

## 9. Landscape and Visual

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### 9.1 Existing Environment

#### 9.1.1 Introduction

This section describes the present situation at the existing Mutton Island WWTP with the assessment distinguishing between landscape and visual effects which are described in separate **Section 9.3.1**.

#### 9.1.2 Scope

The coverage of the study area was chosen with the following objectives in mind:

- to reflect the land within an estimated visual envelope (see **Figure 9.1**); and
- to include an area that is sufficient to gain a full understanding of the factors that influence the form and appearance of the landscape around the proposed development.

#### 9.1.3 Methodology

A description of the existing (baseline) *landscape* resource and visual amenity<sup>16</sup> forms a cornerstone of the assessment process and establishes the landscape context and sensitivity of the defined study area. The existing environment includes reference to the existing landscape character and quality or condition of the landscape and landscape elements on the site and within the surrounding area, as well as general trends in landscape change across the defined study area.

*Visual* effects are recognised by the Landscape Institute as a subset of landscape effects and are concerned wholly with the affect of the development on views, and the general visual amenity. The existing situation identifies the zone of visual influence (ZVI) of the WWTP as locations within this area may be affected by any visible change to the built environment. This ZVI forms the basis of the subsequent visual assessment.

#### 9.1.4 Existing Situation

##### Local Topography

The topography within the site boundary on Mutton Island is made up of generally even ground very close to sea level. At a wider level, the site lies in Galway Bay between

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<sup>16</sup> Visual amenity as defined by the Landscape Institute ‘*The value of a particular area or view in terms of what is seen*’ and not the more general term.

Claddagh, and Tawin Island. Mutton Island itself has a rocky shoreline with mud banks along the eastern side of the concrete causeway from South Park. The shoreline of the island is an intertidal zone of silt and rock outcrop. Beyond the Island to the north lies the South Park area and further still is Galway Harbour, at the mouth of the River Corrib.

### **The Built Environment**

The existing WWTP takes up a large proportion of Mutton Island. It is made up of a number of treatment tanks, pipes, control buildings and other infrastructure as identified in **Section 3.2**. A high, protective wall surrounds the existing treatment works with rock armouring also protecting the site immediately outside of the boundary wall. The wall is sufficiently high to obscure most of the site infrastructure from outside views with only a few structures visible above it.

The other buildings on the Island include the lighthouse and keeper's cottage. The lighthouse was established in 1817 and expunged in 1977. Both the lighthouse and the cottage are in a poor state of repair and may be restored in the near future. The lighthouse is listed in the Galway City Council Record of Protected Structures (Ref No. 6501).

The Island is connected to the mainland via an 896m long concrete causeway (incorporating the WWTP access road).

The mainland and Galway City are situated to the north beyond Mutton Island and the causeway. The built environment of this area which includes Claddagh and Salthill is urban with a distinct seaside resort ambience. There are many types of buildings along the seafront. These include hotels and guesthouses, recreational facilities such as Leisureland, Atlantiquaria, casinos, pubs and restaurants. During the summer months an outdoor funfair is set up at Leisureland.

The seashore itself is a mixture of stony bays, sandy beach and parkland which ends to the north of the causeway at Alexander Nimmo's Pier at the entrance to Galway Harbour. Road infrastructure for the area begins at the harbour near Wolfe Tone Bridge. The Claddagh Quay Road follows the coastline south and becomes Grattan Road. Several minor roads join Grattan Road to the west of the causeway access namely Fairhill Road and Grattan Terrace. Grattan Road continues west past Grattan Park and Beech Court before joining Dr. Colohan Road and the Seapoint Promenade. This continues in a south westerly direction for several kilometres before joining the roundabout on Salthill Road Upper. Several large carparks which service the recreational facilities of the area line the coast roads.

### **Vegetation**

There is very little vegetation on Mutton Island. There are a few small shrubs around the lighthouse cottage and some grassland but no trees. On the mainland there are areas of amenity grassland but again few trees.

### Planning Policy

The Local Government (Planning and Development) Act 2000 recognises the importance of landscape and visual amenity and requires that the Development Plan includes objectives to preserve the landscape, views and the amenities of places and features of natural beauty.

The Galway City Council Development Plan (2005 – 2011) recognises the importance of a number of views within the City, “*which require special protection due to their significant contribution to scenic amenity*” (Section 4.9). A significant proportion of these views relate to those of the coastal area and the Development Plan recognises that “*these views are not static and can be changed by nature and man*” and that some changes can be “*absorbed without jeopardising the integrity of the view*”.

Protected views include:

- V.4 Seascape views of Galway Bay from Grattan Road, Seapoint Promenade in Salthill and the coast road to the western boundary of the golf course;
- V.12 Seascape views of Galway Bay from Kingston Road; and
- V.14 Seascape views of Galway Bay at Ballyloughane from south of the railway bridge.

Overall, “*It is the objective of the Council to assess proposed developments, which are located in the line of a protected view and prevent developments, which by virtue of their impact scale, design or location would have a detrimental impact on these views.*”

This is formalised in Policy 4.9 (Protected Views of Special Amenity Value and Interest) which states that the Council will:

- *protect views and prospects of special amenity value and interest, which contribute significantly to the visual amenity and character of the city through the control of inappropriate development; and*
- *require landscaping schemes as part of planning applications to have regard to such views and limit any planting which could have a detrimental impact on the value of protected views.*

### Landscape Character

The character of the site area of Mutton Island is that of a small island with a sewage treatment works occupying the majority of the land area. The lighthouse and cottage, once the focus of the island now share the scene although the distinctive white lighthouse with its red railings is still the tallest structure on the island and therefore draws the eye. In the wider context the character of the area is coastal with the expanse of Galway Bay stretching towards the Burren Mountains to the south in Co. Clare.

### Estimated Visual Envelope

The estimated visual envelope is presented in **Figure 9.1**.

### 9.1.5 Predicted Trends

Given that the majority of Mutton Island is now given over to the WWTP it is considered unlikely that the situation will change in any significant manner in the medium term. However, as previously noted the lighthouse and keeper's cottage that previously formed the only built development in the Island are now in a deteriorating condition, although the former continues to be visually relatively prominent. Unless the possible restoration work is undertaken these buildings will continue to deteriorate.

### 9.1.6 Information Gaps

No data which could reasonably have been expected to be obtained that would significantly improve this assessment has been identified.

## 9.2 Potential Effects and Incorporated Mitigation

### 9.2.1 Potential Effects During Construction and Incorporated Mitigation

A major design decision has been taken to confine the proposed upgrade to the area within the existing site boundary. No increase of the WWTP to take up any more land or any development that would require the enlargement of Mutton Island will occur. The existing site perimeter wave wall and rock armouring will not be breached by any proposed development covered within this EIS. Additionally, no physical works to the causeway linking Mutton Island to the mainland are proposed and no construction compound on South Park (or any other local area) will be required.

The above restriction in the spatial extent of the upgrade provides significant mitigation in relation to any potential landscape and visual effects during construction. The construction phase will be relatively short lived and existing screening elements such as the existing perimeter wall will screen the vast majority of the construction activities. However, some tall plant such as cranes will be temporarily visible to short and middle distance receptors.

It is considered that no additional mitigation is required due to the relatively low level construction to be undertaken, the available screening, the distances to visual receptors involved and the overall setting of the WWTP within the expanse of Galway Bay.

### 9.2.2 Potential Effects During Operation and Incorporated Mitigation

The primary mitigation to reduce the visual and landscape effects of the WWTP upgrade, as engrained in the design philosophy for the upgrade (as outlined in **Section 3.3**), is to increase the WWTP's capacity by maximising the efficiency of existing process units and provide minimal additional infrastructure on-site so as to increase capacity of the works without compromising the site boundary and with the absolute minimum in increased profile of the site through additional vertical elements rising above the tallest infrastructure already present at the WWTP.

Investigations have shown that there are two elements of the operational work which may need to rise above the tallest structure already on the site:

- a small amount of ducting/pipework to link process units; and
- the top of any sludge dryer (e.g. CentriDry unit).

Of the two it is considered that the top of the sludge dryer (which is an option for the site [see **Section 3.3.2**]) will be the more prominent. The type of unit considered suitable for the site (e.g. CentriDry unit – see Section 3.3.2) does not incorporate a visually intrusive stack as part of its design).

If possible, the new sludge treatment facility will be constructed with part of it below ground level to reduce potential impacts on views and the landscape. The external protruding part of the sludge dryer shall be a maximum of 4m wide and shall not extend any higher than 2m above the existing treatment works structures. When viewed from a distance of 900m, it will have no impact on the visual amenity of the area.

### Avoidance/reduction measures

**Table 9.1** summarises the incorporated mitigation measures.

**Table 9.1** Avoidance/reduction measures – likely effects

| Receptor  | Changes and potential effects  | Incorporated mitigation measures and rationale for their likely effectiveness   |
|---|--|---|
| <b>Construction</b>   |  |   |
| Visual receptors on the mainland ; and the local <i>landscape character</i> . | Visual intrusion of construction plant and changes to the landscape character                | High certainty of effectiveness:<br><br>Restriction of construction activities to within the current, well screened WWTP with no requirement for any external construction compound in the vicinity of Mutton Island e.g. on South Park.  |
| <b>Operation</b>  |  |   |
| Visual receptors on the mainland  | Visual intrusion of newly built, operational elements and changes to the landscape character | High certainty of effectiveness:<br><br>Restriction in the design to introduce new built elements into the landscape to only those absolutely necessary e.g. some pipework and the top of any sludge dryer. These elements will not rise more than 2m above the tallest structure already on the site.<br><br>Careful consideration of colour and texture on visible elements to minimise any effects (e.g. glint) to mainland receptors. |

### Compensation

No compensation has been identified or is relevant.

### 9.2.3 Implementation of mitigation and enhancement measures

The implementation mechanisms for the identified mitigation measures are given in **Table 9.2**.

**Table 9.2** Implementation of incorporated mitigation and enhancement measures

| Description of measures including any monitoring requirement  | Responsibility for implementation | Implementation mechanism |
|---|-----------------------------------|--------------------------|
| <b>Construction</b>   |                                   |                          |
| Restriction of construction activities to within the WWTP with no requirement for any external construction compound in the vicinity of Mutton Island e.g. on South Park.                                   | Contractor                        | Contract Documents       |
| <b>Operation</b>  |                                   |                          |
| Restriction in the design to introduce new built elements into the landscape to only those absolutely necessary. These elements will not rise more than 2m above the tallest structure already on the site. | Contractor                        | Contract Documents       |
| Careful consideration of colour and texture on visible elements to minimise any effects (e.g. glint) to mainland receptors.   |                                   |                          |

## 9.3 Assessment of Effects

### 9.3.1 Scope and Methodology

This landscape and visual assessment has been based upon the second edition of *Guidelines for Landscape and Visual Assessment (GLVIA)* (Landscape Institute and the Institute of Environmental Management and Assessment, 2002). Regard is also given to the guidelines for *'Landscape and Landscape Assessment'* (Department of the Environment and Local Government, 2002).

The landscape and visual assessment was prepared according to a methodology developed by Entec based upon the above referenced guidelines. Detailed landscape assessment was restricted to the application site and the immediate and neighbouring landscape and seascape character areas. Effects beyond these areas have been assessed under the visual assessment through the selection of potential visual receptors.

