(ii) Operational Phase

Population and Housing; Tourism and Recreation

WWTP: The preliminary treatment at the WWTP must include for septicity control in addition to Screening and Grit Removal due to the length of the conveyance system. It is recommended that Preliminary treatment facilities be incorporated within a building with air extraction to an odour control system. The appointed contractor will be required to comply with the *Waste Water Treatment (Prevention of Odours and Noise) Regulations* (2005) *(S.I. No. 787 of 2005).*

Collection System: It is essential that the pumping stations include for Standby power arrangements to prevent the overflow discharge of raw effluent to the Harbour. At a minimum 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. There is a strong potential for septic conditions to arise in the collection and conveyance systems en route from the waste water sources in the different towns to the WWTP due to the length of the conveyance system and the distance from the population centres to the treatment plant. Due to the odour nuisance associated with septicity and the long residence times of raw waste water in the conveyance systems it is essential that the inlet channels and chambers be covered, vented and connected to an odour control system. The appointed contractor will be required to comply with the *Waste Water Treatment (Prevention of Odours and Noise) Regulations, 2005 (S.I. No. 787of 2005).*

Employment and Economic Activity

WWTP and Collection System: It is considered that no negative impacts will be associated with the WWTP, with regard to employment and economic activity and therefore mitigation is not required.

Land-use

As there are no significant impacts, no mitigation measures are proposed relating to land-use.

Health and Safety

WWTP and Collection System: Access to the site by unauthorised persons will be prevented. Safety features for minimising risk to all plant personnel/visitors/intruders will include the following:

- Handrails to uncovered tanks, where appropriate
- Handrails and toe-boards to access platforms, walkways, etc.
- Controlled access to all stairs and platforms
- Safety chains/cages to units/ladders, where appropriate
- Safety grid flooring to all ducts and channels
- Local emergency stop buttons on all machinery
- Life buoys at strategic locations around all tanks
- Hand rails and harnesses for maintenance personnel

- Perimeter security fence with an intruder alarm system linked to the central control station
- Portable gas monitor and breathing apparatus for use by site personnel

Facilities for diverting flows from the various treatment units will be provided to effect ease of maintenance and to facilitate isolation of any integral unit should breakdown occur, without significantly impairing the overall treatment efficiency. A comprehensive Health and Safety Statement will be prepared for the operational phase of the development and will comply with all Health and Safety Regulations.

Traffic

WWTP and Collection System: As there are low volumes of traffic associated with the operational phase and no significant impacts, no additional mitigation measures are proposed in relation to traffic.

3.1.6 Residual Impacts

No residual negative impacts on human beings are anticipated from the proposed development provided that the development is managed effectively during the construction and operational phases and all mitigation measures are implemented.

DOUGLAS

MONKSTOWN (URBAN)

MONKSTOWN (RURAL)

COBH (RURAL)

COBH (URBAN)

PROPOSED SITE

CARRIGALINE (CORK)

LISCLEARY

CARRIGALINE (KINSALE)

TEMPLEBREEDY

LEGEND

PROPOSED SITE

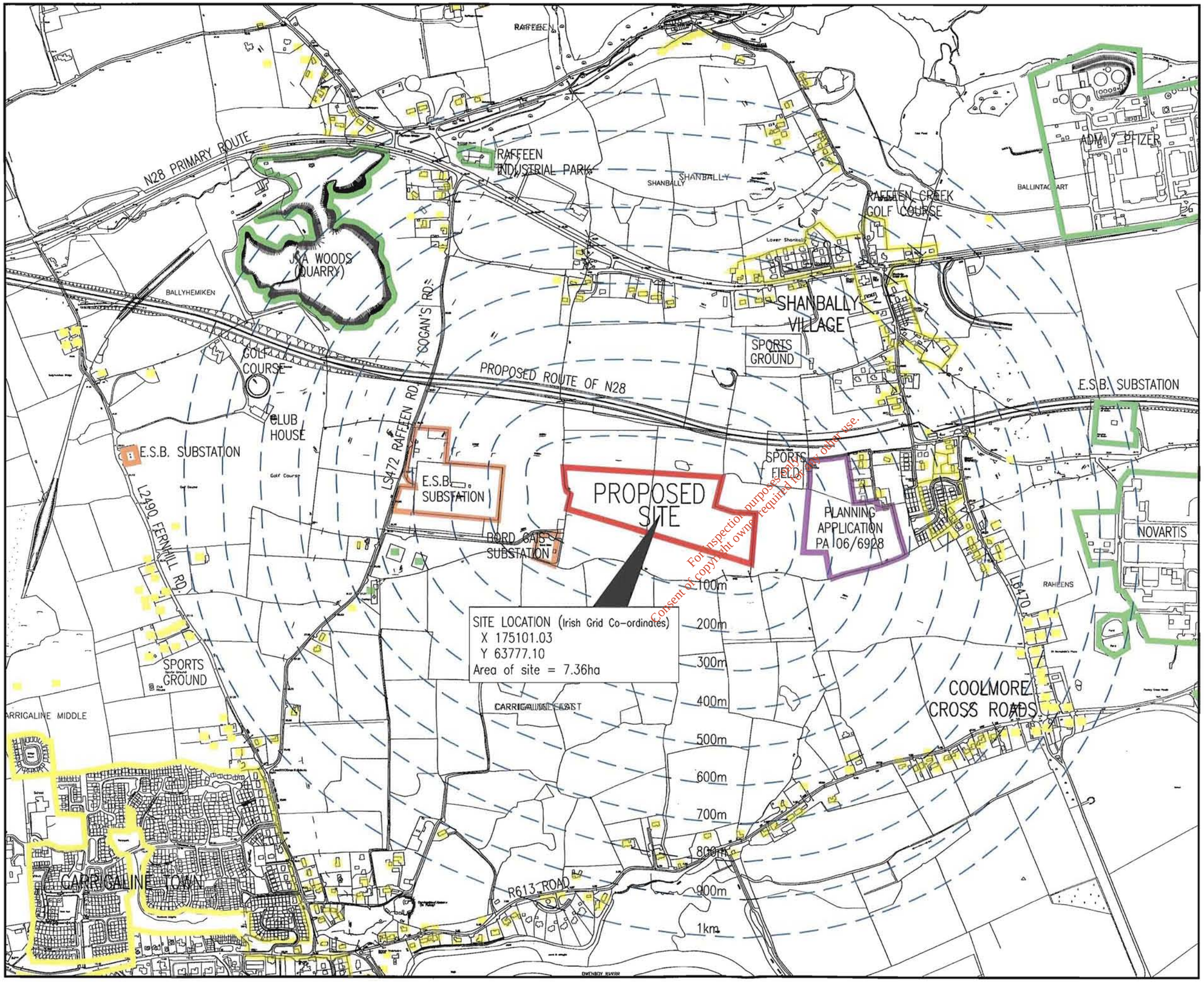
N

Mott MacDonald

FIGURE 3.1.1 DISTRICT ELECTORAL DIVISION OF CARRIGALINE (CORK RURAL DISTRICT)

SCALE 1:35,000

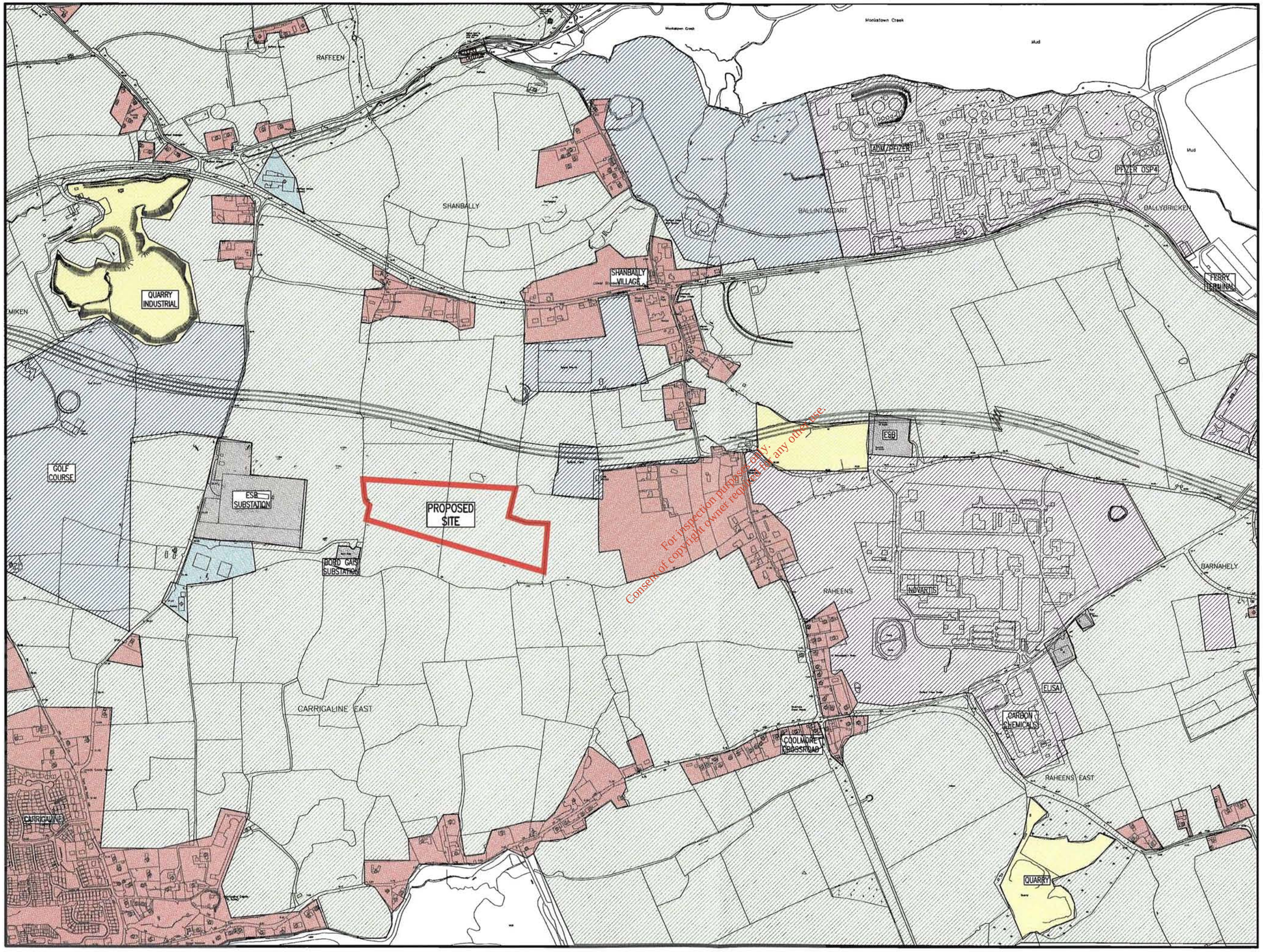
CORK HARBOUR MAIN DRAINAGE SCHEME
ENVIRONMENTAL IMPACT STATEMENT
JOB NR. 234541
DRG NR. 5670/1655



Mott MacDonald

FIGURE 3.1.2 PROXIMITY OF RESIDENTIAL DWELLINGS SCALE 1:10,000

EXTRACT FROM O.S. MAPS CORK 6471-C, 6471-D, 6472-C, 6510-A , 6510-B & 6511-A
CORK LOWER HARBOUR MAIN DRAINAGE SCHEME
ENVIRONMENTAL IMPACT STATEMENT
JOB NR. 234541
DRG NR. 5670F056



LEGEND

- AGRICULTURE
- AMENITY LAND
- EXTRACTIVE INDUSTRY
- MANUFACTURING INDUSTRY
- COMMERCIAL USE
- HOUSING
- PUBLIC UTILITIES
- PROPOSED SITE

Mott MacDonald

FIGURE 3.1.3. ADJACENT LAND USES

SCALE 1:10,000

EXTRACT FROM O.S. MAPS CORK 6471-C, 6471-D, 6472-C, 6510-A, 6510-B & 6511-A

CORK LOWER HARBOUR MAIN DRAINAGE SCHEME
ENVIRONMENTAL IMPACT STATEMENT
JOB NR. 234541
ORG NR 5670FC57

3.2 Terrestrial and Marine Ecology

3.2.1 Introduction

A terrestrial and marine ecology assessment and report was prepared by Ecofact Environmental Consultants Ltd. on behalf of MMP to address the potential impacts of the proposed WWTP and upgraded collection system on the ecology of the receiving environment. The terrestrial and marine ecology report is presented in full in *Volume III, Appendix 2A*.

