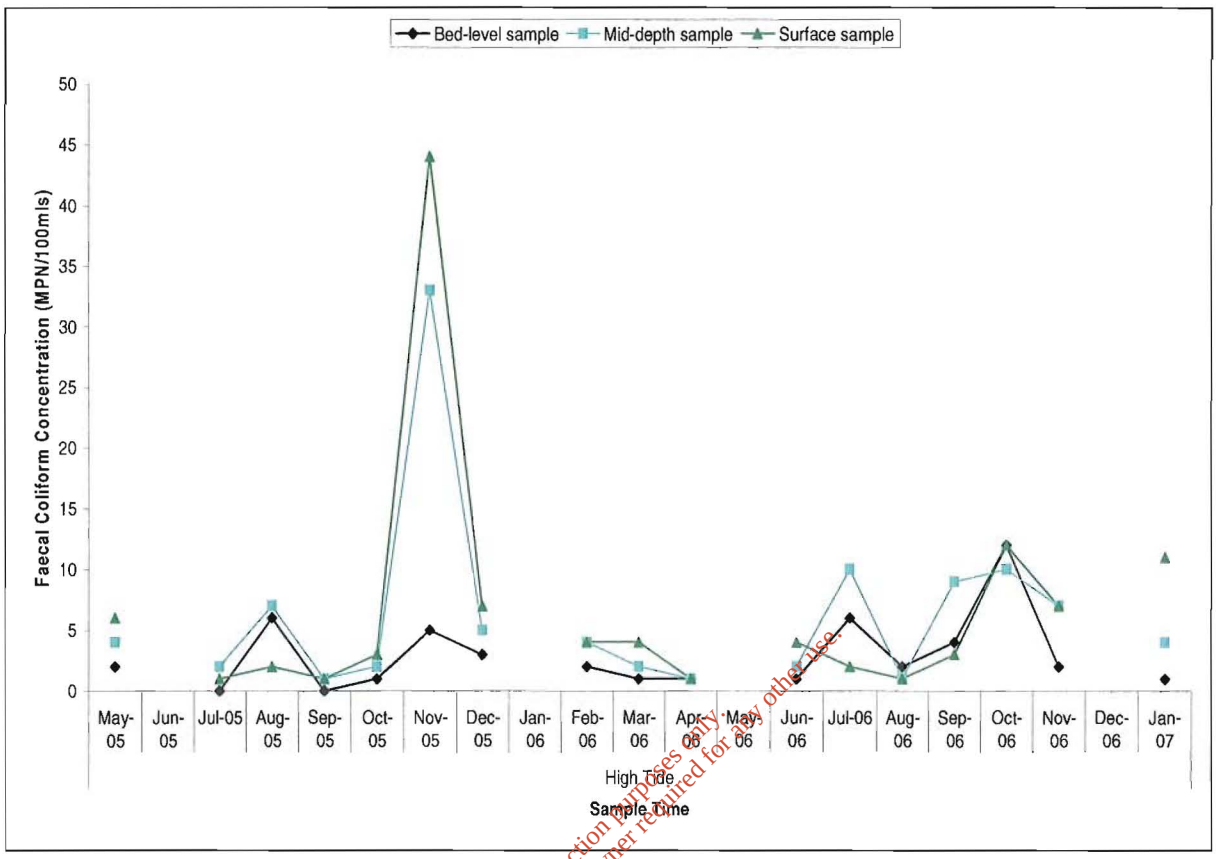

Figure 3.3.1: Faecal coliform concentrations in Cork Lower Harbour at High Tide (May 2005-January 2007).