Visual assessment was restricted to the potential visual envelope from where there may be a view of the proposals, as shown in **Figure 9.1**, and this is used as an appropriate starting point for undertaking the visual assessment.

## Landscape

### Landscape Receptors

The introduction of the proposed sludge dryer will have *indirect* and *direct* effects on the landscape, with *indirect* effects being those which affect the landscape character and *direct* effects those which physically modify landscape elements. Five aspects of the landscape resource are considered:

- On-site landscape elements which may experience *direct* physical effects;
- The contextual patterns and dynamic of development and broad scale characteristics found throughout the study area which may be *indirectly* affected through the WWTP upgrade, and these are encompassed in the grain of the landscape;
- The landscape character types which have been identified in the baseline that apply to parts of the study area and which may be indirectly altered through the WWTP upgrade;
- Designated features, such as designed landscapes and important buildings which may be *indirectly* altered through the WWTP upgrade; and
- Designated landscapes, such as Special Landscape Areas, or non-designated landscapes identified under specific criteria.

The landscape effects will be assessed by consideration of three criteria: type of effect; the sensitivity of the landscape resource; and the predicted magnitude of change. Consideration of the sensitivity of the landscape resource against the magnitude of change posed by the development is fundamental to landscape assessment and these two criteria are defined in more detail later in this section.

### Types of Landscape Effect

The effect of the sludge dryer on each identified landscape receptor is classified according to its ability to accommodate the consequent effects of the construction and operation of the proposed sludge dryer. This ability is expressed using the following definitions:

- **Positive** where it is felt to complement or contribute to the landscape, strengthening it or adding positive characteristics and qualities which were not previously available;
- **Neutral** where it neither contributes to nor detracts from the landscape, and can be accommodated comfortably by the landscape context;
- **Negative** where it introduces elements which are not currently found in the landscape and cannot be accommodated without some detrimental effect.

The ability of landscape receptors to accommodate the sludge dryer is assessed through professional judgement based on the factors considered in the evaluation of the

sensitivity of receptors and the magnitude of the effects and on the knowledge of the study area as a whole which the assessors have gained. The significance of the effect of the sludge dryer on each of these landscape receptors is assessed through a combination of their sensitivity and the magnitude of the change that they will experience.

### **Magnitude**

The magnitude of change is an expression of the degree of addition, change or loss which would be experienced by the baseline landscape conditions and is classified as high, medium, low or negligible.

The following factors are considered in the evaluation of magnitude of change:

- The **nature** of the perceived contrast, or integration, of any new features or changes with the existing landscape including the nature of the sludge dryer facility layout;
- The **scale** of change in the landscape with respect to the proportion of the landscape affected by the sludge dryer and the degree to which it is affected; and
- The **duration** and **reversibility** of the effect on the landscape.

The manner in which these considerations are reflected in the magnitude categories used in the assessment are indicated in **Table 9.3**, although it is recognised that for some developments in certain locations there may be combinations of factors that do not comply with the range of effects set out in the table. In these situations professional judgement has to be made concerning the definition of the level of landscape effects.

**Table 9.3 Magnitude of Landscape Effects**

| Predicted Landscape Effects   | Level       |
|---|-------------|
| Large-scale changes in landscape character over an extensive area/intensive, irreversible change over a more limited area/complete loss of notable features or elements | High<br>↓   |
| Moderate scale changes over a localised area/partial loss/alteration of notable features or elements  | Medium<br>↓ |
| Little change in any landscape feature  | Low         |

## **Sensitivity**

The sensitivity of each landscape receptor is dependent on its value and its ability to accommodate the proposed sludge dryer, and is classified as high, medium or low. This classification is derived from consideration of a number of variables:

- **Landscape quality:** an appraisal of the state of repair or condition of landscape elements, the integrity and intactness of the landscape, and the extent to which its distinctive character is apparent in a particular area.
- **Landscape value:** an appraisal of the importance of the landscape, with consideration given to any national and local designations which may apply, the perceived value of the landscape to users and other consultees, and any intrinsic aesthetic characteristics of the landscape such as scenic quality or sense of place. These may be derived from literature, films, television programmes and guides. It should be noted that a landscape of high value may not always equate to areas of high landscape quality (particularly if they are designated for other landscape and visual reasons) and that areas of low landscape value may contain areas of higher landscape quality.
- **Development within the landscape:** the ability of the landscape to accommodate the sludge dryer can be influenced by the presence and extent of any existing development within the study area, especially in cumulative views. Landscapes which are already influenced by development similar in some way to the type proposed generally have a greater capacity to accommodate the proposed changes, while those lacking any influence from built form or other human elements may be more susceptible. In this assessment the evaluation of the sensitivity of landscape receptors does assume knowledge of the nature of the development proposed.
- **Scale of the landscape:** this also affects the ability of the landscape to accommodate the sludge dryer. A large scale landscape of simple landform generally has a greater capacity to absorb development than a smaller scale, complex setting where misleading comparisons of scale may occur.
- **Visibility:** whilst visibility is primarily a visual concern, the extent of enclosure and variation in topography has a role to play in determining the sensitivity of a particular landscape to change.

The manner in which these considerations are evaluated to derive a sensitivity category is set out in **Table 9.4**. Nevertheless it is recognised that the categories can only be considered as indicative and there may be situations where due to specific circumstances and the associated need to apply professional judgement result in alternative landscape resource sensitivities being used in an assessment.

**Table 9.4 Sensitivity of Landscape Resources**

| Landscape Resource Categories   | Sensitivity |
|---|-------------|
| Important components or landscapes of particularly distinctive character and therefore likely to be subject to national designation and be vulnerable to relatively minor changes | High<br>↓   |
| Moderately valued characteristics reasonably tolerant of change particularly if subject to local landscape designation  | Medium<br>↓ |
| Relatively unimportant/immature or damaged landscapes tolerant of substantial change  | Low         |

## Visual

Visual effects are recognised by the Landscape Institute as a subset of landscape effects and are concerned wholly with the affect of the development on views, and the general visual amenity. Visual effects may include the following:

- **Visual obstruction** - physical obstruction or blocking of a view, only likely to occur close to the development or within the application site boundary.
- **Visual effect** - a change in the appearance of the landscape as a result of development appearing in an existing view or the loss of particular landscape elements or features already present in the view.
- **Other visual effects** - The overall visual amenity of an area may be affected to the extent that the visual appearance of a particular landscape character type or the visual setting, ‘sense of place’<sup>17</sup> or of a particular location such as a village is significantly changed. Effects on areas of general amenity are considered in the context of landscape change and may also be either negative or positive.

## Viewpoint Assessment

Viewpoint assessment is conducted from particular viewpoints from which the WWTP would be visible. The purpose of this is to assess both the level of visual effect that would be sustained by particular receptors, and to help guide the assessment of the overall effect on visual amenity and areas of particular landscape character or designation within the study area.

## Visual Sensitivity

The sensitivity of each view or route is classified as high, medium or low through consideration of:

- Visual quality: an appraisal of the quality of the view available to the visual receptor(s) relating to its amenity and its integrity and intactness;

<sup>17</sup>: ‘Sense of Place’ the essential character and spirit of an area or *genius loci*.

- Visual value: an appraisal of the importance given to the view, as indicated by factors such as its recognition as a tourist viewpoint with facilities provided for its enjoyment or its location within an area covered by a landscape designation.

Based on the *Guidelines for Landscape and Visual Assessment. Second Edition*, (The Landscape Institute and Institute of Environmental Management and Assessment, 2002), the different receptor categories identified in the baseline assessment are ranked in order of their sensitivity to visual effects as set out in **Table 9.5**. It should be stressed that this table is indicative only as it would be impossible to rigidly tabulate sensitivity to change.

**Table 9.5 Sensitivity of Visual Receptors**

| Visual Receptor Categories                             | Sensitivity |
|--|-------------|
| Designated long distance footpaths                     | High        |
| Residential communities (towns, villages & hamlets)    | ↓           |
| Close distance private residential properties          | ↓           |
| Close distance isolated private residential properties | Medium      |
| SAMs and Historic Parks & Gardens                      | ↓           |
| Other Public Rights of Way (PRoWs)                     | ↓           |
| Public and private recreational open space             | ↓           |
| Rights of way associated with highways                 | ↓           |
| Businesses and industry                                | Low         |

### Magnitude of Change

The magnitude is described as high, medium, low or negligible, to take account of possible landscape changes, which may affect the view. The magnitude and scale of visual change is described by reference to:

- The scale of change in the view and the loss or addition of features in the view and changes in the composition and extent of view affected. The scale of the development relative to its landscape setting may be more or less emphasised by the presence or lack of scale indicators<sup>18</sup>;
- The degree of contrast or integration of any new features or changes in the landscape with the existing or remaining landscape elements and characteristics in terms of mass, scale, colour and texture;

<sup>18</sup> Scale indicators are familiar objects in the landscape such as buildings which appear in close proximity to the sludge dryer and provide an indication of the true scale and height of the development such as the lighthouse.

- The distance between the visual receptor and the development and the frequency and ease with which the development may be viewed from a particular viewpoint taking into account seasonal factors such as weather conditions, sea fog etc;
- The angle of the main direction of the view and whether the development would be viewed against the skyline or a background landscape;
- The duration, whether temporary or permanent, intermittent or continuous; and
- The potential for indirect effects. The Landscape Institute defines these as effects that are not a direct result of the development, but are often produced away from it or as a result of a complex pathway. An example may include the potential for visual effects as a consequence of increased traffic levels generated by delivery lorries during the sludge dryer construction period.

Visual assessment considers the above factors, together with the mitigation incorporated into the design, to arrive at a judgement on the sensitivity of the view and magnitude of change posed by the development. General guidance for this assessment has been provided in **Table 9.6** which provides examples of how different considerations interact to produce different visual magnitude categories.

**Table 9.6 Visual Magnitude**

| <b>Visual Magnitude Categories</b> |  |
|------------------------------------|--|
| <b>High</b>                        | A major change, obstruction of a view or intrusion into a view that is directly visible and likely to appear in the foreground.  |
| <b>Medium</b>                      | A moderate change or partial view of a new element within the view which may be readily noticed, directly or obliquely visible including glimpsed or intermittent views and appearing in the middle ground partly screened or mitigated.                       |
| <b>Low</b>                         | A low level of change, affecting a small part of the view which may be obliquely viewed or partly screened and or appearing in the background landscape. May include travelling views from roads/rail.   |
| <b>Negligible</b>                  | Few viewers affected by a small or intermittent change to the view which may be obliquely viewed and mostly screened and or appearing in the distant background or viewed at high speed over short periods and capable of being missed by the casual observer. |

### Types of Visual Effect

Landscape and visual effects may be positive, neutral, or negative. A positive effect would require development to add to the landscape value, quality, character and or visual amenity of an area. Certain types of development and mitigation associated with some developments such as enhancement of vegetation and the improvement of landscape features could also be regarded as positive.

A neutral landscape and/or visual effect would constitute ‘negligible change’ to the existing landscape or view, and would include changes which may be considered as part of the ‘normal’ landscape processes (such as harvesting) or a negligible magnitude of change affecting a view.

A negative effect may include the loss of landscape elements such as stone walls and hedgerows as part of construction, although usually these types of effects can be avoided.