3.2.2 Methodology

The current study consisted of a desk study and a field assessment. The field survey comprised a systematic walk over of the proposed site, pumping stations and collection system. Much of the pipeline route comprises existing road or built ground. A Phase 1 habitat survey of the site, pipeline routes and pumping stations was conducted during June 2007 using methodology developed by the Joint Nature Conservation Committee (JNCC, 1993). Habitats were classified and mapped using habitat descriptions and codes published in the Heritage Council's *A Guide to Habitat Types in Ireland* (Fossitt, 2000). Plant species nomenclature follows Stace's *New Flora of the British Isles* (1997). All birds encountered during the course of the surveys were noted and the habitats present on the site were assessed as to their suitability for breeding and wintering bird species. The affected areas were also examined for signs of/or the presence of mammals (including potential bat roosts and badger setts). The marine field survey comprised a systematic walk over and boat survey of the areas that would be potentially affected by the proposed development (i.e. outfalls, areas adjoining pipeline routes etc.). Habitats were classified and mapped using habitat descriptions and codes published in the Heritage Council's *A Guide to Habitat Types in Ireland* (Fossitt, 2000) and the JNCC *Marine Habitat Classification for Britain and Ireland* (O'Connor, 2004). A marine fauna assessment of the affected areas was undertaken using JNCC Marine Monitoring methods (Davies *et al*, 2001).

Shore (littoral) and sub-littoral sampling was undertaken at 23 stations during low spring tides with a further 4 stations sampled from a boat. Sampling involved the use of quadrates (quadrate area 0.25m^2), cores (0.01m^2) and a hand held grab (AMS type, 0.023 m^3) and conformed to JNCC methodology. Specimens were identified to the lowest possible taxonomic level, counted and weighed. Marine fauna nomenclature follows Barnes' *the brackish-water fauna of North-western Europe* (1994).

This study was carried out with reference as applicable to the EPA's *Guidelines on the Information to be Contained in Environmental Impact Statements* (March, 2002) and *Advice Notes on Current Practice* (2003), the Institute of Environmental Assessment's *Guidelines for Baseline Ecological Assessment* (1995), along with experience of 'best practice' in the ecological assessment.

Preparation of this section included consultation with:

- National Parks and Wildlife Service (NPWS);
- Environmental Protection Agency (EPA);
- Cork County Council;
- Botanical Society of the British Isles (BSBI);
- South Western Regional Fisheries Board (SWRFB);

- Department of Communications, Energy and Natural Resources (formally DCENR and now Department of Agriculture, Fisheries and Food (DAFF));
- Marine Institute (MI);
- Bat Conservation Ireland (BCI);
- BirdWatch Ireland (BWI);
- Irish Whale and Dolphin Group (IWDG);
- National Roads Authority (NRA);

The results of the ecological survey were evaluated to determine the significance of identified features located in the study area on an importance scale ranging from international-national-county-local. The criteria used are shown in Table 3.2.1 *Criteria used in assessing the ecological importance of ecological features.*

The means of assessing impact significance is based on the Institute of Ecological and Environmental Management (IEEM) *Guidelines for Ecological Evaluation and Assessment-Draft Guidelines* (2002). Impact type and magnitude are defined in Tables 3.2.2 *Criteria for assessing impact type* and 3.2.3. *Criteria for assessing impact magnitude.*

Impacts during both the Construction and Operational Phases of the proposed development are considered, in the Short, Medium and Long term (as per the EPA *Guidelines on the Information to be Contained in Environmental Impact Statements, 2002*) where considered appropriate.

Table 3.2.1: Criteria used in assessing the ecological importance of ecological features.

Importance	Criteria
International	An internationally designated site or candidate site (SPA*, pSPA, SAC, pSAC, Ramsar Site, Biogenetic Reserve). Also sites which qualify for designation as SACs or SPAs – this includes sites on the NGO shadow list of SAC's.
National	A nationally designated site or candidate site (NHA**, pNHA) (unfortunately there is no published criteria used in selecting these areas). Sites which hold Red Data Book (Curtis and McGough, 1988) plant species.
County	Sites which hold nationally scarce plant species (recorded from less than 65 10km squares), unless they are locally abundant. Sites which hold semi-natural habitats likely to be of rare occurrence within the county. Sites which hold the best examples of a semi-natural habitat type within the county.
High Local Importance	Sites which hold semi-natural habitats and/or species likely to be of rare occurrence within the local area. Sites which hold the best examples of a high quality semi-natural habitat type within the local area.
Local Importance	Sites which hold high quality semi-natural habitats
Local Value	Any semi-natural habitat

*SPA - Special Protection Area; pSPA - Proposed Special Protection Area; SAC – Scientific Area of Conservation; pSAC – Proposed Scientific Area of Conservation

**NHA – Natural Heritage Area; pNHA – Proposed Natural Heritage Area

Table 3.2.2: Criteria for assessing impact type

Impact type	Criteria
Positive impact:	A change is likely to improve the ecological feature in terms of its ecological value.
Neutral	No effect.
Negative impact:	The change is likely to adversely affect the ecological value of the feature.

Table 3.2.3: Criteria for assessing impact magnitude

Impact magnitude	Definition
No change:	No discernible change in the ecology of the affected feature.
Imperceptible Impact:	A change in the ecology of the affected site, the consequences of which are strictly limited to within the development boundaries.
Minor Impact:	A change in the ecology of the affected site which has noticeable ecological consequences outside the development boundary, but these consequences are not considered to significantly affect the distribution or abundance of species or habitats of conservation importance.
Moderate Impact:	A change in the ecology of the affected site which has noticeable ecological consequences outside the development boundary. These consequences are considered to significantly affect the distribution and/or abundance of species or habitats of conservation importance.
Substantial Impact:	A change in the ecology of the affected site which has noticeable ecological consequences outside the development boundary. These consequences are considered to significantly affect species or habitats of high conservation importance and to potentially affect the overall viability of those species or habitats in the wider area.
Major Impact:	A change in the ecology of the affected site which has noticeable ecological consequences outside the development boundary. These consequences are considered to be such that the overall viability of species or habitats of high conservation importance in the wider area2 is under a very high degree of threat (negative impact) or is likely to increase markedly (positive impact).

3.2.3 Existing Environment

Background

Cork Harbour is a large, sheltered bay system, with several river estuaries - principally those of the Rivers Lee, Owenboy, Douglas and Owenacurra. It is connected to the Atlantic Ocean by a narrow inlet between Roche's Point and Crosshaven, at the south of the Harbour. The River Lee which flows through Cork City enters the Harbour at the north-west, via the west passage. The Owenboy River flows through Carrigaline, to the south-east of Cork City, and enters the Harbour at Crosshaven, to the south-west of the Harbour.

Cork Harbour has a surface water area of around 100km^2 and is a large, sheltered, naturally deepwater Harbour. Strong estuarine influences dominate the upper reaches of the Harbour and the coastline is mixed, consisting of built infrastructure, shallow cliffs, intertidal mudflats, reedbeds, shingle and rocky foreshores, which are exposed by the tide. Owing to the sheltered conditions, the inter-tidal flats are often muddy in character (King, 2002).

Designated Areas

Designated areas in the vicinity of the proposed development works are shown in Figure 3.2.1 *Conservation Designated Sites in the Study Area*. Sections of the proposed development are located within the Cork Harbour Special Protection Area (SPA) for birds (Site Code 004030). The Cork Harbour SPA is an internationally important wetland site, regularly supporting in excess of 20,000 wintering waterfowl. Several of the species which occur regularly within Cork Harbour are listed on Annex I of the E.U. Birds Directive (*Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds)*, i.e. Whooper Swan, Golden Plover, Bar-tailed Godwit, Ruff and Common Tern. Proposed works associated with the development are located within 2km of the Great Island channel Special Area of Conservation (SAC) (Site Code: 0001058). The Great Island Channel stretches from Little Island to Midleton. It is designated due to the presence of the Annex I habitats; mudflats and Atlantic salt meadows. Sites designated as SACs and SPAs are recognised as being of international importance. Monkstown Creek Natural Heritage Area (pNHA) (Site Code 001979) and the Owenboy River pNHA (Site Code 001990) are designated areas of national importance due to wintering water birds. The study area includes areas within designated SPAs and pNHAs which are of international importance due to the abundance of important bird species and also the presence of internationally important coastal habitats.

Flora and habitats

Following the Phase 1 habitat survey and marine habitat survey of the study area, the different habitat types (as classified according to Fossitt, 2000 and O'Connor, 2004) were identified. The following is a description of the various habitats found within and adjacent to the study area. The habitat code according to Fossitt is in brackets after the habitat name. The habitats present in both terrestrial and coastal areas recorded in the study during the June 2007 survey are discussed below. The habitats of selected marine areas are indicated in Figure 3.2.2 *Habitat Map of Selected Marine Areas* and the habitat map of the WWTP is presented in Figure 3.2.3 *Habitat Map of WWTP site*.

Terrestrial Habitats

Improved Agricultural Grassland (GA1): The proposed site for the WWTP and the majority of the proposed pipeline routes running through fields are located in improved agricultural grassland. This grassland is species poor and is dominated by rye grass *Lolium perenne*, meadow grasses *Poa* spp., Yorkshire fog *Holcus lanatus* and white clover *Trifolium repens*. Agricultural herbaceous species such as the common sorrel *Rumex acetosa*, broad leaved dock *Rumex obtusifolius*, thistles *Cirsium arvense*, *C. vulgare* and nettles *Urtica dioica* also occur frequently within this habitat. These areas have reduced plant biodiversity. The plant community is influenced by nutrient enrichment which results primarily in a monoculture of grass species. Consequently this area is of **local importance**.

Amenity Grassland (GA2): Areas of amenity grassland are located nearby the site of the proposed Monkstown pumping station. Amenity grassland is dominated by grass species such as plantains; in particular ribwort plantain *Plantago lanceolata* and meadow grasses *Poa* spp. Broadleaf herbs are dominated by clovers *Trifolium* spp. dandelion *Taraxacum* spp and daisy *Bellis perennis*. This habitat is commonly used for recreational activities and is generally managed through frequent fertiliser application and mowing. This is a habitat of **local ecological importance**.