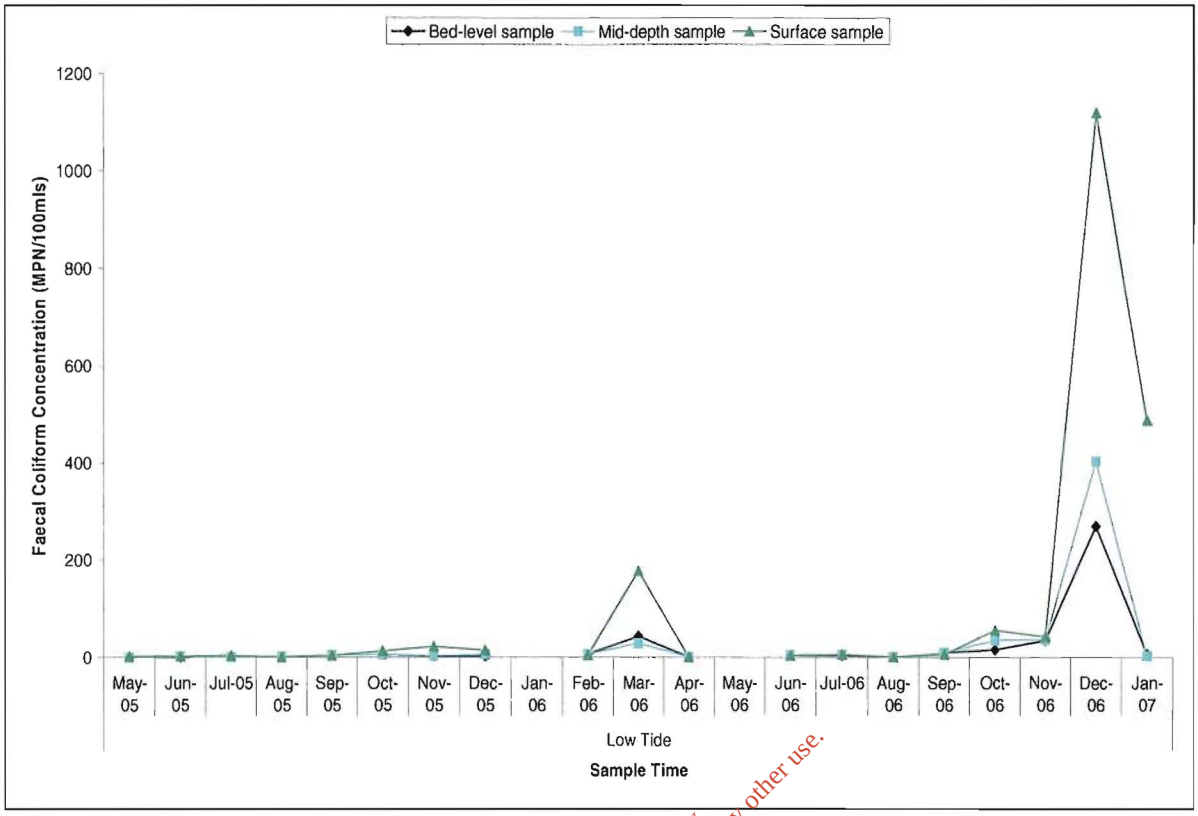

Figure 3.3.2: Faecal coliform concentration in Cork Lower Harbour at Low Tide (May 2005-January 2007).

The data presented in Figures 3.3.1 *Faecal coliform concentrations in Cork Lower Harbour at High Tide (May 2005-January 2007)*.and 3.3.2 *Faecal coliform concentration in Cork Lower Harbour at Low Tide (May 2005-January 2007)* illustrates that faecal coliform concentration in Cork Lower Harbour during high tide reached a maximum of 44 MPN/100mls in November 2005. During low tide faecal coliform concentration is generally higher and reached a peak of 1,120 MPN/100mls in December 2006.

As previously stated, Cork Lower Harbour is not designated a sensitive water under the *Bathing Water Regulations* of 1992 however, it is a used for recreational purposes. Under the *Bathing Water Regulations* (S.I. No. 155 of 1992) a limit is set of ≤1000 faecal coliforms/100mls in ≥80% of samples and ≤2000 faecal coliforms/100mls in ≥95% of samples. Currently the waters of the Lower Harbour are below these limits. The new *Bathing Water Directive 2006/7/EC* specifies a standard of 100 intestinal enterococci (cfu/100ml) and 250 *Escherichia coli* (cfu/100ml) in a 95-percentile evaluation for excellent quality coastal waters, however, no data on intestinal enterococci or *E. coli* is available for Cork Lower Harbour at present due to the change in sampling parameters. The revised Directive will come in to force in 2008.

Existing Waste Water Discharges from Cork Lower Harbour Catchment

At present, untreated raw effluent is being discharged from Cobh, Passage West, Monkstown, Carrigaline, Ringaskiddy and Crosshaven at numerous outfall locations around Cork Lower Harbour. The existing discharges at outfalls in Cork Lower Harbour are presented in Table 3.3.6 *Outfall locations and discharge rates (2001 data).* Figure 2.1 *Location of Existing Outfalls and Proposed Outfall* illustrates the location of the existing outfalls in the area.

Table 3.3.6: Outfall locations and discharge rates (2001 data)

Outfall Location	Catchment	Co-Ordinates	Existing Scenario (2001)			
			Status	Flow (DWF)	Typical Faecal Coliform Concentration^	Faecal Coliform
				m^3/day	fc/ m^3	fc
IDA Outfall -	Crosshaven, Carrigaline, Shanbally	E181358, N62522	Untreated	4,075.03	1 e^{+11} *	4.08 e^{+14}
Monkstown	Monkstown	E176550, N69225	Untreated	185.33	1 e^{+11}	1.85 e^{+13}
Glenbrook	Glenbrook	E177180, N67449	Untreated	327.08	1 e^{+11}	3.27 e^{+13}
Passage West	Passage West	E177243, N66523	Untreated	547.01	1 e^{+11}	5.47 e^{+13}
Pilots Pier Outfall	Part of Cobh	E180796, N66551	Untreated	353.81	1 e^{+11}	3.54 e^{+13}
Corbett Outfall	Part of Cobh	E180440, N66507	Untreated	178.10	1 e^{+11}	1.78 e^{+13}
Kings Quay Outfall	Part of Cobh	E180016, N66416	Untreated	444.95	1 e^{+11}	4.45 e^{+13}
West Beach Outfall	Part of Cobh	E179808, N66375	Untreated	668.31	1 e^{+11}	6.68 e^{+13}
White Point Outfall	Part of Cobh	E178247, N65576	Untreated	634.80	1 e^{+11}	6.35 e^{+13}
Ringaskiddy Village Outfall	Ringaskiddy Village	E178202, N64724	Untreated	101.29	1 e^{+11}	1.01 e^{+13}
TOTAL Catchment				**7,515.71**		**7.52** e^{+14}
Total Ringaskiddy Outfall				**4,075.03**		**4.08** e^{+14}