### 9.3.2 Significance evaluation methodology

#### Landscape Effects

##### Criteria for the Evaluation of Landscape effects

The significance of landscape effects reflect the sensitivity of the landscape to change (see **Table 9.4**) and the magnitude of that change (see **Table 9.3**). The evaluation of criteria and thresholds is primarily based upon professional judgement.

##### Significance of Landscape Effects

There has been a general consensus in recent landscape assessments on the recognition of three thresholds of significance that are derived from different combinations of landscape resource sensitivity and impact magnitudes, as reflected in the LI / IEMA Guidelines. These are:

- ‘**major**’ meaning high sensitivity or major magnitude;
- ‘**minor**’ meaning medium sensitivity or some magnitude; and
- ‘**not significant**’ meaning low sensitivity or minor magnitude.

The assessment of significance is on a qualitative basis, as a scoring system does not avoid subjectivity and suggests a certainty that may not be present.

#### Visual Effects Evaluation

##### Criteria for the Evaluation of Visual effects

Significance is dependent on two criteria:

- the sensitivity of the receptor to the identified impact; and
- the magnitude of the predicted changes as measured along an agreed continuum.

The different receptor categories are ranked in order of their sensitivity to visual impacts as set out in **Table 9.5**.

The magnitude of visual effect is a function of three factors:

- The number of visual receptors affected;
- The distance from receptors to the source(s) of visual impact; and
- The degree of change to existing views and the scale of the proposed extension.

These factors are graded in accordance with **Table 9.6**.

## **Significance of Visual Effects**

There has been a general consensus in recent landscape assessments on the recognition of three thresholds of significance, that are derived from different combinations of sensitivity and magnitude, reflecting the categories and principles laid down by the LI / IEMA. These are:

- ‘**major**’ meaning high sensitivity or high magnitude;
- ‘**minor**’ meaning medium sensitivity or medium magnitude; and
- ‘**not significant**’ meaning low sensitivity or low magnitude.

It is clear that a number of intermediate situations occur with, for example, a receptor of medium sensitivity combined with an effect of high magnitude. Relevant guidelines (The Landscape Institute, 1999) suggest that in such situations, professional judgement should supplement the rigid application of matrix tables. The assessment of significance is on a qualitative basis, as a scoring system does not avoid subjectivity and suggests a certainty that may not be present. The type of effect in the evaluation of the visual effects is categorised as being neutral because the effects constitute negligible change to the view.

### **9.3.3 Predicted effects and their significance**

#### **Predicted effects during construction**

##### **Landscape**

The predicted landscape effects are concerned with the changes in the fabric, quality and character of the landscape. The evaluation of the landscape effects of the proposals indicate that there will be negligible localised negative landscape effects caused by the construction operations. The mitigation proposed, especially the restriction of construction activities to within the existing, screened site will be highly effective.

##### **Visual**

This section of the assessment considers the predicted main visual environmental effects upon identified visual receptors that would result from the construction and operation of the proposed sludge dryer. To minimise repetition, many individual receptors have been grouped together where it is considered that the predicted effects will be substantially the same (e.g. the majority of properties along coastal roads). The principal receptor groups are identified in **Table 9.8** (see **Figure 9.1** for locations).

The main effects on visual receptors during the construction period are the temporary introduction of vertical elements that will break the skyline cranes (e.g. cranes) and an increase in traffic movement on the agreed traffic routes to/from the site and the causeway. However, it is predicted that the upgrade construction works will not have any significant visual effects on any of the identified groups of potential visual receptors along the coast between Salthill and Renmore as well as any boats within the visual envelope.

This is principally because the existing WWTP on Mutton Island is already a small to moderate element in the current views available to many of these receptors. Most construction activities will take place within the existing site boundary with only a very small number of plant (e.g. cranes etc.) visible from receptors. Additionally, traffic numbers are predicted to be relatively low. Hence, the construction will only represent a small, incremental increase in the extent of existing visual elements as opposed to the introduction of completely new visual elements. This factor will reduce its potential visual intrusiveness in addition to the key factor that Mutton Island is off-shore and has a minimum separation distance of almost 1 km from the closest visual receptors (except for boats).

### **Predicted effects during operation**

#### **Landscape**

The predicted landscape effects during the operational period will come about due to the introduction of new vertical elements into the landscape. However, the identified mitigation to minimise the number and scale of these elements will be highly successful in reducing the effect to a negligible negative change to the landscape character in the locality which is already dominated by the mass of the existing WWTP and the lighthouse on Mutton Island.

#### **Visual**

The main effect on visual receptors after the upgraded WWTP becomes operational is the introduction of a small number of vertical elements that will break the skyline to a very small degree. **Figure 9.2** is indicative of the changes that will occur, and this figure is based on a worst case situation with respect to a 2m high, 3.5m wide increase in the visible structure on-site due to the introduction of a possible sludge dryer.

It is predicted that the upgraded WWTP will not have any significant visual effects on any of the identified groups of potential visual receptors. This is principally because the existing WWTP on Mutton Island is already a small to moderate element in the current views available to many of these receptors. The upgrade will primarily be located within the existing site boundary using material and an architectural style that will reflect that of the existing WWTP, hence it will only represent a small, incremental increase in the extent of existing visual elements as opposed to the introduction of a completely new visual element. This factor will reduce its potential visual intrusiveness in addition to the key factor that Mutton Island is off-shore and has a minimum separation distance of almost 1 km from the closest visual receptors (except for boats).

### **9.3.4 Compensation**

No compensation has been identified.

### **9.3.5 Additional mitigation/enhancement measures**

No additional mitigation or enhancement measures have been identified.

### 9.3.6 Summary of significance evaluation

The results of the landscape assessment are presented in **Table 9.7** and the visual assessment in **Table 9.8**.

**Table 9.7** Effects on landscape and evaluation of significance

| Landscape Impact        | Type of Effect       | Probability of Effect Occurring | Sensitivity | Magnitude of Effect | Significance Level | Significance Rationale   |
|-------------------------|----------------------|---------------------------------|-------------|---------------------|--------------------|--|
| <b>Construction</b>     |                      |                                 |             |                     |                    |  |
| Construction activities | Negative / Temporary | Certain                         | Low         | Low                 | Not significant    | Minimal landtake by construction plant, temporary for the duration of construction   |
| <b>Operation</b>        |                      |                                 |             |                     |                    |  |
| Operation               | Negative / Permanent | Certain                         | Low         | Low                 | Not Significant    | Minor change to the landscape character of the Island through the incremental increase in the mass and volume of operational plant on the Island |

**Table 9.8** Effects on visual receptors and evaluation of significance

| Visual Receptor   | Type of Effect | Probability of Effect Occurring | Sensitivity | Magnitude of Effect | Significance Level | Significance Rationale   |
|---|----------------|---------------------------------|-------------|---------------------|--------------------|--|
| R1:<br>Residential receptors on the Long Walk/Dock Road | Neutral        | Likely                          | High        | Low                 | Not Significant    | Residents, especially those located on the edge of the harbour, will have long distance views of the construction and operation of the WWTP on Mutton Island. They will experience a negligible incremental change in their views as the introduction of the sludge dryer will visually only represent a small scale increase in the extent of an existing feature (the WWTP) which in itself is a relatively minor element in the extensive seaward views available to these receptors. |
| R2:<br>Residential                                      | Neutral        | Likely                          | High        | Low                 | Not Significant    | Most residents along this road are in properties that are orientated to have   |

| Visual Receptor   | Type of Effect | Probability of Effect Occurring | Sensitivity | Magnitude of Effect | Significance Level | Significance Rationale  |
|---|----------------|---------------------------------|-------------|---------------------|--------------------|---|
| receptors on Grattan Road north of the causeway                                 |                |                                 |             |                     |                    | eastern views and as such will have only oblique middle distance views of the sludge dryer.   |
| <u>R3:</u><br>Residential receptors on Grattan Road to the west of the causeway | Neutral        | Certain                         | High        | Low                 | Not Significant    | The majority of the residential receptors at this location will sustain direct middle distance views in the context of the existing WWTP  |
| <u>R4:</u><br>Residential receptors along Seaport Promenade                     | Neutral        | Certain                         | High        | Low                 | Not Significant    | Views across Galway Bay towards Mutton Island. At 1.4km any changes to the skyline will be difficult to distinguish   |
| <u>R5:</u><br>Residential receptors along Salthill Road Upper                   | Neutral        | Unlikely                        | High        | Negligible          | Not Significant    | Oblique views over a minimum distance of 2.3km in which the WWTP will be difficult to clearly discern.  |
| <u>R6:</u><br>Recreational users at Cromwell's Fort                             | Neutral        | Certain                         | Medium      | Low                 | Not Significant    | Long distance views from the north east in which Mutton Island is only a small-scale component within the extensive views available   |
| <u>R7</u><br>Recreational users at Nimmo's Pier                                 | Neutral        | Likely                          | Medium      | Low                 | Not Significant    | The WWTP is a minor element in long distance southern views   |
| <u>R8</u><br>Recreational users at South Park, Claddagh                         | Neutral        | Likely                          | Medium      | Low                 | Not Significant    | The existing WWTP is already visible from South Park so the predicted, minor changes would only represent a small, incremental increase in the scale of this existing visual element. |
| <u>R9</u><br>Recreational users at Grattan Beach                                | Neutral        | Certain                         | Medium      | Low                 | Not Significant    | The effects from the proposed upgrade development will not significantly effect recreational users of Grattan Beach due to the distance to the proposals                              |
| <u>R10</u><br>Recreational users near the Atlantiquarium                        | Neutral        | Certain                         | Medium      | Low                 | Not Significant    | Mutton Island and the existing WWTP are already a focal point in the middle distance in seaward (eastern) views from this area.   |
| <u>R11</u><br>Recreational  | Neutral        | Certain                         | Medium      | Negligible          | Not Significant    | Mutton Island and the existing WWTP are only visible in oblique long  |

| Visual Receptor  | Type of Effect | Probability of Effect Occurring | Sensitivity        | Magnitude of Effect        | Significance Level  | Significance Rationale  |
|--|----------------|---------------------------------|--------------------|----------------------------|---------------------|---|
| users of Salthill Beach  |                |                                 |                    |                            |                     | distance eastern views and its lack of prominence in views from this location will not be modified by an incremental increase in the extent of the Island's built development   |
| <u>R12</u><br>Recreational users at Galway Golf Club             | Neutral        | Certain                         | Medium             | Negligible                 | Not Significant     | At a separation distance of 3 km the scale of the proposed visual changes cannot exceed a negligible magnitude of change.   |
| <u>R13</u><br>Road users along Grattan Road                      | Neutral        | Likely                          | Low                | Low                        | Not Significant     | Incremental increase in the amount of built development on Mutton Island likely to generate negligible magnitude of change in the composition of views available to these motorists   |
| <u>R14</u><br>Road users along Seaport Promenade Road            | Neutral        | Likely                          | Low                | Low                        | Not Significant     | Long distance views of Mutton Island are fleeting and the proposed changes will have negligible visual effects upon the present views   |
| <u>R15</u><br>Road users along Salthill Road Upper               | Neutral        | Likely                          | Low                | Low                        | Not Significant     | Scale of visual change in south-eastern views will be too small to generate any significant visual effects  |
| <u>R16</u><br>Industrial users of the Galway Harbour             | Neutral        | Certain                         | Low                | Medium                     | Not Significant     | Boats and maritime traffic using the harbour may receive closer distance views than land receptors but their low sensitivity categorisation will ensure that overall the effects will not be significant  |
| <u>R17</u><br>Industrial users of Galway Harbour Enterprise Park | Neutral        | Certain                         | Low                | Low                        | Not Significant     | As with all other middle distance receptor groups the magnitude of change in present views as a consequence of the construction and operation of the sludge dryer will be very low in the overall context of their views across the expanse of Galway Bay |
| <b>Key</b>   | <b>Effect</b>  | <b>Probability</b>              | <b>Sensitivity</b> | <b>Magnitude of Effect</b> | <b>Significance</b> |   |
|  | Positive       | Certain                         | High               | High                       | Major               |   |
|  | Negative       | Likely                          | Medium             | Medium                     | Minor               |   |
|  | Neutral        | Uncertain                       | Low                | Low                        | Not Significant     |   |
|  |                |                                 |                    | Negligible                 |                     |   |

## 9.4 References

Department of the Environment and Local Government, (2002), Landscape and Landscape Assessment (Draft).