Hedgerows (WL1): Hedgerows are located around the field boundaries (with a field boundary located through the centre of the proposed site) and access road of the proposed WWTP site. The hedgerow located through the centre of the site appears to be planted and is dominated by hawthorn *Crataegus monogyna*. However at the northern end of this hedgerow gorse *Ulex europeaus*, bramble *Rubus fruticosus* and cleaver *Galium aparine* become more common. The hedgerow located around the boundary of the site is dominated by gorse and hawthorn with abundant bramble and nettles. Hedgerows are located nearby the pipeline routes on the nearby agricultural land areas. These habitats are dominated by hawthorn and blackthorn with species such as bramble, elder, honeysuckle, dog rose and ivy *Hedera helix* also occurring frequently. Large deciduous trees also occur occasionally on the hedgerows situated within the proposed pipeline routes. These habitats are important aspect of the Irish landscape, as well as being of value as wildlife corridors. Hedgerow habitats are of **high local ecological importance**.

Mixed Broad leaved woodland (WD1): An area of mixed broad leaved woodland is present along the southern area of Cobh, a route taken by the proposed pipeline. This area of woodland which appears to be planted is dominated by sycamore *Acer pseudoplatanus*. Ash, sessile oak and beech *Fagus* sp. also occur occasionally. The shrub layer of the woodland contains many garden escapes. This is a fragmented area of woodland, possibly planted as part of a nearby demesne. It is dominated by the non-native sycamore in addition to a shrub layer that contains many non native garden escapes. However this area of woodland may act as a wildlife corridor for mammals and a nesting area for bird species. This habitat is of **high local ecological importance**.

Treelines (WL2): Treelines are located nearby the proposed Monkstown pumping station. Tree species present within this habitat include beech, ash, horse chestnut *Aesculus hippocastanum*, sycamore and poplar *Populus* spp. Treelines are located along many of the proposed pipeline routes, both beside roadways and around field boundaries. Many of these treelines were also planted as shelter belts near dwellings. Tree species present within this habitat include beech, ash and oak, while Scots pine *Pinus sylvestris*, horse chestnut, sycamore and poplar are also common. Treelines are usually planted for aesthetic or shelter purposes. They may be of some use to birdlife for feeding and nesting. Treelines are of **local ecological importance**.

Arable crops (BC1): Fields of wheat *Triticum* spp are located to the south of the WWTP site. Other areas located nearby the proposed pipeline routes contain arable crops such as barley *Hordeum vulgare*, oats *Avena sativa* and potatoes *Solanum tuberosum*. In general these habitats are highly modified and use of herbicides ensures that plant diversity is kept to a minimum. This habitat is of **local ecological importance**.

Tilled land (BC3): An area of tilled land is located to the south of the WWTP site. This habitat is of **local ecological importance**.

Stones walls (BL1): Stone walls are located on some road and field boundaries throughout pipeline routes. The stone walls in these are generally composed of shale and sandstone that typifies the geology of this area of Ireland. The common plant species include ivy, navelwort *Umbilicus rupestris*, hedge bindweed *Calystegia sepium*, bryophytes and ferns *Asplenium* spp, *Polypodium* spp. Stone wall habitats that are not bound with mortar often contain diverse macroinvertebrate communities. These in turn are utilised as a food source by many birds and small mammals. As a result these habitats are an important food source for terrestrial animals and are of **local ecological importance**.

Artificial surfaces (BL3): The existing pumping station at Church Rd, Carrigaline is located upon artificial surfaces. Three of the proposed pumping stations are situated on artificial surfaces (the fourth, West Beach, Cobh is situated on sheltered rocky shore (LR3)). This is a habitat of low ecological value which supports little or no plant species due to consistent anthropogenic activity. Artificial surfaces are located throughout the proposed development areas and include the roadways located along and the buildings located beside the proposed pipeline routes. Most of these roadways are not vegetated. The centre of the roadway leading to the WWTP site is vegetated by meadow grasses and plantains. These areas contain little or no plant species and are therefore of **low ecological importance**.

Grassy verges (GS2): Grassy verges are present beside most of the proposed pipelines located upon roadways. These habitats are dominated by grass species such as ribwort plantain *Plantago lanceolata*, cocksfoot *Dactylis glomerata*, bent grasses *Agrostis* spp, meadow grasses *Poa* spp and hairy brome *Bromopsis ramosa*. Herbaceous species such as vetch *Vicia* spp., cow parsley *Anthriscus sylvestris*, hogweed *Heracleum sphondylium*, nettles, thistles *Cirsium* spp., black knapweed *Centaurea nigra* and foxglove *Digitalis pupurea* are common along the roadside verges of the proposed pipeline routes. Wetter roadside areas contain abundant silverweed *Potentilla anserina*. Some shrubs and tree saplings also grow within this habitat and include ash, sycamore, hawthorn, blackthorn and gorse. These habitats are generally located beside areas of intense anthropogenic use i.e. roads. However they generally support a moderately diverse assemblage of grasses and herbs due to an absence of fertilisation and repeated mowing. Like hedgerows, grassy verges may act as a corridor for wildlife present in the nearby area. This habitat is of **local ecological importance.**

Ornamental/ non native shrub (WS3): This habitat is located within garden areas that will be impacted by the proposed development works, east of the Cobh to Cork roadway R624 and opposite the dockyard area. These habitats are present in garden areas of private dwellings. Plants include *Griselinia* spp., *Escalonia* spp, fuscia *Fuschia magellanica*, Portugese laurel *Prunus lusitanica* and Lawson's cypress *Chamaecyparis lawsoniana*. This habitat contains many non native species introduced into garden and park areas for aesthetic purposes. Therefore this habitat is of **local ecological importance**.

Spoil and bare ground (ED2): Areas of spoil are located nearby two of the proposed pipeline routes near the centre of Great Island. Spoil heaps have been created through the excavation of soil to possibly facilitate the laying of a pipeline. These habitats contained little plant diversity as they were recently excavated and colonisation of ruderal species has not yet occurred. This habitat contains no plant species and is considered to be of **low ecological importance**.

Rare flora: During the field survey, the habitats were also assessed as to their potential suitability for rare plants that are listed as occurring in the *New Atlas of British and Irish Flora* (Preston *et. al.*, 2002) in grid squares W 76, W 77 and W 86. However, none of these species were recorded during the current survey and habitats recorded are generally sub-optimal for the above species.

Marine Habitats

The marine habitats present in and adjacent to the study area are described below with an assessment of their ecological value. Areas of the following habitats which are present within a pNHA are evaluated as being of national importance due to their presence within pNHAs. Habitats which are present within an SPA are evaluated as being of international importance due to their presence within SPAs. At this stage of the process, the finalised design for the WWTP and collection system is not complete and therefore the design and exact location of e.g. emergency storm outfalls is not finalised. The existing environment is described below as per the indicative design, however, it should be noted that at the final design and construction stage, that any habitats impacted within pNHAs are ecologically evaluated as being of national importance and habitats within SPAs of international importance.

Estuaries (MW4) and Sea inlets and Bays (MW2): Cork Harbour and the River Lee channel at Passage West/Monkstown is a continuum between the above habitats. The Owenboy and Monkstown Creeks are estuaries. These habitats are located nearby the existing Church Rd. and the proposed Raffeen pumping stations. The salinity of these areas is variable due to riverine inputs and tidal currents. This habitat type corresponds loosely with the EU Annex I Habitats 'Estuaries (1130) and 'Large shallow inlets and bays' (1160) and so is of **international importance**.

Infralittoral gravels and sands (SS1): This habitat is present in Cork Harbour at Haulbowline and also along the existing IDA pipeline in a moderately exposed to sheltered environment. The faunal communities here are influenced by high levels of disturbance from wave action or tidal currents and include robust fauna such as bivalve molluscs, anemones and robust polychaete worms. This habitat has links to the Annex I habitat 'Sandbanks which are slightly covered by seawater all the time' (1110) and therefore is of **international importance**.

Infralittoral muds (SS3): This habitat occurs in the river channel at Monkstown/Passage-West and consists of sandy muds and soft muds, with conditions ranging from fully marine to estuarine. The only plant or animal life recovered from this area during grab sampling were ragworms (*Hediste diversicolor*). This habitat is of **high local importance.**

Sea walls, piers and jetties (CC1): Sea walls are situated along the R610, the road leading to Monkstown and Passage West, at Rushbrook and at Cobh. This roadway is on one of the proposed pipeline routes. This habitat generally contains few species. Polypody fern *Polypodium* spp, herb robert *Geranium robertanium* and the salt tolerant grass red fescue *Festuca rubra* were recorded in sections of this habitat. This is a highly modified habitat but is of **local importance**.

Shingle and gravel shores (LS1): This habitat is present at East Beach, Cobh. This is a moderately exposed shore with accumulations of mobile rocky material. Sediments here comprise mainly shingle, gravel and shells. Coarse mobile sediments typically support little marine life other than opportunist amphipod and isopod crustaceans and oligochete worms. This habitat is evaluated as being of **high local importance.**

Mud shore (LS4): Mud shore habitat occurs immediately south of the proposed Raffeen pumping station, at Carrigaline, at Crosshaven, to the east of the town centre on the southern shore, at Passage-West at both sides of the river and at Rushbrook and Whitepoint, both on Great Island. These mud shores are formed primarily of very fine sediment and are present along the most sheltered sections of coastline. They are subject to variable, reduced or low salinity. The mud shores were found to support communities of polychaete worms (e.g. estuary ragworm and *Nephytes spp.)*. One Oligochete worm was found at the uppermost site at Carrigaline. These worms are usually present where there is significant freshwater influence. This habitat is dominated by open areas of mud and is a feeding area for estuarine birds. This habitat occurs south of the Raffeen pumping. This habitat is evaluated as being of **national and international importance** at the area south of the **Raffeen** pumping station due to being within a pNHA and SPA. At all **other sites** mud shores are evaluated as being of **high local importance**.

Sand Shore (LS2): This habitat occurs at Ringaskiddy, on the east facing beach. This is a sheltered shore of medium and fine grained sand, with a small proportion of mud. Scattered stones or shells occur on the surface. Mobile sand of the upper shore is typically impoverished of animal and plant life with the lower shore characterised by amphipod and isopod crustaceans, with some polychaete worms and bivalve mussels. This habitat is of **high local importance**.

Mixed sediment shore (LS5): This habitat occurs at Crosshaven, east of the town centre on the southern shore. It also occurs within the Owenboy estuary, to the south of the Great Island, on the eastern shore of Ringaskiddy and on the margins of Lough Beg. This habitat is a sheltered shore with poorly sorted mixes of sediments of different grades. It supports some fucoids (*Fucus serratus),* Carragheen *(Chondrus crispus) and* sea lettuce *(Ulva lactuta*). The habitat did not hold an abundance of fauna with Gammaridae, shore crabs and flat periwinkles found. This habitat is dominated by open areas of mixed substrate. Areas of this habitat are present within a pNHA and SPA along the **Owenboy Estuary** and the habitat at this site is evaluated as being of **national and international importance**. **Other sites** with mixed sediment shores are of **high local importance**.

Moderately exposed rocky shore (LR2): This habitat occurs at the eastern end of Cobh and at the east facing beach at Ringaskiddy and consisted of moderately exposed shores of bedrock, boulders and stable cobbles. These shores were dominated by communities of barnacles (*Eliminus modestus)*, molluscs such as periwinkles (*Littorina* spp.), with bivalves also present. Common mussel (*Mytilus edulis*) beds occurred at Cobh. Fucoid cover was incomplete at these habitats. This habitat forms shelter for a variety of marine/estuarine organisms. This habitat is of **high local importance**.