^ Typical concentration of faecal coliforms in untreated sewerage

* e = exponential function

It is proposed to collect waste water from the Cork Lower Harbour catchment area and treat the effluent at a WWTP in the townland of Shanbally. The treated effluent will then by discharged at the existing Ringaskiddy IDA outfall, resulting in a reduction in the number of outfall points in Cork Lower Harbour.

The hydrodynamic study conducted by UCC modelled the existing flow rates and loadings of effluent from the Lower Harbour catchment area. The concentrations indicated are not representative of the actual water quality in the Harbour, but of the concentrations in the Harbour due to the untreated discharges in the Lower Harbour area.

Faecal Coliforms and *E. coli*

Due to the loadings and die-off rates of faecal coliforms and *E. coli* being identical, the following section is representative of levels of faecal coliforms and *E. coli*. The maximum number of faecal coliforms/*E. coli* during repeating spring tides ranged from 2 to 1,500 faecal coliforms/*E. coli* per 100ml across the harbour, with the exception of the areas in the immediate vicinity of the outfalls. The results of the repeating neap tides were similar. Figure 3.3.3 *Location of fifteen points of interest within Cork Lower Harbour* illustrates the location of fifteen points of interest within Cork Lower Harbour and Table 3.3.7 *Average and maximum concentrations of faecal coliforms/E. coli in Cork Lower Harbour in 2010 (untreated effluent)* lists the maximum and average concentration of faecal coliforms/*E. coli* at these points following the discharge of untreated effluent from the Lower Harbour area in 2010.