The Landscape Institute, (1999), *Practice Note (01/99)*.

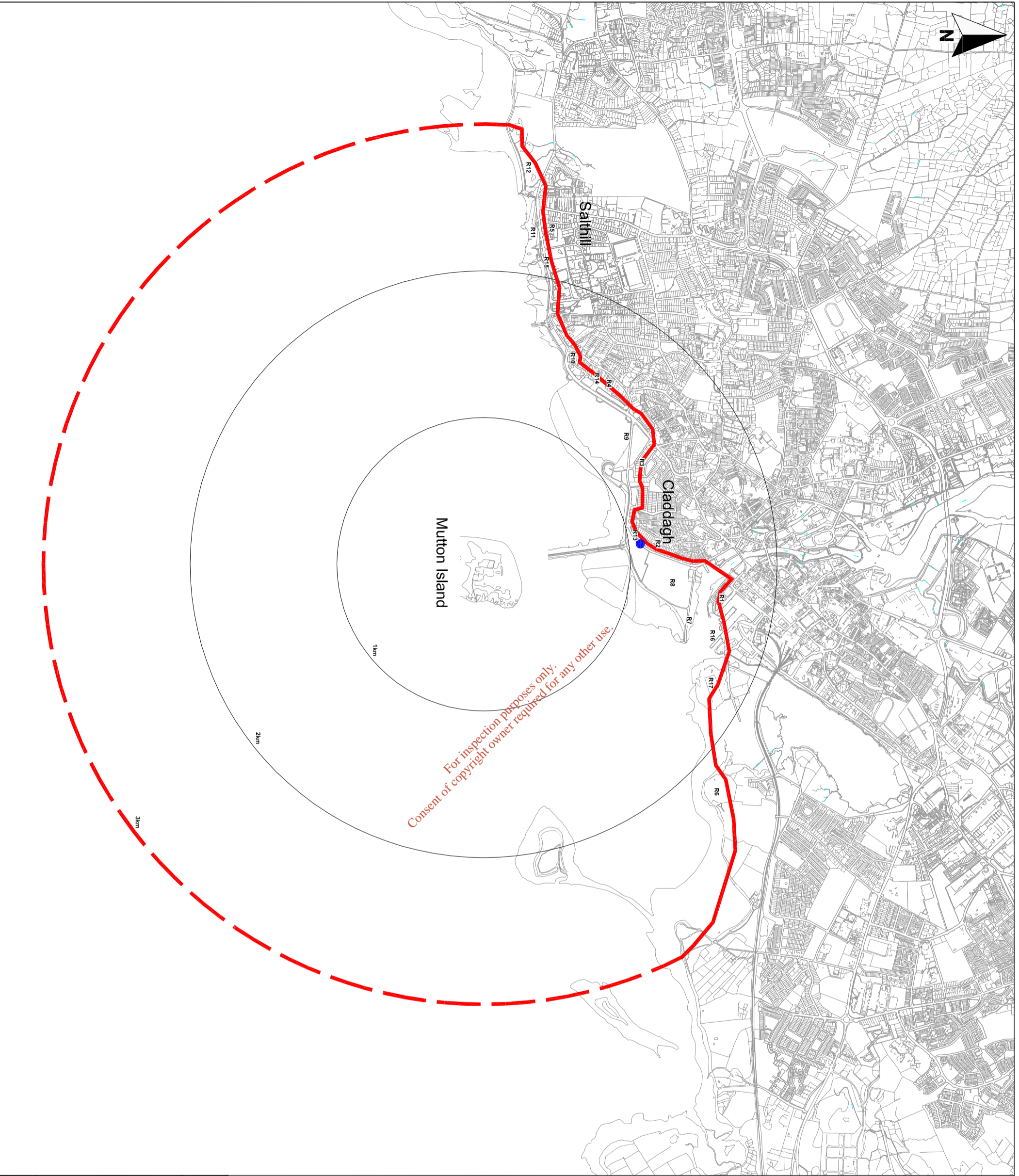
The Landscape Institute and Institute of Environmental Management and Assessment, (2002), *Guidelines for Landscape and Visual Impact Assessment: Second Edition*. Spon Press, London.

TOBIN, O'Dwyer and Entec. (2004). *Mutton Island Wastewater Treatment Works Upgrade – Scoping Report*.

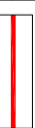

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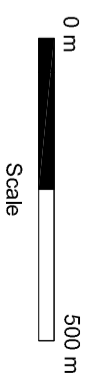


**Key**

-  Visual envelope
-  Grattan Road noise monitoring location

**Visual Receptors**

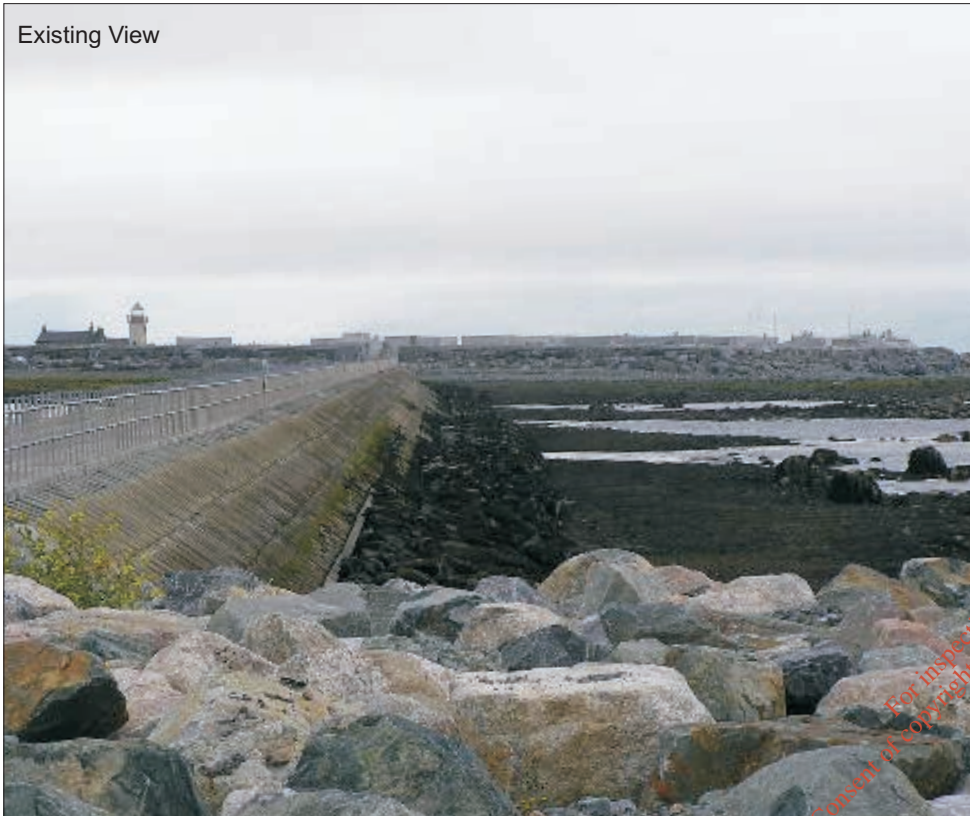
- R1 Residents on the Long Walk/Dock Road
- R2 Residents on Grattan Road north of causeway
- R3 Residents on Grattan Road west of causeway
- R4 Residents along Seaport Promenade
- R5 Residents along Salthill Road Upper
- R6 Recreational users at Cromwell's Fort
- R7 Recreational users at Nimmo's Pier
- R8 Recreational users at South Park
- R9 Recreational users at Grattan Beach
- R10 Recreational users near Altantiquaria
- R11 Recreational users at Salthill Beach
- R12 Recreational users at Galway Golf Club
- R13 Road users along Grattan Road
- R14 Road users along Seaport Promenade
- R15 Road users along Salthill Road Upper
- R16 Industrial Maritime users of Galway Harbour
- R17 Industrial users of Galway Harbour Enterprise Park



Mutton Island Waste Water Treatment Plant Upgrade  
EIS

**Figure 9.1**  
**Estimated Zone of Visual Influence and Noise Monitoring Location**

Existing View



Proposed Future View



Potential new element  
from sludge drier  
(max 2.0m above  
existing building)



Mutton Island Waste Water Treatment  
Plant Upgrade  
EIS

**Figure 9.2**  
**Indicative Change to the Visible Extent**  
**of Mutton Island WWTP**

February 2006  
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## 10. Water Quality

### 10.1 Existing Environment

#### 10.1.1 Introduction

Mutton Island WWTP discharges directly into Galway Bay, a large coastal embayment located on the west coast, receiving fresh water inflows from the River Corrib. The water environment comprises both surface and groundwater bodies and the proposals have the potential to affect identified waters, and their legitimate uses. A source-pathway-receptor approach is used and therefore where any one of these elements is missing, no effects will result.

#### 10.1.2 Scope

The main receptor has been identified as Galway Bay and the particular water quality designations at various locations within it, and the baseline situation with regard to this water is presented.

The extent of the existing treated effluent plume discharged from the Mutton Island WWTP will vary in extent and spatial coverage under the influence of tides and wind, therefore a large radius (5km) of coverage has been used within Galway Bay to identify receptors.

#### 10.1.3 Methodology

The baseline state of the water environment is determined using a wide range of data and published material, along with the use of a 2-dimensional water quality model to represent the current discharge from Mutton Island WWTP. Additionally, consultations with bodies relating to the local and wider water environment have been undertaken. The data collected and other sources of information are listed in **Table 10.1**.