Sheltered rocky shore (LR3): Sheltered rocky shore habitat occurs at Passage West, near the bottom of the slipway at the end of a public green and at Whitepoint (at the southern tip of Great Island) and at the proposed West Beach pumping station. These habitats include sheltered to extremely sheltered rocky shores of bedrock, and stable accumulations of boulders, cobbles and pebbles. Dense growths of fucoids occurred at these sites. The sheltered rocky shores surveyed were found to contain a diverse range of macro-fauna with barnacles (*Eliminus modestus*) and keel worms (*Pomatoceros lamarcki*) especially abundant. This habitat is of **high local ecological** importance.

Mixed substrata shore (LR4): Mixed substrata shore occurs near the proposed Carrigaloe pumping station, at Crosshaven, just east of the town centre on the southern shore, at Ringaskiddy, on the north facing beach opposite Whitepoint and at Monkstown/Passage West and Carrigaloe (both sides of the river near the proposed marine crossing). The shore comprises a mixture of rock and sediment; the sediments included gravel sand and mud. These shores occurred in moderately exposed to sheltered locations. Fucoid cover was incomplete at these habitats in Carrigaloe and Crosshaven. Macro-fauna at other locations included the common mussel, starfish, periwinkles and barnacles. Fucoid cover was incomplete at these habitats. This habitat is of **high local importance**.

Fauna-Birds

Estuarine birds: Cork Harbour is an area of international importance for wintering waterfowl (i.e. wildfowl and waders). A wetland qualifies for international importance if it regularly holds at least 20,000 waterfowl or at least 1% of the population of a species. Of particular note is that the site supports an internationally important population of Redshank and Black-tailed Godwit. A further 15 species present in the site have populations of national importance (Crowe, 2005). The importance of Cork Harbour for wintering waterfowl (i.e. wildfowl and waders) has been recognised through the designation of sections of Cork Harbour as a SPA for birds (site code 4030) under the *EU Birds Directive (79/409/EEC)*. Sections of the Harbour are also designated as SACs and pNHAs. The SPA site synopsis for Cork Harbour is provided in *Volume III, Appendix 2A* along with a description of estuarine species occurring in the area. The bird populations of Cork Harbour are of International importance and much of the Harbour is designated as a SPA.

Inland bird populations: During the walkover study a wide range of relatively common species were noted including skylark, starling, blackbird, dunnock, pied wagtail, jackdaw, rook, wren, robin, chaffinch, blue tit, song thrush, great tit, wood pigeon, collard dove, sparrow, stonechat, swallow, pheasant, kestrel, and song thrush. The bird populations of the proposed WWTP site and areas affected by pipelines are of local importance.

The New Atlas of Breeding Birds in Britain and Ireland: 1988-1991 by Gibbons *et al* (1993) was used to generate a list of inland bird species of conservation concern previously recorded breeding in the study area. A list of bird species of conservation concern and the likelihood of them breeding in the areas affected by the proposed development is provided in *Volume III, Appendix 2A*. According to Birdwatch Ireland Peregrine falcons nested at a quarry located approximately 600m northwest of the proposed WWTP site in 2002. This species is listed under Annex 1 of the *EU Birds Directive* and is a species of very high conservation importance. These birds have quite large territories and may use parts of the study area for foraging.

Fauna-Mammals

Badger *Meles meles* is common in this part of County Cork. One badger sett was recorded on the west side of the hedgerow located along the eastern boundary of the proposed WWTP site (at IG W75265 63901). This sett was located away from the footprint of the proposed WWTP but within the same field. It is located within 30m of the proposed development. This sett had three entrances and was considered to be active at the time of the survey. Badger hair was found on a barbed wire fence nearby. No other setts were recorded during the survey along the pipeline routes; although it must be noted that not all areas could be viewed in detail due to land access restrictions. The badger is protected in Ireland under the *Wildlife Act* (1976) and *Wildlife (Amendment) Act* (2000) (hereafter called the *Wildlife Acts* (1976 and 2000)).

Otter *Lutra lutra* is listed in Annex II of the *EU Habitats Directive* (*Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora* and amendments) and is protected under the Irish *Wildlife Acts* (1976 and 2000). No otters holts or evidence of otters was found in the immediate vicinity of the proposed/existing outfall sites or foreshore pipeline routes. However, otters are present in the area and are known to forage along the affected areas of shoreline. Persistent wet weather during the current foreshore survey may have made signs of otters (i.e. spraints, footprints) difficult to detect.

All Irish Bats are protected by the *Bonn Convention* (1992) (Agreement on the Conservation of Bats), the *Bern Convention* (1982) and the *Wildlife Acts* (1976 and 2000). Bats are present in the area, however no roosts were identified. Due to the presence of bats in the area, hedgerows and treelines in the study area are likely to be used by bats for foraging and commuting.

Other protected species likely to be present in the study area are hedgehog *Erinaceus europaeus,* pygmy shrew *Sorex minutus*, and Irish hare *Lepus timidus hibernicus*. These species are protected under the *Wildlife Acts* (1976 and 2000). No direct observations or evidence was observed, however suitable habitat for these species is present within the study area.

Cork Harbour is known to contain both resident and vagrant populations of common dolphins *Delphinus delphis*. The Annex II listed Harbour porpoise *Phocoena phocoena* and bottlenose dolphin *Tursiops truncatus* have also been recorded in Cork Harbour as well as common, striped and Risso's dolphin and killer whales (IWDG, pers. comm.). Seals have been observed in Cork Harbour (Ecofact, unpublished) and reference has been made to the presence of both Harbour and grey seals occurring here in the scientific literature (e.g. Smiddy, 1998). *Volume III, Appendix 2A* lists details of protected mammals which occur within the 10km grids of the study area.

Fauna-Reptiles and Terrestrial Invertebrates

Two reptile species occur in Ireland; the viviparous lizard *Lacerta vivipara* and the slow worm *Anguis fragilis*. The viviparous lizard occurs in County Cork, however, no direct observations were made but suitable habitat occurs in the study area and this species may be present. Terrestrial invertebrates in general are an understudied group. However, it is likely that the invertebrate populations present within the proposed development area are typical of Irish farmland and urban areas. It is unlikely that any rare species occur due to the generally highly modified nature of the habitats present.

Fauna-Crustaceans

Crustaceans: Arthropods are the most numerous animal group. Arthropods have an external skeleton and paired, jointed limbs. Phylum Arthropoda includes crustaceans, insects and spiders. Crustaceans include crabs, lobsters, shrimp, krill and barnacles (Hayward and Ryland, 2005). From the sampling of 23 sites along the intertidal part of the shore in Cork Harbour, a total of 7 species of crustacean were recorded. Only 2 species were recorded from core sampling; the mud shrimp *Corophium volutator* was found at the upper site on the Owenboy Estuary (C1) at Carrigaline and also at Cobh (C8) while the green shore crab *Carcinus maenas* was found at the lower site on the Owenboy Estuary (C3). The small numbers of crustaceans recorded by core sampling was expected due to the nature of this sampling technique i.e. sampling to depths on mudflats where crustaceans cannot live.

In the quadrat sampling, crustaceans were recorded at all sites with the exception of the barren site (Q13) at Cobh. Where there was suitable habitat such as rocks and boulders, barnacles were present in their hundreds. *Elminius modestus* was well distributed (found at 9 sites) and was the dominant sedentary crustacean species. *Semibalanus balanoides* was found at two sites on the western channel; Q4 at Ringaskiddy and Q6 at Monkstown. Also recorded at sites adjacent to these was *Balanus crenatus*, as well as at Site Q11 on Great Island south of the ferry crossing. The habitats where barnacles were recorded were 'Moderately exposed rocky shore' (LR2) and 'Mixed substrata shore' (LR4). The ubiquitous green shore crab was generally common throughout the intertidal area and the highest densities were recorded at Sites 7 (38/m^2) and 9 (28/m^2) on the Monkstown/Passage West side of the channel, and at Sites 14 (24/m^2) and 15 (28/m^2) at the eastern end of Cobh town on Great Island. The preferred habitat for the crab was 'Mixed substrata shore' (LR4), 'Sheltered rocky shore (LR3)' and 'Moderately exposed rocky shore' (LR2). Through macroalgae, stones and other invertebrates, these habitats offer refuge and feeding opportunities to these scavengers.

The freshwater shrimp *Gammarus deubeni* was recorded at 4 sites and was most common at Site 14 in Cobh. It was sparsely distributed around other parts of the Harbour, occurring at Passage West and Ringaskiddy. Fair numbers of mud shrimp were recorded at the eastern side of the channel at Site Q11. Another gammarid, *Chaetogammarus marinus* was present on 'Mixed Sediment shore' at Crosshaven. This species was only found at this site.

Crustacean food supply is probably the most important factor in determining the distribution of fish. Some fish, such as flounder fish feed on benthic infauna. For example, the flounder consumes *Corophium*, snails such as *Hydrobia* and some bivalve species and is generally found where these dominate the benthos. Bass specializes on the shrimp *Crangon* and mysids while whiting feeds on *Crangon,* mysids, amphipods and cumaceans (Henderson *et al*, 1992). In winter, most crustaceans migrate out to deeper water; so generally, numbers are higher in estuaries in summer.

Fish and Fisheries

The majority of fish found in estuaries feed primarily on the benthos (organisms living on or at the bottom of a body of water). Estuarine opportunist species typically enter estuaries from the sea for a period each year, but do not stay there permanently. The majority drift into estuaries as larvae from eggs spawned in coastal waters and as young fish they take advantage of the rich benthic food sources of the Harbour. The Harbour is therefore deemed important as a nursery ground for juvenile fish before they return to the sea as recruits to their adult population. Adult mullet were seen grazing on algal films from the soft substrata at the Owenboy estuary and also on the River Lee western passage near Cobh during the current survey.

A marine fisheries survey of Cork Harbour was undertaken by the Central Fisheries Board during 2001 (King, 2002). A total of 33 sites were examined over a five-day period. No specimens of the Annex II listed juvenile twaite shad (*Allosa fallax)* or lamprey species were recorded during the assessment. The most commonly encountered groups were juvenile sprat/herring, flounder, gobies, mullet, sand smelt and the 15-spined stickleback. The highest species diversity was found in the Lower Harbour area. A total of 13 species were taken at the north most point of Ringaskiddy, directly south of Haulbowline. As well as the commonly recorded species, this site yielded two species of pipefish, two wrasse species, blenny, bullhead and butterfish. Species diversity was also higher at the stations at Rushbrook, Cuskinny Beach and the slipway at Crosshaven.

Cork Harbour is also used by a number of anadromous and catadromous fish species migrating to and from rivers which flow into the Harbour. Species important in this respect are Atlantic salmon, river lamprey and sea lamprey (anadromous) and the European eel (catadromous). The main river of fisheries importance flowing into Cork Harbour is the River Lee which is known to contain all of these species (O'Halloran *et al,* 1998). Table 3.2.4 list the fish species expected to occur in areas which may be affected by the proposed development.

Table 3.2.4: Fish species expected in areas affected by the proposed development.