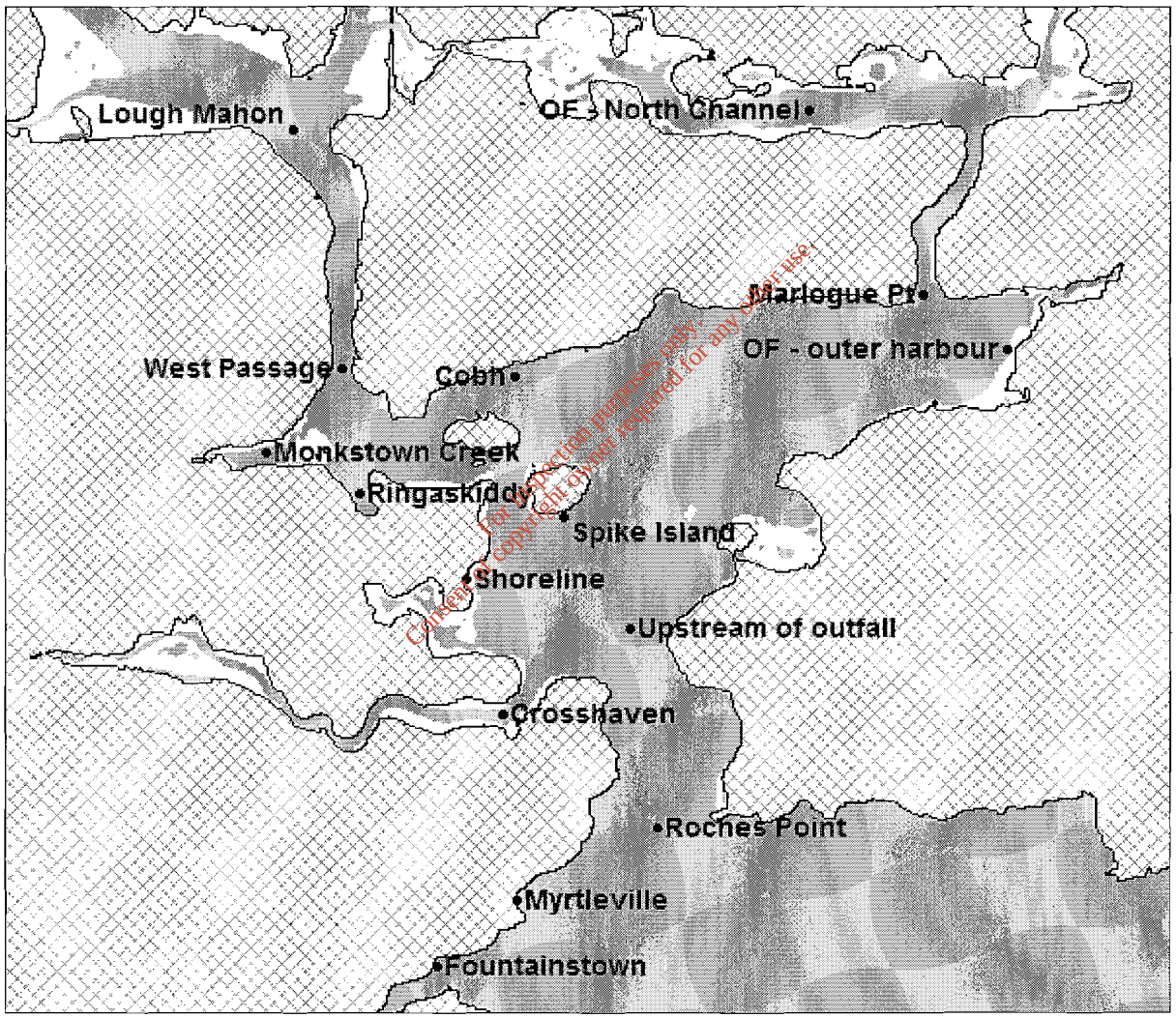

Figure 3.3.3: Location of fifteen points of interest within Cork Lower Harbour.

Table 3.3.7: Average and maximum concentrations of faecal coliforms/*E. coli* in Cork Lower Harbour in 2010 (untreated effluent).

Year	2010		2010	
Treatment	No Treatment		No Treatment	
Repeating Tide	Spring	Neap	Spring	Neap
	AVG	AVG	MAX	MAX
Fountainstown	0.29	0.09	1.0	0.5
Myrtleville	0.79	1.75	3.7	4.5
Roches Point	63.79	77.24	354.3	555.8
Crosshaven	5.96	1.28	24.5	5.6
Ringaskiddy	18.86	7.89	59.1	23.8
Monkstown Ck	11.56	8.47	33.8	118.1
Oyster F - NC	0.02	0.00	7.8	0.0
Marlogue Point	3.62	0.04	36.1	1.1
Oyster F - Outer	0.04	0.00	3.7	0.0
Cobh	113.10	153.99	478.4	475.4
Spike Island	14.22	19.24	66.0	97.0
Shoreline	2.71	0.89	15.2	14.0
Upstream Outfall	115.62	289.31	1838.8	2294.3
West Passage	77.28	112.43	194.4	245.6
Lough Mahon	63.40	58.61	215.0	188.4
All concentrations are expressed in number of faecal coliforms/E. coli per 100ml				

Norovirus

The maximum number of *Norovirus* in the harbour for the untreated waste simulation ranged from 2 to 18,000 *Norovirus* per cubic metre. Table 3.3.8 *Average and maximum concentrations of Norovirus interesting Cork Lower Harbour in 2010 (untreated effluent),* lists the concentrations of *Norovirus* at fifteen points of interest in Cork Lower Harbour following the discharge of untreated effluent from the Lower Harbour area.

Table 3.3.8: Average and maximum concentrations of *Norovirus* in Cork Lower Harbour in 2010 (untreated effluent).

Year	2010	2010
Treatment	Untreated	Untreated
	Max	Average
Fountainstown	3886	1008
Myrtleville	4542	1505
Roches Point	6478	2650
Crosshaven	7940	2507
Ringaskiddy	11740	7423
Monkstown Ck	12214	7239
Oyster F – NC	5870	1331
Marlogue Point	10772	3341
Oyster F - Outer	5475	2550
Cobh	16152	8452
Spike Island	10048	4008
Shoreline	8967	3964
Upstream Outfall	14991	3787
West Passage	15318	8766
Lough Mahon	14730	7518
All concentrations are expressed in number of Norovirus per m^3		
The average values are for the 20 day viral pulse		

Organic Nitrogen, Ammonia and Nitrate

Maximum concentrations of organic nitrogen at the fifteen points of interest ranged from 0.000844 mg/L at the oyster farm in the North Channel to 0.004708mg/L upstream of the IDA outfall. Concentrations of ammonia ranged between 0.000655-0.008214mg/L and concentrations of nitrate ranged between 0.000684-0.004048mg/L. Average concentrations at these points were considerably less and are presented in Table 3.3.9 *Maximum and average concentrations of nitrogen, ammonia and nitrate in Cork Lower Harbour in 2010 (untreated effluent).*

Table 3.3.9: Maximum and average concentrations of nitrogen, ammonia and nitrate in Cork Lower Harbour in 2010 (untreated effluent).