**Table 10.1 Sources of Information: Water Environment**

| Topic           | Sources of Information  |
|-----------------|---|
| <b>Geology</b>  | Geological Survey of Ireland Map 14   |
| <b>Rainfall</b> | Environmental Protection Agency, Hydrological Data, July 1997.                    |
| <b>Wind</b>     | Wind data from Belmullet has been used in the water quality modelling undertaken. |

| Topic                                | Sources of Information   |
|--------------------------------------|--|
| <b>Bathing Waters</b>                |  |
| Standards/Directives                 | EPA (2005), The Quality of Bathing Waters in Ireland 2004  |
| Measured Quality                     | Galway City Council (2005) Electronic data – water quality monitoring results 2003 and 2004  |
| <b>Shellfish Waters</b>              |  |
| Standards/Directives                 | SI No. 200 of 1994 – Quality of Shellfish Water Regulations, 1994, giving effect to Council Directive 79/923/EEC.  |
| Locations of farms                   | Department of Communication, Marine, and Natural Resources.<br>AutoCAD plan of bay and aquacultural activities   |
| <b>River Corrib</b>                  |  |
| Chemical Quality                     | EPA (2005) Hydrometric Area 30 Corrib (Ref location no: 30/C/02)   |
| Flows                                | Office of Public Works (2005), Hydro-data Web Site ( <a href="http://www.opw.ie/hydro/index.asp?mpg=main.asp">http://www.opw.ie/hydro/index.asp?mpg=main.asp</a> ) |
| <b>Galway Bay</b>                    |  |
| Tides, currents and bathymetry       | Reeds Nautical Almanac (2004) and Admiralty Chart No. 1984   |
| Trophic Status                       | EPA (2001) An assessment of the Trophic Status of Estuaries and Bays in Ireland  |
| <b>Mutton Island Treatment Works</b> |  |
| Various flow and load data           | Galway Main Drainage Phase 3 Preliminary Report (TOBIN and O'Dwyer, 2006)  |

#### 10.1.4 Existing Situation

The existing situation is presented in terms of the baseline for:

- the local climate and weather, which affect hydrology and treated effluent transport (via wind induced advection and turbulent mixing);
- Mutton Island geology and groundwater;
- the River Corrib (as a main input to Galway Bay);
- other discharges to the bay (which may affect water quality); and
- the quality of the water in Galway Bay itself (including specifically identified receptors for water quality).

#### Climate and Weather

The climate and weather patterns in Galway Bay are dominated by the Atlantic Ocean, with this coastal location receiving an annual average of 1331mm of precipitation per year. (EPA, 1997).

### Geology and Groundwater

Geology Sheet 14 shows Mutton Island composed of rocks of the 'metagabbro and orthogneiss suite', that is, undifferentiated quartz diorite gneiss, granitic gneiss and hornblende metagabbro. It is considered that these metamorphic rocks do not have potential as groundwater aquifers.

### Physical and Tidal Characteristics

Galway Bay is a transitional water body, receiving freshwater inflows from the River Corrib, as well as the flows from Mutton Island WWTP.

The bathymetry around Mutton Island is markedly different to the north than to the south (as shown in **Figure 10.1**). To the north, a rocky inter-tidal zone links the island to the mainland shore at South Park, just off Grattan Road. Water entering (on a flood tide) or exiting (on an ebb tide) the entrance to the Corrib estuary (and Galway Dock) will flow to the east and south of Mutton Island, as the causeway linking the island to the mainland provides a physical barrier to flow to the north of Mutton Island.

To the south of Mutton Island the water quickly deepens to over 10.0m bCD (below Chart Datum). This deeper water extends to the south-west, deepening further towards the outer bay.

Summary tidal elevation data for Galway Bay is presented in **Table 10.2**. Tides are mesotidal and semi-diurnal in character.

The wave climate in inner Galway Bay can be considered to be sheltered from that of the Atlantic due to the protective presence of the Aran Islands, partially blocking incoming waves.

**Table 10.2 Galway Tidal Elevations**

| Lever           | Spring Tide Height (m above CD) | Neap Tide Height (m above CD) |
|-----------------|---------------------------------|-------------------------------|
| Mean High Water | 5.1                             | 3.9                           |
| Mean Low Water  | 0.6                             | 2.0                           |

Heights are referenced to Chart Datum which is approximately the level of Lowest Astronomical tide.

### River Corrib

The River Corrib has a catchment area of 3,111 km<sup>2</sup> and drains Lough Corrib, which is the Republic of Ireland's largest freshwater lake. Hydrometric data derived at Wolfe Tone Bridge (Station 30061 at National Grid Reference M 296 249), the bridge over the River Corrib closest to its mouth, yields a mean annual flow of 108.7m<sup>3</sup>/s for the period 1987-2001, with a highest recorded annual maximum of 381m<sup>3</sup>/s, recorded on 27<sup>th</sup> January 1995.

**Figure 10.1** indicates the locations at which hydrometric data, biological quality and chemical quality parameters have been monitored.

- Biological Quality

Biological Quality Ratings (Q-values<sup>19</sup>) have been derived at Salmon Weir Bridge in Galway City, (located upstream of the hydrological station at Wolfe Tone Bridge). For the 1985 to 2000 monitoring period this site has received a Q-value of 4 (which indicates a generally unpolluted status, with ‘fair’ water quality leading to ‘satisfactory’ status).

- Chemical Quality

Chemical analyses of the River Corrib has been undertaken at Waterside, central Galway. Waterside is located upstream of both Wolfe Tone Bridge and Salmon Weir Bridge. Data is available from 1998 to 2003. At this location the river is designated as a EC Freshwater Fish Directive (78/659/EEC) salmonid fishery.

Parameters collected include pH, conductivity, temperature, dissolved oxygen, biochemical oxygen demand (BOD<sub>5</sub>), chloride, total ammonia, un-ionised ammonia, oxidised nitrogen, ortho-phosphate and colour. For comparative purposes the minimum, median and maximum values for each period have been included in **Table 10.3**.

**Table 10.3 River Corrib selected water quality data (1998-2003)**

| Chemical Analyses |  |     |     |                           |       |      |                               |      |     |                             |        |       |
|-------------------|--|-----|-----|---------------------------|-------|------|-------------------------------|------|-----|-----------------------------|--------|-------|
| Year              | BOD <sub>5</sub><br>(mg/l O <sub>2</sub> ) |     |     | Total ammonia<br>(mg/l N) |       |      | Oxidised nitrogen<br>(mg/l N) |      |     | Ortho-phosphate<br>(mg/l P) |        |       |
|                   | Min  | Med | Max | Min                       | Med   | Max  | Min                           | Med  | Max | Min                         | Med    | Max   |
| 1998 -<br>2000    | 0.5  | 1.1 | 2.2 | 0.01                      | 0.02  | 0.06 | <0.1                          | 2.4  | 9.1 | 0.01                        | 0.01   | 0.04  |
| 2001              | 0.4  | 0.9 | 1.4 | 0.01                      | 0.02  | 0.04 | 0.1                           | 0.5  | 1.3 | 0.005                       | 0.009  | 0.023 |
| 2002              | 0.3  | 0.6 | 2.7 | 0.01                      | 0.01  | 0.28 | <0.1                          | 0.2  | 2.0 | <0.005                      | 0.012  | 0.036 |
| 2003              | <1   | <1  | 1.3 | <0.03                     | <0.03 | 0.04 | 0.4                           | <0.4 | 1.1 | <0.012                      | <0.012 | 0.017 |

Source: Environmental Protection Agency

The BOD results are characteristic of waters with a very low organic loading, as are the total ammonia results (with the exception of the maximum value of 0.28mg/l N which

<sup>19</sup> The Q-value of a stretch of river is assessed by the EPA during National River Monitoring Programmes.

could result from a pollution incident but is nevertheless well within salmonid water standards<sup>20</sup>). The nutrient concentrations in the river (oxidised nitrogen and ortho-phosphate) are, in general, not excessive. However, the loadings of nutrients to Galway Bay are important, and the contribution of the River Corrib is discussed below.

The 2002 OSPAR direct riverine loads report (OSPAR Commission, 2004) states that the Corrib delivered a nitrogen load of 3.456 tonnes/day (as N), an ammonia load of 51 kg/day (as N) and suspended sediment load of 15.444 tonnes/day to Galway Bay in 2002<sup>21</sup>. The report states that:

*“Pollutant loads in most rivers [in Ireland] in 2002 were generally substantially greater than the comparable figures for 2001, and average for the 1990-2000 period. This was largely attributable to above normal rainfall in 2002. Mean annual flows in the rivers in 2002 were on average 115 per cent of the respective averages for the period 1990 to 2000.”*

Examination of the concentrations given in **Table 10.3** suggests that nitrogen loads have reduced since 2002.

### Other Discharges

There are a number of Combined Sewer Overflows (CSOs) which discharge to the River Corrib. Some of these CSOs discharge directly to the River while others are thought to spill indirectly into the River Corrib through cross connections into the surface water system.

Additional to the CSOs discharging to the Corrib Estuary, there are also another 12 CSOs discharging directly to the north coast of North Bay in/near Galway City within a 5km radius of Mutton Island. Again it is possible that there are more CSOs which discharge to the bay which have not been identified at time of writing.

Apart from these CSO discharges there are no other, major point source discharges within 5km of Mutton Island WWTP.

### Water Quality in Galway Bay

Water quality in Galway Bay is monitored at a number of locations for a variety of purposes (see **Figure 10.1**). A 5km search area has been used to identify relevant data within Galway Bay. Beyond 5km it is felt that the influence of the treated effluent plume from the discharge will be small.

The approach to determining the current influence of the Mutton Island WWTP is presented below, followed by identification of water quality receptors and how they are affected by the current discharge.

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<sup>20</sup> See *European Communities (Quality of Salmonid Waters) Regulations*, S.I. 293 of 1988

<sup>21</sup> The loads were derived from flow-weighted annual mean concentrations and annual flow.

## Mutton Island WWTP Discharge

The existing Mutton Island WWTP began receiving flows in the latter half of 2003 and has been fully operational in its present state since April 2004. Previous to this a large number of raw sewage discharges occurred from Galway City, along its immediate coastline and into the River Corrib. The original design loads for the existing WWTP are as outlined in **Table 10.4**.

**Table 10.4 Design loads for Mutton Island WWTP**

| Parameter                                     | Load                      |
|---|---------------------------|
| <b>WWTP influent</b>                          |                           |
| Biochemical Oxygen Demand (BOD <sub>5</sub> ) | 5,500 kg/d                |
| Total Suspended Solids (TSS)                  | 6,412 kg/d                |
| Chemical Oxygen Demand (COD)                  | 13,177 kg/d               |
| Dry Weather Flow (DWF)                        | 28,800 m <sup>3</sup> /d  |
| Max flow to full treatment (3DWF)             | 86,400 m <sup>3</sup> /d  |
| Max flow to Preliminary treatment (6DWF)      | 172,800 m <sup>3</sup> /d |
| <b>WWTP effluent</b>                          |                           |
| Biochemical Oxygen Demand (BOD <sub>5</sub> ) | 720 kg/d                  |
| Total Suspended Solids (TSS)                  | 1,008 kg/d                |
| Chemical Oxygen Demand (COD)                  | 3,600 kg/d                |

Source: Galway Main Drainage Stage 3 Preliminary report (TOBIN and O'Dwyer, 2006)

The effluent standards applied to the existing WWTP represent the statutory requirement to comply with the Urban Wastewater Treatment Regulations (UWWTR), which implement Directive 91/271/EEC. The effluent concentrations in **Table 10.5** therefore apply. The concentration standards and percentage removal standards are presented as alternatives in the Directive but the approach adopted in Ireland has been based on use of the concentration standards for compliance assessment.