Location	Fish species expected to be present
Crosshaven.	Flounder, mullet, electric ray, eel, common goby, plaice, Pollack, mackerel, garfish, wrasse, bull huss, bass, salmon, sea trout, sea lamprey, river lamprey.
River Lee West Channel (Ringaskiddy, Monkstown, Cobh)	Pipefish, wrasse species, blenny, bullhead and butterfish, sprat/herring, flounder, common goby, sand goby, mullet, sand smelt, 15-spined stickleback, scad, pipefish, bull huss, coalfish, bass, mackerel, turbot, electric ray blonde ray, homelyn ray, thornback ray, grey mullet, conger, plaice, dab, rockling, whiting codling, dogfish, eel, sea lamprey, river lamprey, salmon, sea trout.
Owenboy River Estuary	Mullet, flounder, salmon, sea trout, eel, stickleback, sea lamprey, river lamprey

Adapted from Dunlop and Green (1992) on SWRFB website www.swrfb.com

Shellfish

Cork Harbour is a shellfish production area (Code CK-CH). This area lies north of a point from Roberts Head (coordinates -8.30375 51.74379) to Roches Point (coordinates -8.25113 51.79285) up to and including the mean high water mark. In Ireland the main bivalve species are mussels, native and pacific oysters, razorfish, scallops, clams and cockles. Shellfish areas are classified by the microbiological quality of the water. Areas are assigned a classification of A, B or C by the DAFF based on microbiological monitoring. Table 3.2.5 *Designated Bivalve Mollusc Production Areas in Ireland (October, 2005)* lists the shellfish production areas in Cork Harbour based on information contained on the FSAI (Food Safety Authority of Ireland) website.

Table 3.2.5: Designated Bivalve Mollusc Production Areas in Ireland, (October 2005)

I	II	III	IV	V	VI
Production Area	**Boundaries**	**Bed Name**	**Species**	**Previous Classification**	**Current Classification**
Cork Harbour	Between 8°16.4' W and 8° 15.6' W.	North Channel West	Oysters	B	B
Cork Harbour	Between 8°14.6'W and 8°13.2'W.	North Channel East	Oysters	B	B
Cork Harbour	Aghada Pier to Gold Point	Rostellan	Oysters	B	B

Figure 3.2.5 *Sites with oyster aquaculture licences and oyster order sites in Cork Harbour* illustrates the location of shellfish production areas.

Water quality

The EPA undertakes an annual survey of the water quality of estuaries and near shore coastal waters. In the latest *Water Quality in Ireland 2005* report, which covers the period 2001-2005, a total of 10 estuaries or less than 15% of those waters surveyed were classified as eutrophic. The most recent information available rates the estuarine and coastal water quality for Cork Harbour in the period 2001-2005 as being 'Intermediate' (EPA's *Estuarine and Coastal Water Quality 2001-2005 Map).*

The Intermediate status of water quality in Cork Harbour is reflected by growths of *Enteromorpha* and *Ulva*. These arise from high concentrations of nutrients such as nitrates and phosphates. Currently, there are active raw sewage outfalls at Carrigaline/Crosshaven, Passage West, Glenbrook, Monkstown, Ringaskiddy village and Cobh. A hydrodynamic model and EIA conducted by O' Kane and Barry (2007) found that for the year 2010, the untreated discharge from the Cork Lower Harbour area will contributing a concentration of 1500fc/ml to parts of Passage West, Cobh, and Ringaskiddy shores.

3.2.4 Impact Assessment

(i) Construction Phase Impacts

WWTP Site

Flora and Habitats

Improved agricultural grassland habitats will be permanently lost at the site of the proposed WWTP. This habitat is of low conservation importance and the loss of this habitat is not of ecological significance. Site development and boundary treatments will result in the permanent loss of hedgerows within and on the margins of the site. Loss of all of these hedgerows would be of imperceptible negative impact in a local context.

Fauna-Terrestrial

The machinery and noise associated with construction could have a short-term negative impact upon terrestrial mammals such as badgers. Disturbance to the sett (located within 30m of the WWTP site) during construction would be a short-term significant negative impact for the badger social group involved. However, with appropriate mitigation measures this sett could be fully protected during the construction phase of the proposed development.

No known bat roosts will be affected by the proposed development. However, some trees along the pipeline route may be used to some degree by bats. With the mitigation measures proposed (i.e. checking any trees to be felled for bats) no direct negative impact on bats would occur, although there will be a negative impact on bats due to loss of habitat.

According to Birdwatch Ireland Peregrine falcons nested at a quarry located approximately 600m northwest of the proposed WWTP site in 2002. However, no potential nest sites or important areas for this species would be in any way affected by any aspect of the proposed development.

Collection System

Flora and Habitats

Hedgerow habitats (refer to Figure 3.2.3 *Habitat Map of WWTP Site*) and stonewall habitats will be temporarily disturbed during the construction phase of the development at locations where the pipeline passes and/or runs along field boundaries. Sections of hedgerow habitats may be permanently disturbed during the widening of the access road into the site. Where possible, stone walls will be re-instated following the installation of the sewer network and hedgerows re-planted. Impacts on these habitats would be considered as minor negative impacts. Disturbance of hedgerows, particularly with mature trees, would be of slight to moderate negative significance, where such disturbance results in either direct habitat loss through hedgerow removal, or indirect effects such as dieback through severance or restriction of tree roots.

The route of the proposed pipeline network is mainly restricted to the existing road infrastructure. The impacts associated with the laying of the sewer network in these locations will be negligible. This habitat type is of no ecological interest. Therefore, the general potential impact on flora is rated as imperceptible negative. However, the installation of pipelines along the existing road network could also have impacts on the adjacent habitats that fauna use due to contaminated runoff and potential damage e.g. to the roots of hedgerows and tree lines. Birds nesting in hedgerows could be disturbed and their young left abandoned. However, with the mitigation measures proposed this should not occur.

The disturbance of improved agricultural grassland, arable and horticultural land, artificial surfaces and drainage ditches along the pipeline network is of imperceptible negative impact, as these are all modified habitat types. Discharge into a designated area via drainage ditches could potentially occur on the pipeline route located in agricultural land to the south of the Owenboy Estuary pNHA.

Fauna-Marine animals

A pipeline is proposed to run along a section of the foreshore at the Owenboy River (within the Owenboy River pNHA and Cork Harbour SPA). Excavation of the foreshore will result in the disruption of macrofaunal communities in this area. However the extent of the area is relatively limited and disturbance to the foreshore area will be reduced as far as possible. Works associated with the installation of this section of pipeline could result in significant habitat loss and increase the risk for suspended solids laden runoff. This would result in a substantial negative impact.

It is predicted that there will be a short term increase in the turbidity of the water column as increased suspended solids enter the water column. However, the pipeline in the Owenboy River will be placed along the upper shore, thereby reducing the level of suspended solids (due to decreased flushing from high tides). An increase in turbidity could result in increased siltation, smothering of organisms and a reduction of light for phytoplankton over the construction period. High levels of suspended solids settling on the estuary bed could potentially alter habitats resulting in a potential loss of feeding and spawning grounds. Mobile species may move away from unfavourable conditions, however sessile, benthic fauna may be smothered and lost. However, estuarine habitats have very high natural levels of suspended solids so this impact is likely to be negligible with suitable mitigation. Moreover, the benthic faunal community in affected areas such as the Owenboy River is considered to be a very tolerant one.

Other types of animals may also be affected by increased suspended-sediment concentrations. An increased flux of sediment settling on the bed is likely to affect animals that feed on deposited sediment. Lower water clarity may affect the quantity, type and depth to which bottom-living microscopic algae and seaweeds can grow, thus affecting feeding and distributions of grazers such as limpets. Lower water clarity may also affect feeding abilities of visual fish feeders such as mullet. However, it must be noted that no macroinvertebrate grazers were recorded in the Owenboy River in the current survey and the community identified would be very tolerant to increased suspended solids levels. Mullet were recorded in the Owenboy River at Carrigaline and probably occur throughout the estuary, but their ability to relocate with ease would decrease the chances of a decline in their status. Any suspended solids released during the construction phase of the current project would also be short-term in nature and this would also reduce the potential for significant effects.

The machinery and noise associated with construction could have a short-term negative impact upon mammals such as otters and perhaps seals using the shoreline. Construction activity will be responsible for an increase in the noise levels in the water near all areas under construction.

Marine Crossing

Fauna-Marine Animals

The single largest marine construction is the installation of the marine crossing across the River Lee west passage. It is envisaged that the marine crossing will be tunnelled or laid by open cut techniques. The open cut technique is considered to have more potential environmental impacts associated with it and so impacts associated with the open cut technique are considered in this section. With the open cut technique, the pipelines will be laid below the river bed and backfilled to the original river bed profile. It is likely that the pipes will be encased in concrete for protection in shallower sections. Temporary anchors may be installed in the river bed in order to place the pipeline correctly. The disturbed area would be protected so as to reduce potential bed erosion by tidal movements during construction.

It is not envisaged at this stage that the construction of the marine crossing will involve particularly invasive underwater construction works such as blasting and so significant impacts on dolphins, porpoises and other marine mammals are not expected. This area is already continually disturbed as a result of the existing ferry moving back and forward at this location.

Localised sediment plumes may present a small level of habitat disturbance to seals foraging in the River Lee west channel while installing the marine pipeline but is not considered to be significant as areas nearby will remain unaffected. It is most likely that any effects of the proposed excavation work at the marine crossing on seals will have a temporary minor negative impact on seals and other marine mammals. As such, these communities would be acclimatised to episodic increases in turbidity levels associated with living in estuarine conditions.

Limpets, a keystone species are not present at the proposed crossing and populations to the south are not expected to be affected. The activities associated with the open cut technique would result in the disruption and removal of parts of the mussel beds and starfish colony in the vicinity, which would be a moderate negative impact for these species. However, the impacts on mussels, starfish and other fauna would be more than compensated for by the cleaner conditions brought about by the proposed development.

Benthic excavation activity can result in damage to the biological environment but a relatively small area of the River Lee west channel would be disturbed. The disturbed area would be protected so as to reduce potential bed erosion by tidal movements during construction. Since the substrate will not undergo any major changes, no change in the redox potential discontinuity (RPD) depth, and therefore no consequences for the infauna outside the construction area are envisaged. In addition, the dominant infauna of the mudflats (ragworms) are versatile creatures and could cope with minor environmental changes. With the placement of anchoring devices, flows could be impeded and oxygen availability to fauna nearby reduced but considering the relative size of the proposed devices and flow rates in the channel this is not expected to be a significant impact. It can be concluded that due to the adaptability of the organisms present in this area and the flow regimes in the channel, at most minor negative impacts are envisaged from this part of the scheme.

Should the tunnelling option be used rather than the open cut technique for the marine crossing, the impacts on the marine ecology will be significantly reduced as there will be no interface between the tunnelling environment and the marine environment other than minimal vibrations. These would not be considered to have a significant impact on the marine ecology.

Fauna-Birds

Impacts on the foreshore of the Owenboy River could reduce the foraging areas for wintering birds and have an impact on the local macrofaunal community in this area. Construction works near the shore area could deter birds from using the affected areas due to physical intrusion and indirect effects such as noise. However these impacts can generally be avoided with careful site management and appropriate timing of the proposed works (these points are described in Section 3.5.2 *Mitigation Measures*). The pipeline in the Owenboy River will run along the upper shoreline near the existing road and this area is already disturbed and would not be used extensively by birds. With the mitigation measures proposed the lower shore should not be directly or permanently affected.

One of the pipelines associated with the scheme will also run along the road bordering the Monkstown Creek pNHA (included in Cork Harbour SPA). Noise, disturbance and runoff from these areas could also have significant impacts in the absence of mitigation. However again, the road corridor is already disturbed and all the significant potential impacts can be mitigated.

Water Quality

The road network where the proposed pipelines will be installed is mainly older road, which does not have the pollution control of the modern highway systems currently being built in Ireland under the strict NRA environmental guidelines (NRA, 2005) e.g. interception of run-off prior to entering the sewer system. Water and other substances which find their way onto these roads would run untreated into the nearest drain/stream or river. Machinery working on the road during the excavation, laying, backfilling and installation of the pipeline has the potential to produce pollutants both directly (i.e. leaking fuels, oils etc.) and indirectly as a result of the construction work (i.e. suspended solids, leached pollutants etc.).