	Nitrogen (mg/L)		Ammonia (mg/L)		Nitrate (mg/L)	
Year	2010	2010	2010	2010	2010	2010
	Max	Avg	Max	Avg	Max	Avg
Fountainstown	0.000321	0.000138	0.000655	0.000276	0.000684	0.000244
Myrtleville	0.000413	0.000222	0.000836	0.000434	0.000832	0.000315
Roches Point	0.001366	0.000408	0.002529	0.000737	0.001582	0.000285
Crosshaven	0.001325	0.000434	0.002549	0.000832	0.001792	0.000542
Ringaskiddy	0.001831	0.001204	0.003655	0.002332	0.003576	0.001666
Monkstown	0.001853	0.001125	0.003688	0.002192	0.003527	0.001637
Oyster F - NC	0.000805	0.000124	0.001640	0.000261	0.001813	0.000325
Marlogue Point	0.002090	0.000416	0.003966	0.000820	0.002705	0.000692
Oyster F - OH	0.000884	0.000277	0.001756	0.000569	0.001812	0.000603
Cobh	0.002976	0.001697	0.005501	0.003152	0.004048	0.001612
Spike Island	0.001770	0.000663	0.003422	0.001249	0.002581	0.000705
Shoreline	0.001344	0.000352	0.002647	0.000675	0.002279	0.000439
Up. Outfall	0.004708	0.000660	0.008214	0.001196	0.002188	0.000482
West Passage	0.002601	0.001408	0.004962	0.002646	0.003609	0.00151
Lough Mahon	0.002517	0.001264	0.00480	0.002390	0.003512	0.001450

3.3.4 Impact Assessment

(i) Construction Phase Impacts

WWTP and Collection System

Chemical contamination could occur from accidental spillages, such as oil and other chemicals through poor operational management, the non-removal of spillages, poor storage, handling and transfer of oil and chemicals. This would result in a slight-moderate negative impact on water quality.

It is predicted that there will be a short term increase in the turbidity of the water column during the construction phase due to the laying of pipelines and the marine crossing as increased suspended solids enter the water column. Impacts of increased turbidity are likely to be minimal in an overall context as there is a high degree of natural suspended solids in the area due to the high tidal current regime and sedimentary nature of the area. Additional suspended solids are likely to be rapidly dispersed by the strong currents in some areas. The depositional nature of the hydrodynamics in some areas could lead to increased sedimentation in some areas.

During the construction of the marine crossing, there may be slight short-term negative impacts on water quality due to increased sedimentation. However, this will depend on the method of construction. Open-cut methods may result in an increase in sedimentation in the water; however a tunnelling method would not have this effect.

(ii) Operational Phase Impacts

WWTP and Collection System

At present the population centres in the Lower Harbour area discharge untreated effluent into the harbour at several outfalls. The proposed WWTP and upgraded collection system will have a positive impact on water quality in Cork Lower Harbour due to the secondary treatment of the sewage from the Lower Harbour area and discharge of the treated effluent through a single outfall into the deep water channel in the Lower Harbour.

A hydrodynamic modelling study conducted by UCC was used to estimate the relative reduction in faecal coliforms, *Norovirus*, organic nitrogen, ammonia and nitrate following treatment in the proposed WWTP. The upgraded collection system will result in a reduction in the number of outfalls to a single outfall into the deep water channel near Dognose Bank. The full study conducted by UCC is presented in *Volume III, Appendix 3A*. It should be noted that the impact assessment in this section considers the impact of the proposed WWTP and collection system on the waters of Cork Lower Harbour, and waste water from the Lower Harbour catchment area is only one of many factors contributing to water quality in the Harbour. In this context, the positive impacts are moderate. However, the proposed WWTP and collection system is considered to have significant positive impacts for the towns, villages and populations of the Lower Harbour catchment area.

Faecal Coliforms and *E. coli*

It was assumed that there are $1.0*10^{11}$ faecal coliforms/*E. coli* in every cubic metre of raw sewage (Tchobanoglous *et al.*, 2003) which is equivalent to $1.0*10^{7}$ faecal coliforms/*E. coli* in every 100ml. Due to the concentrations and die-off rates of faecal coliforms and *E. coli* being identical, the results of the hydrodynamic model are identical for both species. It was also assumed and that the proposed WWTP will remove 90% of the organic matter. Therefore there are $1.0*10^{10}$ faecal coliforms/*E. coli* in every cubic metre of treated effluent which is equivalent to $1.0*10^{6}$ faecal coliforms/*E. coli* per 100ml. Comparison of the concentrations of faecal coliforms/*E. coli* in untreated and treated effluent revealed that there is an 80% relative reduction in the number of indicator organisms following secondary treatment in the WWTP. For the inner harbour and the East and West passages a 95% relative reduction in the number of indicator organisms was found. This represents a significant reduction in the numbers of faecal coliforms/*E. coli* discharged from the Lower Harbour area, resulting in a long-term moderate and positive impact on water quality in Cork Lower Harbour. Table 3.3.10 *Average and maximum concentrations of faecal coliforms/E. coli in Cork Lower Harbour in 2010 (treated effluent)* details the maximum and average faecal coliform/*E. coli* levels at the fifteen points of interest in Cork Lower Harbour following discharge of the treated effluent from the WWTP.