**Table 10.5 UWWTR effluent concentrations (Second Schedule, Part 1, S.I. 254/2001)**

| Parameter                                     | Maximum concentration (mg/l) | Minimum % Reduction |
|---|------------------------------|---------------------|
| Biochemical Oxygen Demand (BOD <sub>5</sub> ) | 25                           | 70-90               |
| Total Suspended Solids (TSS)                  | 35                           | 75                  |

| Parameter                    | Maximum concentration (mg/l) | Minimum % Reduction |
|------------------------------|------------------------------|---------------------|
| Chemical Oxygen Demand (COD) | 125                          | 90                  |

Currently, although there is no legal requirement to do so, Mutton Island is designed to operate as a nitrifying plant, meaning that incoming nitrogen in the form of ammonia ( $\text{NH}_3$ ) is converted to nitrate ( $\text{NO}_3^-$ ). As a result, ammonia concentrations are typically around 5mg/l (as N) and the modelling of the baseline situation has been undertaken using this concentration in the discharge.

The main discharge is made approximately 500m to the south of the Mutton Island High Water level, via a manifold diffuser system (which is designed to maximise the initial dilutions of the treated effluent by discharging through 10 discrete outlets spread over a distance of 100 m on the sea bed). The discharge is into water 10m below Chart Datum.

#### *Dilution and dispersion of the treated effluent plume*

Treated effluent discharged from the outfall will undergo mixing as the buoyant effluent rises from the outfall exit to the sea surface. This process results in an ‘initial dilution’ of the treated effluent as it meets the surface. The principal criteria affecting initial dilution are the discharge rate, the effluent buoyancy, water depth and the ambient current. The initial dilution may be further influenced by the angle of discharge, port size and stratification of the receiving waters. Calculation of the initial dilutions achieved by the current WWTP (under existing 3DWF flow conditions) over the tidal range experienced at the outfall location indicate that under near worst case conditions (95 percentile) a dilution of 30:1 is achieved with dilutions of >60:1 achieved for 50% of the time.

After initial dilution has taken place further mixing of the treated effluent with the receiving water takes place, ‘secondary mixing’, and the effect of the discharge in the medium- and far-field has been modelled using a two-dimensional hydraulic dispersion model. The modelling determines the behaviour of the existing treated effluent plume under a range of tidal and wind conditions. Modelling of the existing (baseline) scenario was based on a scenario involving maximum flow through full treatment at the WWTP (i.e. 3DWF). Under the UWWTR the effluent is limited to a  $\text{BOD}_5$  of 25mg/l and this concentration has been used as the concentration within the discharge, with an ammonia discharge concentration of 5mg/l (as N), as identified above. A more complete description of the modelling process undertaken is contained in **Appendix E**.

**Table 10.6** outlines the combination of wind and tide conditions for which the plume modelling was undertaken. It should be noted that neither a north nor north-easterly wind has been modelled, as it is not anticipated that a wind from this direction would cause pollutant problems at either the bathing waters or the shellfish waters within Galway Bay.

**Table 10.6** Water quality modelling scenarios

| Wind Strength | Wind Direction |   |    |   |    |   | Tidal Conditions |
|---------------|----------------|---|----|---|----|---|------------------|
|               | NW             | W | SW | S | SE | E |                  |
| Calm          |                |   |    |   |    |   | x                |
| Force 3 (F3)  | x              | x | x  | x | x  | x | Mean Neap        |
| Force 6 (F6)  | x              | x | x  | x | x  | x |                  |
| Calm          |                |   |    |   |    |   | x                |
| Force 3 (F3)  | x              | x | x  | x | x  | x | Mean Spring      |
| Force 6 (F6)  | x              | x | x  | x | x  | x |                  |

Modelling of the effects of the existing discharge from Mutton Island WWTP has been undertaken for a range of parameters and each is discussed below.

#### ***Biochemical Oxygen Demand (BOD<sub>5</sub>) and Dissolved Oxygen***

The BOD<sub>5</sub> of an effluent represents the organic component of the discharge. The organic fraction is important because it exerts an oxygen demand, which results primarily from the microbial breakdown of the organic fraction, although some chemical processes will be taking place (hence Bio-Chemical Oxygen Demand). Much of the organic matter is likely to be in the particulate form (referred to as suspended solids).

Oxygen is, of course, critical for all higher organisms, and the fate and behaviour of the dissolved oxygen in waters is crucial to the wellbeing of marine organisms. BOD<sub>5</sub> is a useful comparative measure for risk to dissolved oxygen concentrations.

**Figure 10.2a** shows the maximum concentration envelope of BOD<sub>5</sub> concentrations around the Mutton Island outfall under the current, baseline scenario (over a whole tidal cycle). It should be noted that the maximum concentration envelope does not represent the situation for any one point in time but represents the worst case concentration of the substance being modelled over a whole semi-diurnal tide. This representation allows determination of the influence of the whole plume without resorting to assessment of individual scenarios for differing times during the tidal cycle. If an issue arises, further assessment of the tidal timing and its duration can be made.

Whilst there is no BOD<sub>5</sub> standard for coastal waters, there are several standards available for freshwaters, as set out in **Table 10.7**. Reference to the table and the maximum concentration envelope shows that the BOD concentrations in Galway Bay do not cause any of the standards identified to be breached, or even approached, apart from a very small area immediately around the surface boil from the discharge. Furthermore, the current BOD concentrations from the discharge can be considered

unlikely to significantly alter the dissolved oxygen in the area immediately outside of the initial dilution mixing zone.

**Table 10.7 Available BOD standards**

| Legislation   | Description                      | Standard |
|---|----------------------------------|----------|
| Freshwater Fish Directive (78/659/EEC)<br>(Freshwaters) | Guideline value: Salmonid waters | 3 mg/l   |
| Salmonid Water Regulations<br>(Freshwaters)             | Maximum value:                   | 5mg/l    |

### **Ammonia**

Ammonia is the pollutant most commonly released to the aquatic environment and is present in crude sewage in high concentrations. In natural waters ammonia is present in equilibrium between un-ionised ammonia ( $\text{NH}_3$ ) and the ammonium ion ( $\text{NH}_4^+$ ). Under all normal conditions, the bulk of the ammonia encountered in estuaries and coastal waters will be as the ammonium ion<sup>22</sup>. However un-ionised ammonia exerts the main toxic impact on aquatic life.

The equilibrium between un-ionised ammonia and the ammonium ion is influenced by many external factors, in particular pH, temperature and salinity. The proportion of un-ionised ammonia increases with increasing temperature and pH, but decreases with increasing salinity. However, the ammonia/ammonium equilibrium responds in a non-linear way to these variables, and complex algorithms have been developed to calculate the un-ionised fraction. These are required as there is no routine method currently available for measuring un-ionised ammonia concentrations directly. It is therefore necessary to analyse for total ammonia, subsequently deriving the un-ionised ammonia from the salinity, pH and temperature at the time of sampling (UK Environment Agency, 2005). The proportion of ammonia in the un-ionised form has been calculated for inner Galway Bay and the Corrib Estuary, with the results presented in **Table 10.8**.

<sup>22</sup> The fraction of un-ionised ammonia is normally sufficiently low that total ammonia concentration is a good approximation of the concentration of the ammonium ion.

**Table 10.8 Worst case proportion of un-ionised ammonia**

| Location         | Factors affecting the result |                        |                  | % Un-ionised ammonia |
|------------------|------------------------------|------------------------|------------------|----------------------|
|                  | Salinity (psu)*              | Temperature (Deg C) ** | pH (pH units)*** |                      |
| Corrib Estuary   |                              |                        |                  |                      |
| • Winter         | 14.7                         | 5                      | 8.5              | 3.42                 |
| • Summer         | 28.6                         | 20                     | 8.5              | 9.49                 |
| Inner Galway Bay |                              |                        |                  |                      |
| • Winter         | 30.8                         | 5                      | 8.5              | 3.07                 |
| • Summer         | 31.1                         | 20                     | 8.5              | 9.36                 |

\*Salinity values taken from *An assessment of the Trophic Status of Estuaries and Bays in Ireland* (EPA 2001)

\*\*Worst case assumed temperature.

\*\*\*Worst case assumed pH.

**Figure 10.3a** shows the maximum concentration envelope of total ammonia concentrations around the Mutton Island outfall under the current, baseline scenario (over a whole tidal cycle). It can be seen that there is no discernible effect on ammonia concentrations in Galway Bay. This is a product of the nitrification within the treatment process lowering discharged ammonia concentrations to approximately 5mg/l (as N) plus the initial dilutions available.

Water quality standards for ammonia are presented in **Table 10.9**. The Freshwater Fisheries Directive standard relates to freshwaters but recent work in the UK by the Environment Agency (UK Environment Agency, 2005) has identified standards to assist with assessment of discharges in relation to the EU Habitats Directive (92/43/EEC).

Reference to the table and the maximum concentration envelope shows that the ammonia concentrations in Galway Bay do not cause any of the standards identified to be breached, or even approached, apart from a very small area consisting of the surface boil from the discharge.

**Table 10.9 Available ammonia standards**

| Legislation / Guidance  | Description                     | Standard  |
|---|---------------------------------|---|
| <b>Total Ammonia</b>  |                                 |   |
| Freshwater Fish Directive (78/659/EEC)  | Maximum value:                  | 1mg/l (as NH <sub>4</sub> <sup>+</sup> )<br>(equivalent to 0.78mg/l as N) |
| <b>(Freshwaters)</b>  | Guideline value:                | 0.16mg/l  |
| Salmonid Water Regulations  | Maximum value:                  | 1mg/l (as NH <sub>4</sub> <sup>+</sup> )<br>(equivalent to 0.78mg/l as N) |
| <b>(Freshwaters)</b>  |                                 |   |
| UK Environment Agency operational standard for ammonia in saline waters*              | Annual Average                  | 1.1 mg/l (as N)   |
|   | Maximum Allowable Concentration | 8.0 mg/l (as N)   |
| <b>Un-ionised ammonia</b>   |                                 |   |
| Salmonid Water Regulations  | Maximum value:                  | 20µg/l  |
| <b>(Freshwaters)</b>  |                                 |   |
| UK Environment Agency operational standard for un-ionised ammonia in saline waters ** | Annual Average                  | 21 µg/l (as N)  |

\* This total ammonia limit is based on recommendations from the US Environmental Protection Agency (USEPA, 1989) and USEPA 1999)

\*\* based on Seager J, Wolff E W & Cooper V A (1988) Proposed environmental quality standards for List II substances in water. WRC report TR260, May 1988

### **Other Toxic contaminants**

There are many substances which are considered to be toxic to marine life and therefore have water quality standards set, with the EU Dangerous Substances Directive (74/464/EEC) setting out two lists of compounds for which standards are set by either the EU (List I) or each member state (List II).

A Dangerous Substances monitoring programme is being initiated during 2005 in Ireland as part of the EU Water Framework Directive (2000/60/EC) implementation. This programme will sample for the presence of over 200 substances which were prioritised as persistent, toxic and liable to bio-accumulate. Specifically the programme will include monthly water sampling and annual sediment and biota sampling in the vicinity of Mutton Island causeway.

No data have been made available from this programme to date.

**Bathing Waters**

**Table 10.10** and **Figure 10.1** identifies all recognised bathing areas within a 5km of radius of Mutton Island WWTP.