During the construction phase, pollutants and chemicals used could contaminate the area. Potential contamination of sediments and marine flora/fauna from the accidental release of organic polymers or heavy metals associated with cementing and/or grouting materials from the foundations may occur. These materials are toxic to marine organisms in sufficient quantities and in the event of an accidental release; it could potentially contaminate the estuarine sediments adjacent to the development, inhibiting recolonisation of the area after construction. However, with the mitigation measures proposed potential impacts would be reduced to imperceptible.

The following sources of pollution are included on the Scottish Environmental Protection Agency (SEPA, 1996) list of the main sources of pollution from construction sites:

- The discharge or entry into waters of contaminated site run-off or pumped contaminated surface/ground waters
- Loss of oil from machinery or storage areas
- Cement and cement wash from batching plants, storage areas and other areas where cement grout or concrete is being applied
- Silty water arising from exposed ground, stockpiles of soil, plant and wheel washing, and site roads

In the absence of suitable mitigation, all the above impacts could occur during the construction of the proposed scheme.

(ii) Operational Phase Impacts

WWTP

Fauna-Mammals

There is a possibility that the long-term operation of the WWTP could cause further disturbance to local mammal communities such as badgers due to an increase in human activity. However, disturbance is anticipated to be minimal and mammal species using the areas around the WWTP can be expected to continue to do so during the operational phase. Any significant maintenance works on the scheme (including pipeline network) will be preceded by further consultation with NPWS, where impacts on habitats or species subject to legal protection are predicted to occur.

Fauna-Invertebrates

Current nutrient inputs by foul water outfalls into the affected aquatic areas would be significantly reduced during the operation of the proposed scheme. Such inputs result in increased primary production and turbidity, indirectly suppressing filter feeder activity. Phytoplankton blooms are expected to be less frequent with the expected reduction in nutrient loading due to the proposed development and restrictions on the edibility of shellfish would ease considerably due to the reduction in associated biotoxins. Water quality around the shorelines within the Harbour and along the Owenboy Estuary is expected to improve, encouraging an increase in diversity of infauna (polychaete worms, bivalves, etc.) and epifauna (crabs, crustaceans, snails, etc.). A reason for this increase in diversity is that algal mats would be less frequent and associated anoxic conditions would be deeper than is currently the case. This would influence the macroinvertebrate population by allowing animals to penetrate deeper into sediments – increasing the available habitats three dimensionally. This would also allow for greater biomass and diversity and would be expected to offset any loss of diversity as a result of reduced nutrient inputs. For example, a reduction in ragworm densities would not be a negative impact for feeding birds on mudflats because ragworms would be replaced by other species such as lugworms and catworms.

Water Quality

An accidental release of untreated effluent may affect water quality in the receiving water to which the outfall is discharging. This may result in temporary but significant eutrophication of the water and harmful algal blooms may occur. These harmful algal blooms can cause fish kills, contaminate seafood with toxins, pose a direct risk to human health, or otherwise alter ecosystems in ways that are perceived as harmful. The magnitude of the effect would depend on a variety of factors including the components of such a discharge, the dispersion of these components (related to currents) and the length of time between the operation of the proposed development and a pollution episode (diversity of the aquatic community would be expected to increase with time following operation of the proposed development). However, the risk of such a large scale eutrophication event occurring is extremely low in a modern well managed plant as is proposed. The proposed WWTP will require a discharge licence from the EPA, under the *Waste Water Discharge (Authorisation) Regulations 2007*, which will ensure the protection of human, animal and plant life. In addition, the large size of Cork Harbour along with tidal currents would mean that the receiving waters would have a high resilience to such unlikely events.

The potential impact on the receiving waters from emergency overflows from the Carrigaloe, Monkstown and Raffeen pumping stations is likely to be more negative than the current situation. Overflow discharges at these pumping stations will include the waste water from Cobh, and from Passage West in the case of the pumping stations at Monkstown and Raffeen. However, the normal operating quality of the proposed discharge into Cork Harbour will be much improved from the existing discharges it would replace. This would result in a long-term moderate beneficial impact for Cork Harbour and its associated flora and fauna communities. The reduction in nutrient inputs into the Harbour during the operational phase of the scheme would lead to a decrease in algal mats and *Enteromorpha* plants which thrive on high nutrient loading. This would be a moderate positive impact.

The ecosystem around the outfall would continue to change until a sustainable balance is eventually reached where organisms suited to the new environmental conditions would thrive. The maintenance of this balance would be dependent on a generally unchanging environment such as the one that the proposed discharge would provide. The diversity of organisms would be expected to increase with distance from the proposed outfall.

The value of Cork Harbour as nursery for young fish would increase with improved water quality and the consequences of this would extend beyond the mouth of the Harbour, with increased recruitment to the open sea. Adult mullet would not be as concentrated around previously present outfalls. However, this is considered to be a neutral impact. The reduction of nutrients into the affected aquatic areas would improve water quality, habitats and diversity, and consequently add to the conservation status of Cork Harbour SPA, Owenboy River pNHA and Monkstown Creek pNHA.

Hydrodynamic modelling conducted as part of the engineering design for the proposed development predicted that the concentration of faecal coliforms in effluent from the Lower Harbour catchment area will be significantly reduced (80 to 95% reduction on the current scenario). In addition the hydrodynamic modelling identified that the concentration of *Norovirus* in the Harbour and outside Roche's point (from the Lower Harbour catchment area) would be reduced by 90-95% compared to the existing scenario. Additionally, the study showed that the proposed scheme may reduce considerably the forcing on primary production in Lough Mahon and in the North Channel behind Great Island as a result of decreased levels of organic nitrogen, nitrate and ammonia. The study also predicted a relative decrease in primary production in the outer Harbour, with the possible exception of the immediate vicinity of the diffuser, to be located inside the mouth of the Harbour. This improvement in water quality will have a long-term moderate and positive impact on marine flora and fauna in Cork Lower Harbour.

Collection System

Flora and Habitats

The scheme has been designed to ensure that minimum maintenance of the collection system will be required. Any such maintenance works would be preceded by further consultation with NPWS where impacts on habitats or species subject to legal protection are predicted to occur.

(iii) 'Do Nothing' Impact

The 'do nothing' impact would result in continued discharging of untreated effluent into Cork Lower Harbour. The provision of a modern WWTP in this region is expected to result in moderate significant benefits for water quality in Cork Lower Harbour compared with the "do nothing scenario".

(iv) 'Worst Case Scenario' Impact

In the worst-case scenario (i.e. a failure of the mitigation measures proposed) habitat loss, pollution and disturbance of avifauna in pNHA/SPA areas could occur. However, such worst-case scenario impacts are considered unlikely and would at worst affect only a small area of these sites. During the operational phase a worst case impact would be an accidental release of untreated effluent from the WWTP or the emergency discharge of storm water at the pumping stations. This would 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. The large size of Cork Harbour along with tidal currents would mean that the receiving waters would have a high resilience to such unlikely events. It should be noted that the risk of such an event happening with the proposed WWTP scheme would be much lower than is currently the case. Indeed, at present untreated raw sewage is being released into the Harbour.

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.

LEGEND:

PROPOSED GRAVITY SEWER

PROPOSED RISING MAIN

EXISTING I.D.A. GRAVITY SEWER

MINOR PUMP STATION

MAJOR PUMP STATION

NHAs / SPA

PROPOSED CARRIGALOE PUMPING STATION

Cuskinny Marsh

PROPOSED MONKSTOWN PUMPING STATION

PROPOSED WEST BEACH PUMPING STATION

PROPOSED RAFFEEN PUMPING STATION

Monkstoen Creek

FLOW FROM COBH & PASSAGE WEST/ MONKSTOWN

FLOW FROM RINGASKIDDY

PROPOSED WASTEWATER TREATMENT PLANT SITE

EXISTING OUTFALL PIPELINE

OUTFALL PIPE TO OUTFALL POINT

EXISTING CHURCH ROAD PUMPING STATION

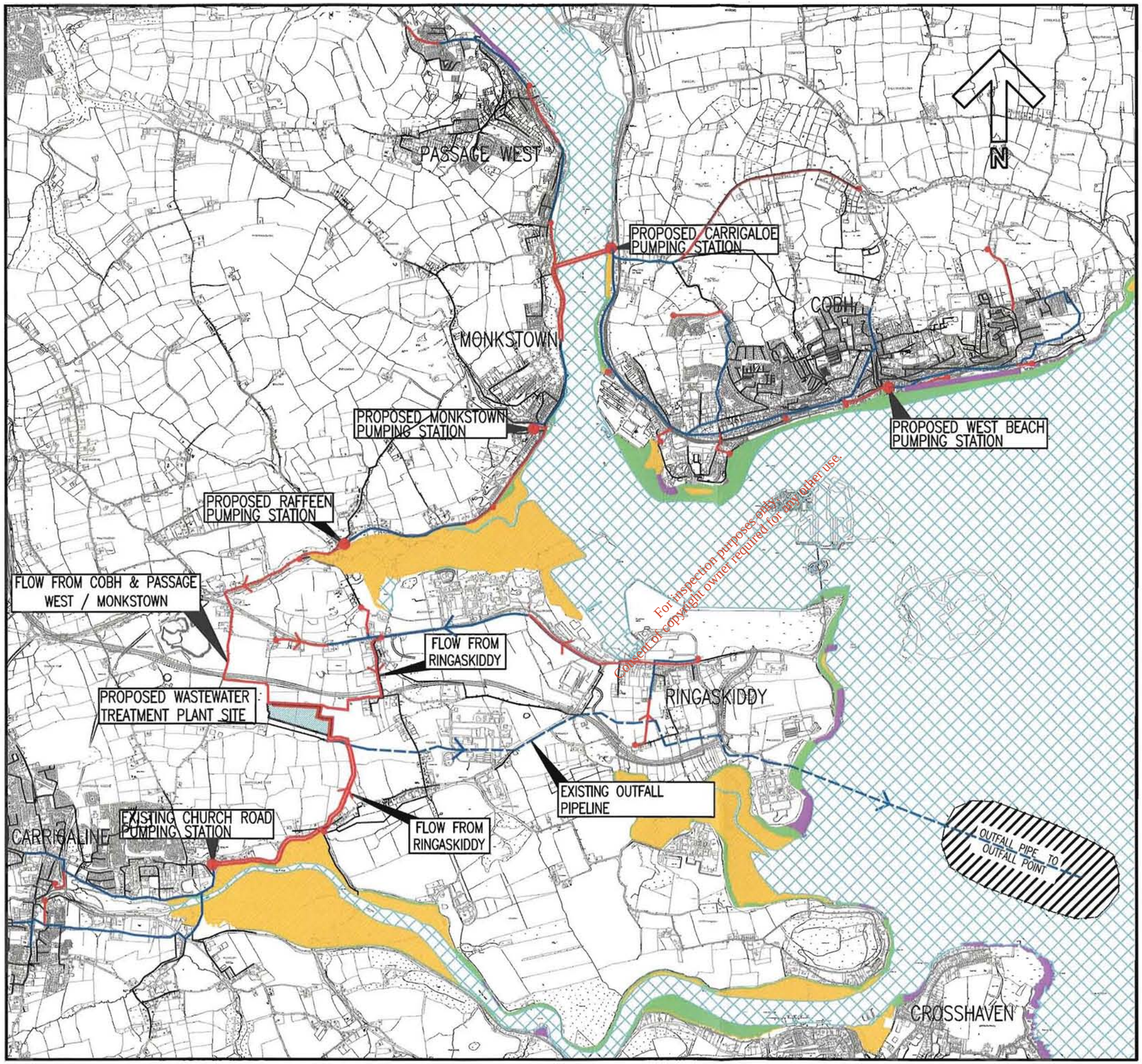
FLOW FROM CARRIGALINE

Owenboy R.