Table 3.3.10: Average and maximum concentrations of faecal coliforms/E. coli in Cork Lower Harbour in 2010 (treated effluent)

Year	2010		2010	
Treatment	Treated	Treated	Treated	Treated
Repeating Tide	Spring	Neap	Spring	Neap
	Max	Max	Avg	Avg
Fountainstown	0.2	0.1	0.05	0.02
Myrtleville	0.7	0.8	0.14	0.32
Roches Point	65.3	102.5	11.65	14.25
Crosshaven	3.8	1.5	0.95	0.19
Ringaskiddy	0.0	0.0	0.01	0.00
Monkstown Ck	0.0	0.0	0.01	0.00
Oyster F - NC	0.1	0.0	0.00	0.00
Marlogue Point	0.3	0.0	0.04	0.00
Oyster F - Outer	0.6	0.4	0.00	0.00
Cobh	23.2	0.9	5.32	0.05
Spike Island	9.1	17.8	1.55	3.16
Shoreline	2.2	1.2	0.56	0.10
Upstream Outfall	333.7	423.0	20.12	53.32
West Passage	1.0	0.0	0.08	0.00
Lough Mahon	0.1	0.0	0.01	0.00
All concentrations are expressed in number of faecal coliforms/E. coli per 100ml				

Intestinal Enterococci

At present, intestinal enterococci levels in the waters of Cork Harbour are not sampled. However, cognisant of the requirements of the new *Bathing Water Directive 2006/7/EC* which is due to be transposed into Irish law in 2008, levels of intestinal enterococci were modelled for the operational phase of the WWTP. The new *Bathing Water Directive 2006/7/EC* will require levels of less than 100 intestinal enterococci (cfu/100mls) in a 95-percentile evaluation for coastal waters. The results of the hydrodynamic model predict that the treated effluent from the Cork Lower Harbour Area will contribute a maximum level of ca. 19 cfu/100mls (during neap tides) upstream of the outfall and concentrations decrease with distance from the outfall point. Average concentrations at the fifteen points of interest ranged from 0.00 - 2.91 cfu/100mls. Refer to Table 3.3.11 *Average and maximum levels of intestinal enterococci in Cork Lower Harbour in 2010 (treated effluent)* for levels of intestinal enterococci at fifteen points of interest in Cork Lower Harbour.

Table 3.3.11: Average and maximum levels of intestinal enterococci in Cork Lower Harbour in 2010 (treated effluent).

Year	2010		2010	
Repeating Tide	Spring		Neap	
	Max	Avg	Max	Avg
Fountainstown	0.05	0.02	0.05	0.01
Myrtleville	0.11	0.04	0.19	0.09
Roches Point	3.18	0.67	5.78	1.01
Crosshaven	0.45	0.14	0.37	0.06
Ringaskiddy	0.01	0.01	0.00	0.00
Monkstown Ck	0.02	0.01	0.00	0.00
Oyster F - NC	0.04	0.00	0.00	0.00
Marlogue Point	0.08	0.01	0.04	0.00
Oyster F - Outer	0.13	0.00	0.20	0.00
Cobh	1.60	0.42	0.30	0.02
Spike Island	0.86	0.20	1.60	0.44
Shoreline	0.34	0.07	0.30	0.03
Upstream Outfall	14.28	1.03	19.18	2.91
West Passage	0.17	0.02	0.01	0.00
Lough Mahon	0.04	0.00	0.00	0.00

Norovirus

It was conservatively assumed that there are 50 million *Norovirus*/m^3 in raw sewage and that the WWTP will remove 90% of the organic matter such that after treatment there are 5 million *Norovirus*/m^3 in treated effluent. Previous studies have estimated 20 million *Norovirus*/m^3 in raw sewage (Pommepuy *et al.*, 2004). Comparison of the concentrations of *Norovirus* in untreated and treated effluent discharged into the harbour in 2010 from the Lower Harbour area revealed that there is an 80% relative reduction in the concentration of *Norovirus* following secondary treatment in the WWTP in the entire harbour area with the exception of the area immediately adjacent to the outfall. For areas of the Inner harbour the improvement was much greater with a 95% relative reduction in *Norovirus*. The operation of the proposed WWTP will have a long-term, moderate positive impact on water quality in Cork Lower Harbour. Table 3.3.12 *Average and maximum concentrations of Norovirus in Cork Lower Harbour in 2010 (treated effluent)* details the *Norovirus* levels at the fifteen points of interest.

Table 3.3.12: Average and maximum concentrations of *Norovirus* in Cork Lower Harbour in 2010 (treated effluent).

Year Repeating Tide	2010 Treated Average	2010 Treated Max
Fountainstown	195	695
Myrtleville	285	798
Roches Point	532	1254
Crosshaven	368	917
Ringaskiddy	219	550
Monkstown Ck	186	556
Oyster F – NC	89	550
Marlogue Point	252	933
Oyster F - Outer	219	545
Cobh	430	1374
Spike Island	523	1203
Shoreline	496	1028
Upstream Outfall	701	3157
West Passage	205	817
Lough Mahon	98	471
All concentrations are expressed in no of Norovirus per m^3		
The average values are for the 20 day viral pulse		