**Table 10.10 Bathing Waters**

| Location                   | Status                 |   |                      |
|----------------------------|------------------------|---|----------------------|
|                            | National Bathing Water | EU Directive Bathing Water (Compliance Data)  | 2005 Blue Flag Beach |
| Salthill                   | Yes                    | 2003 – Did not comply with guideline standard for faecal coliforms<br>2004 – Complied with mandatory and guideline levels | No                   |
| Silver Strand (near Barna) | Yes                    | 2003 – Complied with mandatory and guideline levels<br>2004 – Complied with mandatory and guideline levels                | Yes                  |
| Grattan                    | Yes                    | Not designated  | No                   |
| Ballyloughane (at Renmore) | Yes                    | Not designated  | No                   |

Note: The 2005 EU Bathing Water Directive compliance data is not currently available from the EPA but indicative assessment indicates that both Salthill and Silver Strand should pass the EU and Blue Flag limits for the 2006 bathing season.

The standards against which bathing waters are assessed are outlined in **Table 10.11**.

**Table 10.11 Bacterial Water Quality Standards for Bathing Waters**

| Regulation/<br>Standard                                | Faecal Coliforms (No./100ml) |           | Total Coliforms (No./100ml) |           | Faecal Streptococci (No./100ml) |           |
|--|------------------------------|-----------|-----------------------------|-----------|---------------------------------|-----------|
|  | Mandatory                    | Guideline | Mandatory                   | Guideline | Mandatory                       | Guideline |
| <b>EU Bathing Water Directive</b>                      | 2,000*                       | 100**     | 10,000*                     | 500**     |                                 | 100**     |
| <b>National Bathing Water Regulations<sup>23</sup></b> | 2,000*                       |           | 10,000*                     |           | 300*                            |           |
|  | 1,000**                      |           | 5,000**                     |           |                                 |           |
| <b>Blue Flag Award Scheme</b>                          | 100                          |           | 500                         |           |                                 |           |

<sup>23</sup> *Quality of Bathing Waters Regulations* S.I. 155 of 1992 (as amended by *Quality of Bathing Waters (Amendment) Regulations* S.I. 145 of 1994; S.I. 230 of 1996; S.I. 177 of 1998 and S.I. 22 of 2001)

| Regulation/<br>Standard   | Faecal Coliforms<br>(No./100ml) |           | Total Coliforms (No./100ml) |           | Faecal Streptococci<br>(No./100ml) |           |
|---|---------------------------------|-----------|-----------------------------|-----------|------------------------------------|-----------|
|   | Mandatory                       | Guideline | Mandatory                   | Guideline | Mandatory                          | Guideline |
| * To be conformed with by 95% of samples and not exceeded by any two consecutive samples  |                                 |           |                             |           |                                    |           |
| ** To be conformed with by 80% of samples and not exceeded by any two consecutive samples |                                 |           |                             |           |                                    |           |

A variety of factors affect bacterial concentrations in the environment and sources other than point source sewage inputs can affect concentrations (e.g. diffuse inputs from agricultural and urban sources). Each beach will be subject to differing influences but, the removal of crude sewage inputs at various outfalls around Galway City as Mutton Island WWTP came on line in late 2003 may be obscured as bacteriological data at bathing waters are notoriously ‘noisy’ and often large data sets are required to determine responses to removal of potential sources in the marine environment.

The potential impact from the discharge of faecal coliforms from the Mutton Island outfall has been assessed by modelling the dilution and dispersion of the treated effluent in Galway Bay and producing plots from the discrete scenarios modelled<sup>24</sup> (as identified in **Table 10.6**). These results are presented in **Appendix F**. The modelling shows that no designated beach will fail the rigorous Blue Flag standard for faecal coliforms (a sewage indicator bacteria) and that aquaculture production areas will not be degraded due to the influence of the treated effluent.

Galway City Council monitors for *Salmonella* in the bathing waters identified in **Table 10.10**. The 2003 and 2004 results showed two occurrences of *Salmonella* being present in the one litre samples, comprising one sample at Salthill and one sample at Grattan beach. The mandatory Bathing Water standard is no detections in 95% of samples and not to be exceeded in any two consecutive samples and therefore the standard is complied with.

### Viruses

The Bathing Waters Regulations require monitoring for enteroviruses where an investigation shows, or where there are other grounds for believing, that there has been a deterioration in respect of the parameter or substance in the quality of the bathing water. The specified test detects polio, coxsackie and echo viruses. No such data have been identified for the local Galway Bay beaches.

<sup>24</sup> Bacteria are considered a non-conservative parameter, in that they die-off in the environment. This has been built in to the model, with the time for 90% of the bacteria to die-off (the ‘T90’ time) set to 12 hours.

### *Shellfisheries*

A number of shellfish farms, that are regulated by the Sea Fisheries Division of the Department of Marine under the Live Bivalve Molluscs (Health Conditions for Production and Placing on the Market) Regulations 1996,<sup>25</sup> are located in eastern/southern Galway Bay. These farms harvest a mixture of Mussels, Oysters and Clams. Although it is not known which farms are located on naturally occurring beds, guidance from the Department of Marine indicates that farms have been established where naturally occurring beds were found, however it is also prudent to assume that produce has also been introduced to these locations.

The Sea Fisheries Control and Management Division implements EU Directives on the quality of shellfish waters. The Division operates a monitoring programme in all shellfish production areas. The programme allows shellfish from each area to be given a health classification before they are placed on the market. The Live Bivalve Molluscs Regulations 1996 require that certain bacteriological standards must be met for shellfish that are to be used for human consumption. These standards are summarised in **Table 10.12** and the 2005 production area classifications are shown in **Table 10.13**.

**Table 10.12 Bacteriological standards for Shellfish Flesh Quality**

| Classification/Category   | Faecal Coliforms per 100g of flesh | <i>E. coli</i> per 100g of flesh |
|---|------------------------------------|----------------------------------|
| <b>Class A</b> - Sale for direct human consumption permitted  | <300                               | <230                             |
| <b>Class B</b> - Consumption after purification for 48 hours in an approved plant                                       | <6,000                             | <4,600                           |
| <b>Class C</b> - Consumption after relaying in clean seawater for 2 months at least prior to sale for human consumption | <60,000                            | -                                |

<sup>25</sup> The European Communities (Live Bivalve Molluscs) (Health Conditions for Production and Placing on the Market) Regulations, 1996 (SI 147:1996) implement Council Directive No. 914/92/EEC laying down the health conditions for the production and placing on the market of live bivalve molluscs.

**Table 10.13 Galway Bay Live Bivalve Molluscs (Production Areas) Designations 2005**

| Bed Name           | Species             | Previous Classification (as per Table 10.12) | May 2005 Classification (as per Table 10.12) |
|--------------------|---------------------|--|--|
| Mweeloon Bay       | Oysters             | A  | A  |
|                    | Mussels             | A  | B  |
| Clarenbridge       | Oysters and Mussels | A  | B  |
|                    | Clams               | A  | A  |
| Kinvara Bay        | Oysters and Mussels | B  | B  |
| Aughinis           | Oysters             | A  | B  |
| Poul-na-clough Bay | Oysters and Mussels | B  | B  |

Note: Locations in grey are >5km from Mutton Island but have been included for completeness.

It can be seen that no production areas require significant relaying, compatible with class C status. Some beds fell a grade during 2005 although it is not known why this was (e.g. natural influences or otherwise). Most of the beds are at distances much greater than 5km from Mutton Island and will be subject to various influences relating to bacterial quality e.g. the beds at Clarenbridge will be influenced to a much greater degree by the River Clarin than by Mutton Island WWTP. **Figure 11.1** shows the location of the Mweeloon Bay mussel and oyster beds.

As shellfish are filter feeders, filtering relatively large volumes of water daily, there may be a higher concentration of faecal coliform concentrations within the shellfish than the surrounding water. It is difficult to definitively say what faecal coliform concentrations in open water will result in which classification. However, the Department of Marine has adopted the Shellsan Classification System which relates directly to the faecal coliform concentration in the water in which the shellfish live. The system classifies shellfish waters into three categories, as follows:

- Approved – No further purification necessary;
- Conditional – Purification necessary by relaying the shellfish in uncontaminated seawater; and
- Restricted – Pressure cooking essential.

The Shellfish Regulations (Third Schedule, parameter 10) is less rigorous than the Shellsan Classification System where for “Approved”, geometric mean faecal coliform concentrations must be less than 14/100ml and 90% of samples must have <46 faecal coliforms/100ml.

Additional to those waters designated under the Live Bivalve Molluscs Regulations 1996, two locations in Galway Bay are formally classified under the EC Directive on the Quality of Shellfish Waters 79/923/EEC<sup>26</sup>:

- Clarinbridge/Kinvara Bay; and
- The Bay at Aughinish.

At sites designated under the implementing Regulations<sup>27</sup>, limits are imposed on several parameters including faecal coliforms. Both of the above sites are greater than 5km from Mutton Island.

A biotoxin programme of sampling (to comply with Council Directive 91/492) is also in operation, but samples are only taken when shellfish are being harvested (in some places such as Clarinbridge this would be continuous and sampled on a weekly basis). The most recent data from the Food Safety Authority of Ireland ([www.fsai.ie](http://www.fsai.ie)) shows that both Mweeloon Bay (Oysters) and Killeenaran, Clarinbridge (Mussels) have been open shellfisheries throughout 2005 to date (September 2005) and within prescribed limits for biotoxins.

### *Suspended Sediments*

No data on suspended sediments within Galway Bay have been identified but the Mutton Island discharge complies with the UWWTR discharge standard of 35mg/l Total Suspended Solids (see **Table 10.5**) and the 10 port diffuser will reduce concentrations further by the time the treated effluent reaches the surface. Most of the particulate matter discharged from WWTPs is fine and will not settle immediately in the proximity of a marine discharge due to tidal transport. Any settling at slack water is likely to be minimal once flood or ebb tide velocities increase re-suspending the finer particulates and dispersing them.

It is useful to identify the primary sources of suspended sediment (particulate matter) to inner Galway Bay under the baseline situation to identify the contribution of the current WWTP. These calculations are presented in **Table 10.14**.

**Table 10.14 Suspended Sediment Loadings to Inner Galway Bay**

| Source       | Methodology  | Loading (tonnes/day) |
|--------------|--|----------------------|
| River Corrib | The loads were derived from 2002 flow-weighted annual mean Suspended Particulate Matter and annual flow (OSPAR Commission, 2004) | 15.444               |

<sup>26</sup> 79/923/EEC (as amended) by 91/692/EEC – EC Shellfish Waters Directive

<sup>27</sup> Implemented by the Quality of Shellfish Waters Regulations, 1994 (SI 200:1994)

| Source             | Methodology                                | Loading (tonnes/day) |
|--------------------|--|----------------------|
| Mutton Island WWTP | 91,600 p.e. using 200 litres/day at 35mg/l | 0.802                |

Comparing the contributions from the River Corrib and the WWTP, the two sources input 95.1% and 4.9% of the suspended sediment loading to the bay respectively. This highlights that the River Corrib is the dominant source of suspended sediment into Galway Bay over a year, although there will be some seasonal variation.

There are no standards for suspended sediment in marine waters generally, but to set the discharge in context under the EC Freshwater Fishery Directive (78/659/EEC), there is a 20mg/l suspended sediment standard for the protection of migratory fish.