Mott MacDonald

FIGURE 3.2.1 CONSERVATION DESIGNATED SITES IN THE STUDY AREA

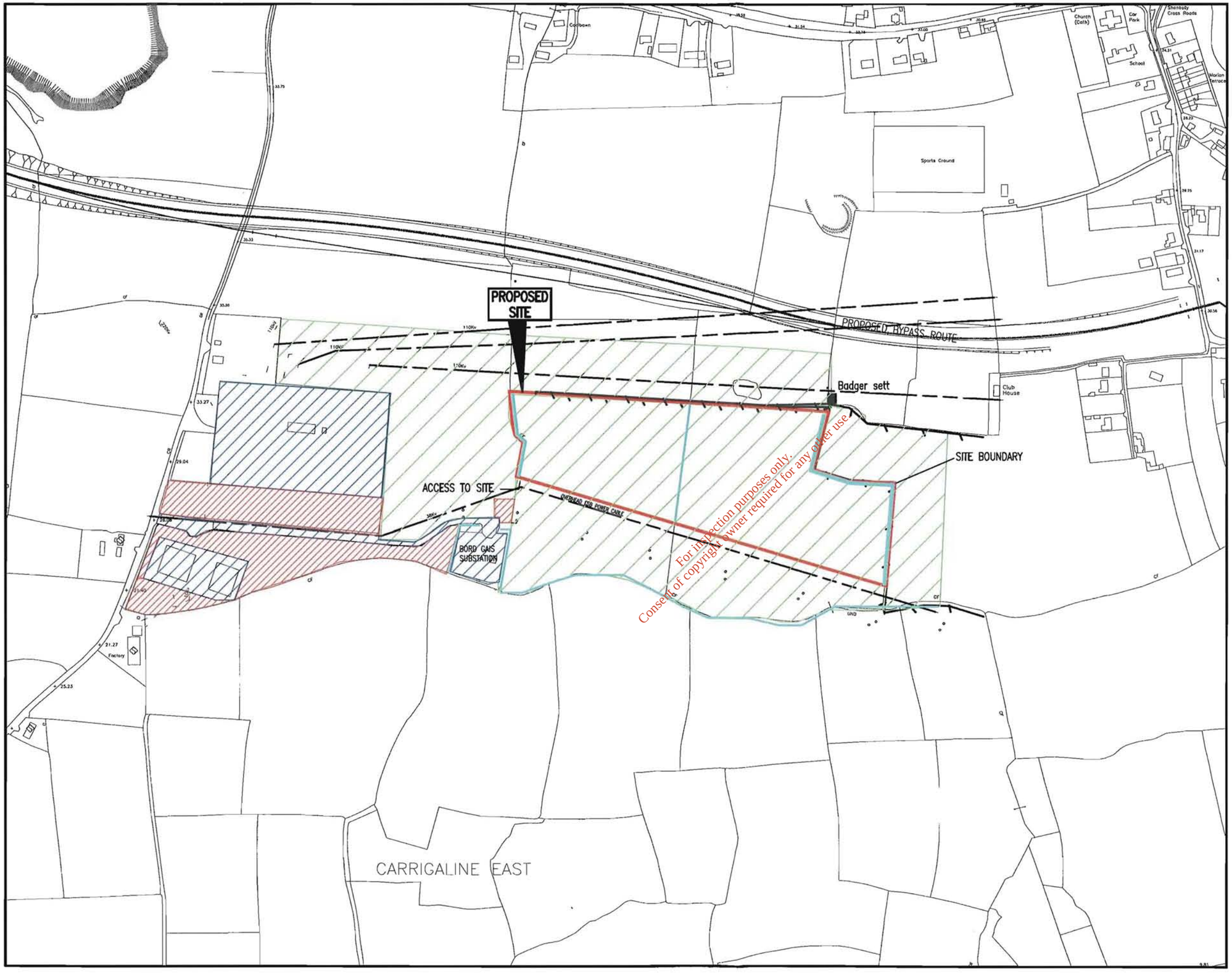
CORK HARBOUR MAIN DRAINAGE SCHEME
JOB NR. 234541
DRG NR. 5670FG125



Mott MacDonald

FIGURE 3.2.2 – HABITAT MAP OF SELECTED MARINE HABITATS

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



Mott MacDonald

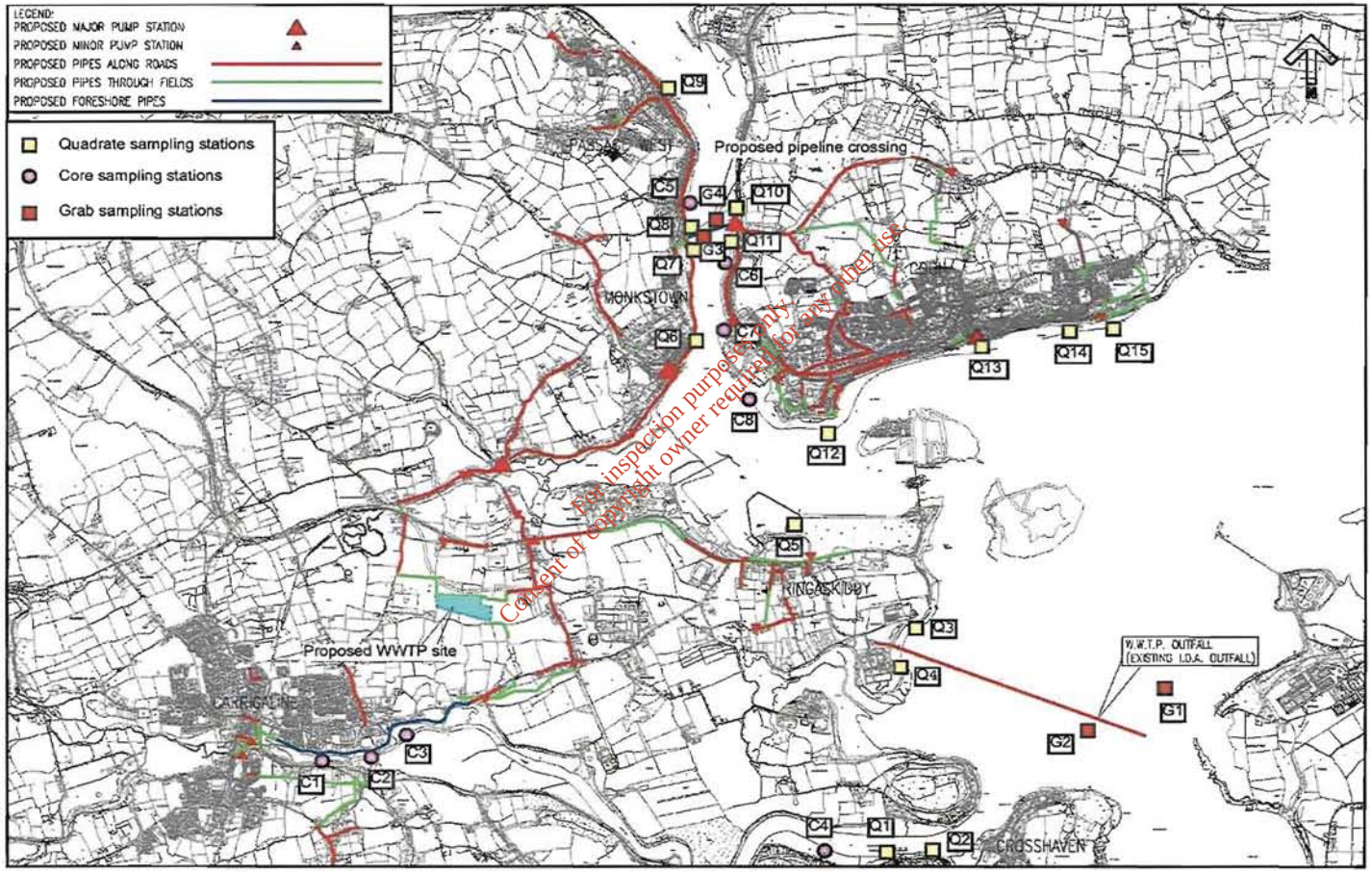
FIGURE 3.2.3 HABITAT MAP OF WWTP SITE

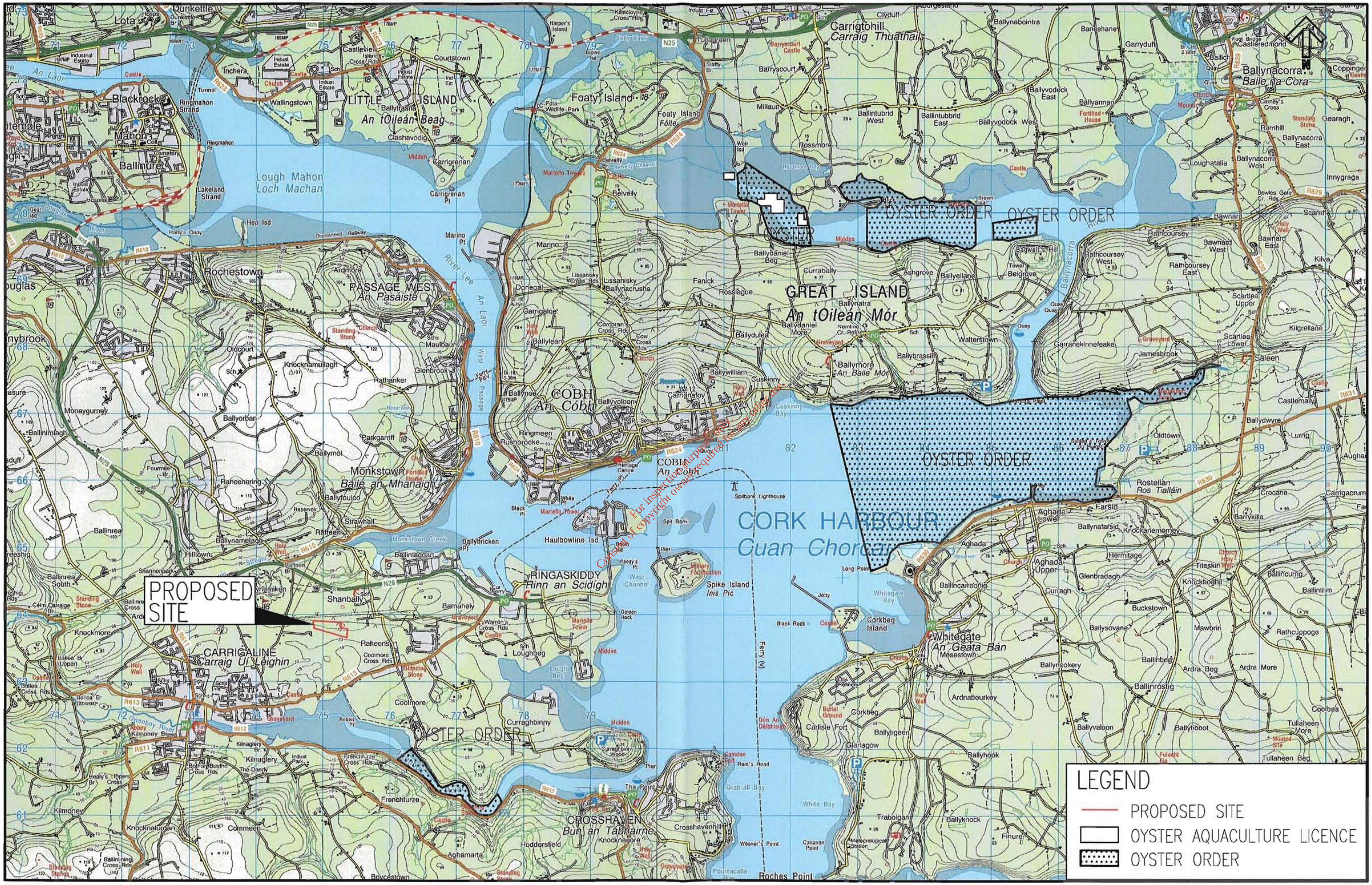
SCALE 1:5,000

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

Mott MacDonald

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.