Organic nitrogen, ammonia and nitrate

Table 3.3.13 *Concentration of organic nitrogen, ammonia and nitrate in raw and treated sewage* details the concentrations of organic nitrogen, ammonia and nitrate in untreated and treated sewage. Table 3.3.14 *Maximum concentrations of nitrogen, ammonia and nitrate in the Lower Harbour area in 2010* lists the concentrations of nitrogen, ammonia and nitrate at fifteen points of interest following the discharge of untreated and treated effluent from the Lower Harbour area. The concentrations of each of these species of nitrogen in the harbour was found to decrease following secondary treatment of the effluent, with the exception of organic nitrogen concentrations at Fountainstown, Myrtleville, Roches Point and upstream of the IDA outfall. These slight increases are due to the discharge of all treated effluent through a single outfall, compared to the present scenario where there are numerous outfall points. It is evident that the proposed development will reduce considerably the forcing on primary production in the Inner Harbour (Lough Mahon) and in the North Channel behind Great Island. There is also an improvement throughout the Outer Harbour with the possible exception of the immediate vicinity of the diffuser itself. As discussed previously, DIN levels in the harbour have exceeded the criterion value during winter sampling periods in recent years. The reduction in nitrate and ammonia in treated effluent from the proposed WWTP will have a moderate positive impact on water quality in Cork Lower Harbour in terms of DIN.

Table 3.3.13: Concentration of organic nitrogen, ammonia and nitrate in raw and treated sewage.

Nutrient	Raw Sewage	Treated sewage
Organic Nitrogen	15mg/l	15mg/l
Ammonia	25mg/l	12.5mg/l
Nitrate	1mg/l	1mg/l

Table 3.3.14: Maximum concentrations of nitrogen, ammonia and nitrate in the Lower Harbour area in 2010.

	Nitrogen (mg/L)		Ammonia (mg/L).		Nitrate (mg/L)	
	2010 MAX (Untreated)	2010 MAX (Treated)	2010 MAX (Untreated)	2010 MAX (Treated)	2010 MAX (Untreated)	2010 MAX (Treated)
Fountainstown	0.000321	0.000432	0.000655	0.000553	0.000684	0.00046149
Myrtleville	0.000413	0.000500	0.000836	0.000631	0.000832	0.0005058
Roches Point	0.001366	0.001779	0.002529	0.001785	0.001582	0.00073657
Crosshaven	0.001325	0.001038	0.002549	0.001156	0.001792	0.00067713
Ringaskiddy	0.001831	0.000393	0.003655	0.000543	0.003576	0.00064122
Monkstown	0.001853	0.000413	0.003688	0.000560	0.003527	0.00060934
Oyster F - NC	0.000805	0.000390	0.001640	0.000526	0.001813	0.00056257
Marlogue Point	0.002090	0.000689	0.003966	0.000850	0.002705	0.00070098
Oyster F - OH	0.000884	0.000809	0.001756	0.000954	0.001812	0.00064305
Cobh	0.002976	0.001831	0.005501	0.001858	0.004048	0.00081516
Spike Island	0.001770	0.001385	0.003422	0.001472	0.002581	0.00074446
Shoreline	0.001344	0.000976	0.002647	0.001060	0.002279	0.00067418
Up. Outfall	0.004708	0.006471	0.008214	0.005683	0.002188	0.00105842
West Passage	0.002601	0.000870	0.004962	0.001027	0.003609	0.00074542
Lough Mahon	0.002517	0.000471	0.00480	0.000614	0.003512	0.00062927

From the data presented above, water quality in Cork Lower Harbour is expected to moderately improve with the operation of a WWTP in the Lower Harbour area due to reductions in the concentrations of faecal coliforms, *Norovirus*, organic nitrogen, ammonia and nitrate entering the Harbour. However, the operation of the WWTP and collection system will have a significant positive impact on the towns, villages and population of the Lower Harbour catchment area.

The potential impact on the receiving waters from emergency overflows from the pumping stations may affect water quality in the receiving water to which the outfall is discharging. However, the risk of such an event occurring is extremely low in a modern well managed plant as is proposed. During storm events the potential exists for storm water overflows to be discharged directly to the harbour. The large size of Cork Lower Harbour along with tidal currents would mean that the receiving waters would have a high resilience to such unlikely events and the risk of such an event happening with the proposed WWTP would be much lower than is currently the case. The normal operating quality of the proposed discharge into Cork Lower Harbour will be much improved from the existing discharges it would replace and will have a long term moderate positive impact on water quality.

Positive impacts on aquaculture, recreation and the economic value of the harbour will also occur as a result of improved water quality.

(iii) Cumulative Impacts

Cork County Council are committed to improving water quality in Cork Harbour and a number of sewerage schemes and WWTPs are due to commence in 2008, namely: Midleton Sewerage Scheme; Little Island Sewerage Scheme; Carrigtwohill Sewerage Scheme and Midleton WWTP extension. The cumulative impact of these domestic sewerage schemes and the proposed WWTP in Cork Lower Harbour will be an improvement in water quality in Cork Harbour due to the treatment of raw effluent prior to discharge to the harbour.

The *Water Framework Directive* (WFD) (2000/60/EC) came into force in 2000 and its target is to achieve the objectives listed below by 2015. Its objectives are to:

- Achieve good ecological and chemical status in surface waters
- Achieve good chemical status and quantitative status in groundwaters
- Achieve good ecological potential and chemical status in artificial and heavily modified waters
- Prevent deterioration in status of surface and groundwaters
- Reverse pollution trends
- Achieve objectives and standards for protected areas
- Cease Priority Hazardous Substances discharges

At present, the EPA's *Proposed Quality Standards for Surface Water Classification* is open for public consultation. Following public consultation, the EPA will make recommendations to the Minister of the Environment, Heritage and Local Government for input into additional Regulations which will give statutory effect to these measures for implementation of the WFD. At present, there are no statutory regulations with regard to a Programme of Measures and Quality Standards for the South Western River Basin District.

Cork County Council are investing in several WWTPs and sewerage schemes in County Cork and in so doing are contributing to the achievement of good ecological and chemical status in surface waters, reversal of pollution trends and ceasing the discharge of Priority Hazardous Substances, which are objectives of the WFD.

(iv) 'Do Nothing' Impact

In the event that the proposed development does not proceed, water quality in Cork Lower Harbour would expect to remain variable and eutrophic in parts. The effects of an increasing population coupled with increased housing demands in the Lower Harbour area would be an increase in the amount of untreated discharges entering the harbour. Impacts would include deterioration in water quality which could negatively impact on ecology, human beings and economic activity due to restricted development as a result of insufficient waste water infrastructure and treatment.

(v) 'Worst Case Scenario' Impact

Where the mitigation measures are not implemented correctly, or fail, the potential exists for the WWTP to discharge untreated effluent into Cork Lower Harbour. The large size of Cork Lower Harbour along with tidal currents would mean that the receiving waters would have a high resilience to such short-term and unlikely events and the risk of such an event happening with the proposed WWTP scheme would be much lower than is currently the case. These situations are unlikely to occur on effective construction and operational management of the development and the implementation of the mitigation measures proposed in the appropriate sections of this statement.

3.3.5 Mitigation Measures

(i) Construction Phase

To prevent chemical pollution, all fuels or chemicals kept on the construction site will be stored in bunded containers. All refuelling and maintenance will be carried out in ramped containment areas away from sensitive environments (i.e. up-gradient of protected habitats or adjacent watercourses). In the event of any spillage or accident occurring below the high water mark of ordinary or medium tides, or above the high water mark which may impact on the foreshore during the carrying out of the works, or during operations following the completion of these works, the Irish Coast Guard will be notified immediately by telephone.

During the construction of the marine crossing, if open-cut techniques are employed, the disturbed area will be protected so as to reduce potential bed erosion by tidal movements during construction.

(ii) Operational Phase

Currently all waste water from the population centres within the Cork Lower Harbour Drainage Scheme is generally not treated (significant elements receive no treatment and limited volumes receive comminution) and is discharged directly to the Lower Harbour. Consequently, the quality of the discharge from any future overflows will be a significant improvement on current practice. Emergency overflows will be located on the collection system at individual pumping stations to prevent localised flooding in the event of a power failure. The provision of duty/standby pumping arrangements in each pumping station will minimise the potential for the discharge of raw sewage except in an emergency. All overflow arrangements will be designed to minimise nuisance and associated health hazards. Where overflows occur, their design will be refined at detailed design to the extent that they meet all accepted industry design parameters and will not have a significant impact on water quality. All pumping stations and associated overflows will be designed in accordance with the Department of the Environment, Heritage and Local Government guidelines including the guideline document issued entitled *Procedures and Criteria in relation to Storm Water Overflows*. The storm water management and treatment system at the WWTP is described in Section 2.5.5 *Proposed WWTP Treatment Options*

In order to minimise the risk of untreated effluent discharging from pumping stations an automated control operating system should be put in place to ensure that if a downstream pumping station fails to operate, the upstream pumping station will cease pumping.

Provision of continuous monitoring and sampling of waste water flow entering and leaving the site will be provided. This will also include monitoring and measuring of the storm water content. In order to comply with the provisions of the *Urban Waste Water Treatment Regulations 2001 & 2004* comprehensive monitoring will be carried out as described in Section 2.10 *Waste Water Monitoring.*

To comply with the *Waste Water Discharge (Authorisation) Regulations* of 2007, a waste water discharge licence will be required from the EPA for the Cork Lower Harbour WWTP. The purpose of the licence is to make provision for the protection of human, animal and plant life from harm and nuisance caused by the discharge of dangerous substances to the aquatic environment as well as to ensure compliance with National law.

The WWTP in Cork Lower Harbour will also be designed so that it can be retro-fitted for nutrient removal, if required in the future.

3.3.6 Residual impacts

Residual impacts which are likely to occur following the implementation of mitigation measures include improved water quality in Cork Lower Harbour which in turn will have positive impacts for ecology, aquaculture, recreation, economic activity and development in Cork Lower Harbour.