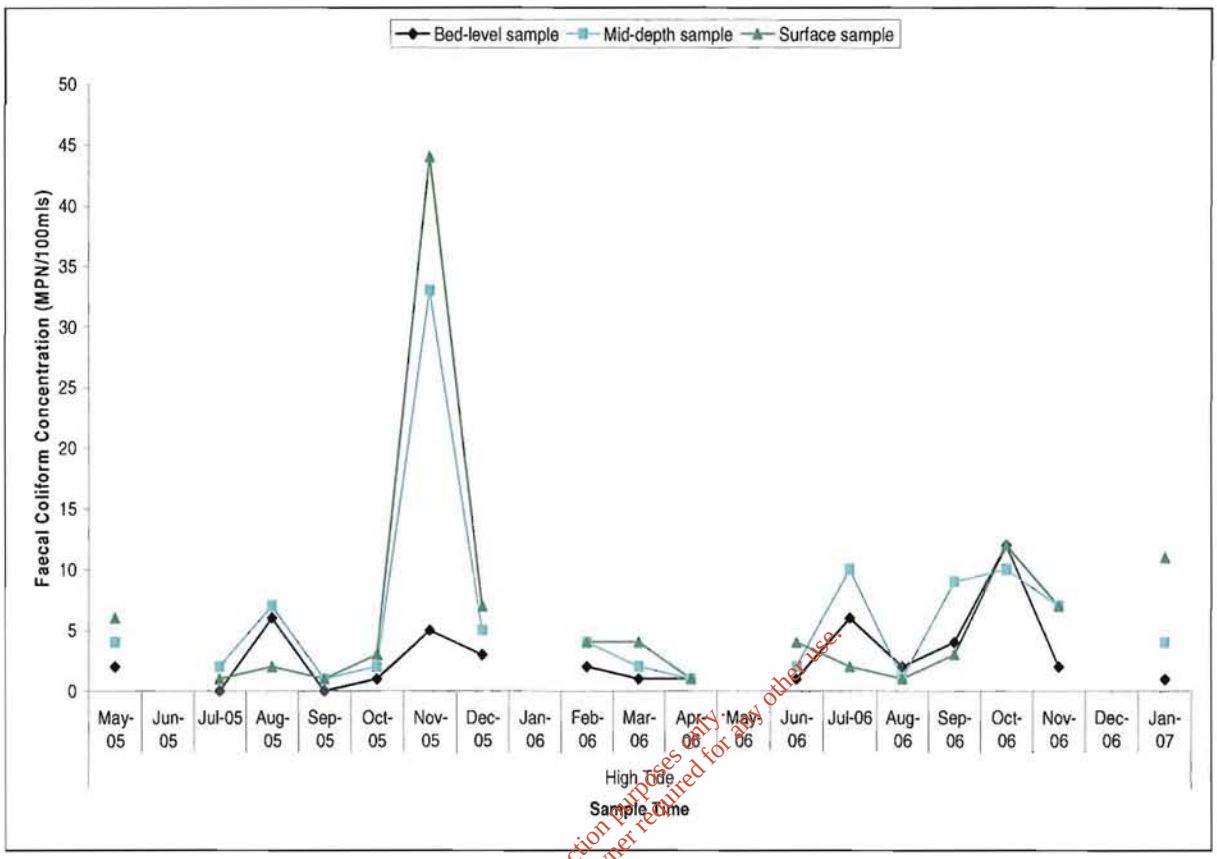


Figure 3.3.1: Faecal coliform concentrations in Cork Lower Harbour at High Tide (May 2005-January 2007).

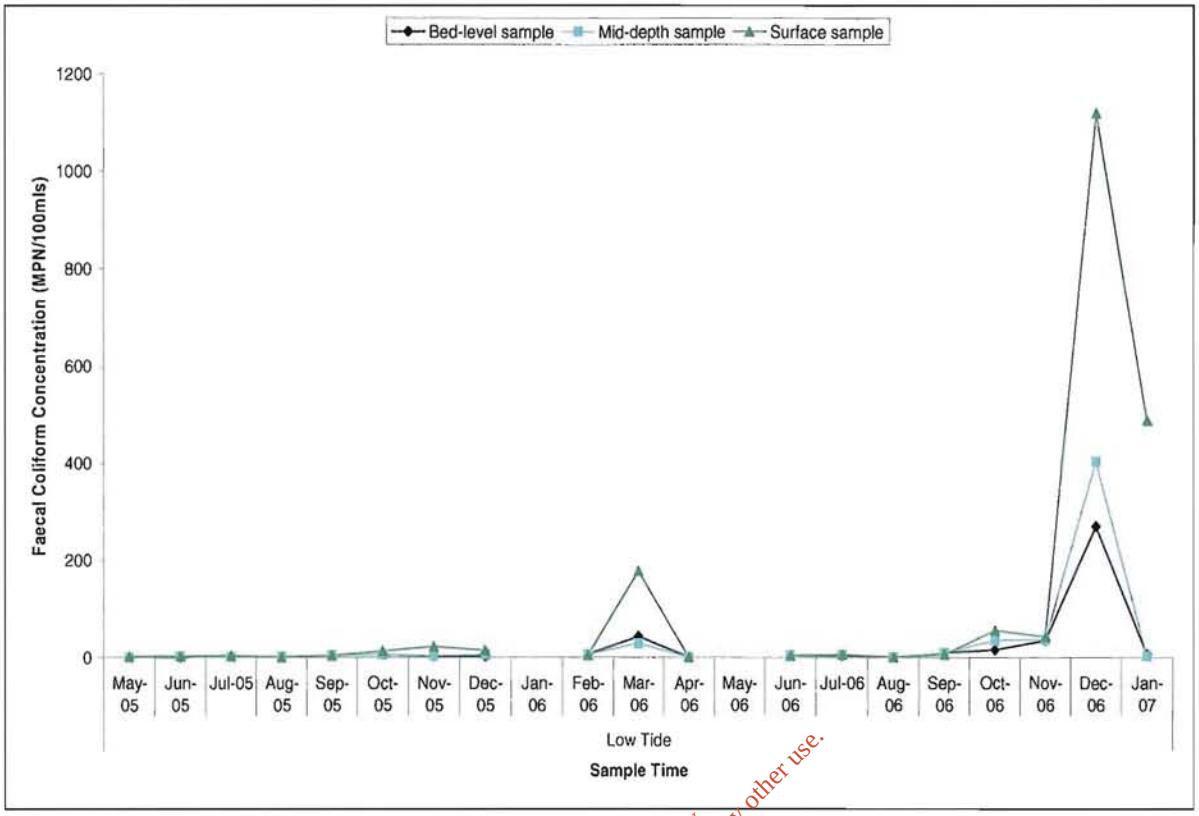


Figure 3.3.2: Faecal coliform concentration in Cork Lower Harbour at Low Tide (May 2005-January 2007).

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.

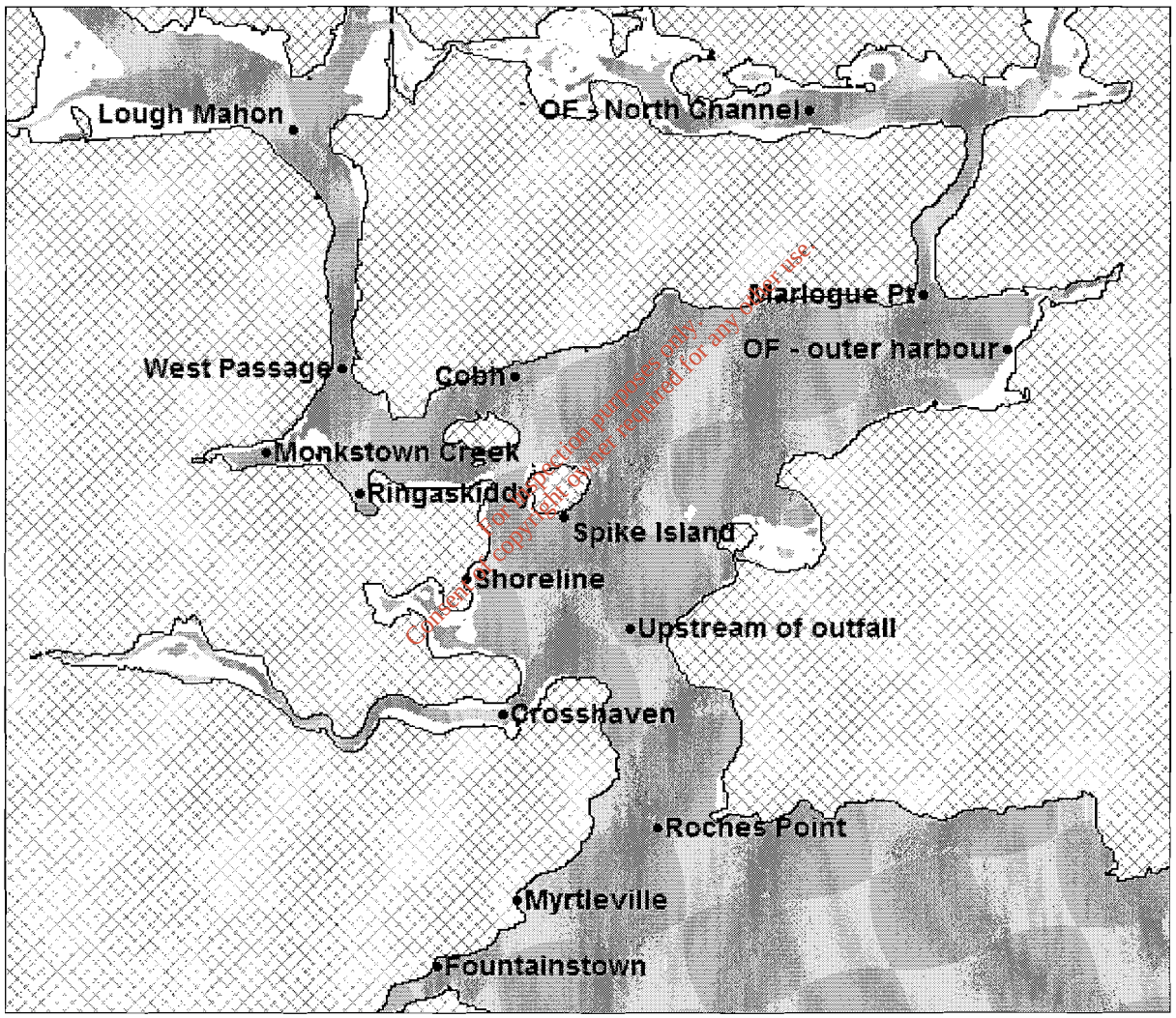


Figure 3.3.3: Location of fifteen points of interest within Cork Lower Harbour.

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.