Compliance with the UWWTR limit of 35mg/l suspended sediment ensures that, after initial dilution (which the existing 95-percentile has been calculated as 30:1), the concentrations in Galway Bay are reduced to significantly lower levels than 20mg/l. It is considered that the dominating influence of the River Corrib will affect the local sediment loading regime and that any effect from the Mutton Island WWTP will be localised to a small area around the discharge point.

### ***Trophic Status and Nutrients***

The issue of eutrophication has come to prominence in the last 10 or so years within the European Union and is considered one of the greatest pressures facing the water environment in general. There are various definitions of eutrophication (including those from the EU Urban Wastewater Treatment Directive and EU Nitrates Directive) but in general, a water body may be considered eutrophic if it exhibits three distinct characteristics (EPA, 2001):

- enrichment by the stated nutrients;
- accelerated growth of algae and higher forms of plants; and
- ‘undesirable disturbance’ to the balance of organisms present and to the quality of the water concerned.

The EPA has undertaken an assessment of the trophic status of key tidal waters bodies in Ireland which receive nutrient inputs either directly or via rivers (EPA, 2001). This assessment was based on survey data collected from 1995 until 1999 and a set of quantitative criteria developed for comparison purposes relating to the three characteristics of eutrophication shown above:

- exceedance of criteria for either molybdate reactive phosphate (MRP) or dissolved inorganic nitrogen (DIN);
- exceedance of criteria for chlorophyll *a*; and
- exceedance of criteria for dissolved oxygen.

**Table 10.15** shows the results from the two coastal waters sites assessed for Galway Bay and the Corrib Estuary. It should be noted that the data were collected prior to the current Mutton Island WWTP being on-line and thus do not represent the current baseline situation.

This review concluded that Galway Bay was **neither eutrophic nor potentially eutrophic**.

Additionally, Galway Bay is not currently designated as sensitive under the Urban Wastewater Treatment Regulations<sup>28</sup> (UWWTR) and is classified as a “non problem area” in relation to eutrophication (OSPAR Report 2003).

Since these data were collected, inputs of crude sewage to the River Corrib and along the coast in/near Galway City will have ceased and thus their influence on the area reduced (due to a reduction in near shore nutrient loading and removal of discharge to a location which receives considerably greater dilution and dispersion). The reaction of local, coastal waters to this change (in terms of trophic status) has not been enumerated but is considered that the data presented in **Table 10.15** present a worst case baseline condition.

**Table 10.15 Eutrophication water quality parameters summary**

| Parameter                                   | Period                      | Corrib Estuary | Inner Galway Bay |
|---|-----------------------------|----------------|------------------|
| Salinity (psu)                              | Winter                      | 14.7           | 30.8             |
|   | Summer                      | 28.6           | 31.1             |
| Dissolved Inorganic Nitrogen (DIN) (mg/l N) | Winter Limit                | 1.562          | 0.519            |
|   | Winter Actual               | 0.701          | 0.187            |
|   | Summer Limit                | 0.659          | 0.499            |
|   | Summer Actual               | 0.044          | 0.018            |
| (MRP) (µg/l P)                              | Winter Limit                | 60             | 44.4             |
|   | Winter Actual               | 27             | 24               |
|   | Summer Limit                | 47.4           | 43.9             |
|   | Summer Actual               | 8              | 8                |
| Chlorophyll a (mg/m <sup>3</sup> )          | Summer: median limit        | 11.78          | 11.07            |
|   | Summer Actual               | 5.4            | 4.7              |
|   | Summer: 90-percentile limit | 23.38          | 22.15            |
|   | Summer Actual               | 10.0           | 10.3             |

<sup>28</sup> Which implement Directive 91/271/EEC

| Parameter                          | Period                      | Corrib Estuary | Inner Galway Bay |
|------------------------------------|-----------------------------|----------------|------------------|
| Dissolved Oxygen<br>(% saturation) | Summer: 5-percentile limit  | 76.46          | 77.85            |
|                                    | Summer Actual               | 89             | 120              |
|                                    | Summer: 95-percentile limit | 123.0          | 122.15           |
|                                    | Summer Actual               | 86             | 116              |

Source: EPA (2001)

Note: The limits have been interpolated from information contained in the EPA report.

Within a marine environment (i.e. with no, or limited, freshwater influence) it is generally accepted that nitrogen is the bio-limiting nutrient (MacGarvin, 1995). Within freshwaters, phosphorus is usually the limiting nutrient, with transitional waters falling somewhere in between. The salinities presented in **Table 10.8** show that inner Galway Bay is approximately 89% full seawater (if full seawater is assumed to be 35 practical salinity units [psu]). Nitrogen, (measured as dissolved inorganic nitrogen<sup>29</sup> (DIN)) is very likely to be the limiting nutrient in these conditions.

As for the suspended sediment baseline previously described, it is useful to identify the primary sources of nitrogen to inner Galway Bay under the baseline situation to identify the contribution of the current WWTP. These calculations are presented in **Table 10.16** assuming dry weather loads from the WWTP.

**Table 10.16 Nitrogen Loadings to Inner Galway Bay**

| Source             | Methodology   | Loading (tonnes N/day) |
|--------------------|---|------------------------|
| River Corrib       | The loads were derived from 2002 flow-weighted annual mean concentrations and annual flow (OSPAR Commission, 2004)  | 3.456                  |
| Mutton Island WWTP | Population equivalent of 90,000 contributing 9.0 g person/day (reduced by 54.4% due to secondary treatment) as per the methodology set out in Marine Direct Impacts Risk Assessment (Methodology Applied to Ireland's River Basin Districts) Second Draft | 0.37                   |

<sup>29</sup> DIN is the sum of the concentrations of nitrate, nitrite and ammonia and is considered the most relevant form of nitrogen to monitor in coastal waters in relation to nutrient enrichment, as nitrate and ammonia are both important as nutrient sources for algae.

Comparing the contributions from the River Corrib and the WWTP, the two sources input 90.3 % and 9.77% of the nitrogen to the bay respectively. This highlights that the River Corrib is the dominant source of nitrogen into Galway Bay over a year.

**Figure 10.4a** shows the modelling results of a discharge from the River Corrib (under mean flow conditions) on total nitrogen concentrations within Galway Bay.

### ***Water Framework Directive***

December 2000 saw the introduction of one of the most significant pieces of water-related legislation in Europe to date: The Water Framework Directive (WFD) (2000/60/EC).

The WFD is the first Directive that fully embraces certain key environmental management principles. Firstly, it adopts a holistic approach; covering ALL waters - rivers, lakes, transitional waters (estuaries), coastal waters and groundwater as well as their dependant wetlands. Secondly, it recognises that water systems do not stop at administrative boundaries, such as county boundaries, requiring waters to be managed at a catchment or River Basin District (RBD) level.

The targets set in the WFD are ambitious. By 2015 all waters should have ‘good status’ and deterioration in existing water quality status is not acceptable.

The main aims of the WFD are to:

- protect/enhance all surface and ground waters;
- achieve ‘good status’ for all waters by December 2015;
- manage water bodies based on river basins (catchments);
- use a ‘combined approach’ of emission limit values and quality standards;
- involve the public; and
- streamline legislation.

Ireland completed the first step in implementing the WFD in December 2003 by making the European Commission (Water Policy) Regulations, (S.I. No. 722 of 2003) which transposed the WFD into Irish Law. Eight River Basin Districts (RBD) have been identified within the island of Ireland with Galway and its environs situated in the Western River Basin District.

The WFD schedule, indicates that one of the Directive’s first major deliverables is a Summary Characterisation Report (Article 5) for each River Basin District in European Union Member States jurisdictions. This requires:

- an analysis of River Basin District characteristics,

- a review of the impact of human activity on the status of surface waters and on groundwater, and
- an economic analysis of water use.

The Article 5 analysis for the Western RBD was completed in December 2004 by the Western River Basin District Project. The Results for the various RBDs was compiled into a national report. This Report, entitled “*The characterisation and analysis of Ireland’s river basin districts in accordance with Section 7(2 & 3) of the European Communities (Water Policy) Regulations 2003 (SI 722 of 2003)*”, was completed in May, 2005.

The characterisation process highlights the following:

- the Galway outfall is located in a transitional water body named Corrib Estuary which is characterised as mesotidal and sheltered;
- the risk assessment of human activities identifies that the Corrib Estuary’s overall risk condition is “at risk”, i.e. it is unlikely that this water body will achieve its WFD objective of good status by the year 2015 unless action is taken to manage the water body;
- the pressures which have resulted in this “at risk” description are morphological (i.e. man-made physical alterations) due to shipping activities and intensive land use;
- in terms of pollution pressures (point and diffuse) the water body is identified as “probably not at risk” – the point source assessment considers the discharge from the existing WWTP; and
- the “probably not at risk” description results from assessment of the existing plant discharge sampling data in accordance with the UWWTD standards and indicates that treated effluent complies with quality standards.

The WFD is an umbrella directive in that it incorporates the requirements of some other earlier pieces of European legislation. The Urban Waster-water Treatment Directive (91/271/EEC) will continue to remain in force in parallel with the WFD. The compliance with the emission control standards set by the UWWTD is identified within the WFD as one of the “basic measures” to be included in the river basin management process. Consequently it remains valid to assess the effluent standards in relation to the UWWTD.

In 2006, the WFD will introduce new classification schemes to describe the status of water bodies. The classification schemes will include biological indicators not currently routinely monitored in Ireland which will result in additional future monitoring requirements and may necessitate more stringent management measures. For transitional waters, the WFD status biological elements will include phytoplankton,

macroalgae (e.g. seaweeds), angiosperms (e.g. sea grasses), benthic invertebrate fauna and fish fauna.

### 10.1.5 Predicted Trends

The main changes to the water quality of Galway Bay may well stem from increased human populations in Galway City and its immediate hinterland. Without adequate wastewater treatment provision, unsatisfactorily treated effluent will reach Galway Bay. This would result in degradation of local water quality and potential breach of water quality standards if sufficient treatment capacity is not available. Accordingly, it is proposed to develop a new Galway East WWTP in the Galway County Council area, in the context of a strategic overview of Galway Main Drainage.

### 10.1.6 Information Gaps

Several small gaps in baseline data have been identified (i.e. no suspended sediment data for Galway Bay or data on toxic substances) but these are not critical to the assessments undertaken in **Section 10.3**.

## 10.2 Potential Effects and Incorporated Mitigation

### 10.2.1 Potential Effects During Construction and Incorporated Mitigation

The Scoping Report (TOBIN, O'Dwyer and Entec, 2004) has identified that no assessment of the construction phase will be progressed in relation to water quality (see **Table 4.1**). Although construction can lead to accidental releases of fuels/oils and soils/sediments to Galway Bay the limited construction being undertaken, entirely within a previously developed site, reduces the risk to a level where no likely significant effects will result.

The construction phase of the development is contained entirely within the existing WWTP site, although access to the site by construction and delivery vehicles will take place across the adjoining causeway.

Potential sources of construction phase pollution include:

- excavations, exposed ground and stockpiles (especially pumping of water from excavations);
- plant and wheel washing; and
- spillages of oils, fuels, cement and concrete from site operations.

There is a general prohibition on entry of polluting matter to waters<sup>30</sup> under the Local Government (Water Pollution) Act 1977 (as amended). The entry of any of these pollutants to a water body during construction has the potential to result in significant

<sup>30</sup> 'waters' include, 'any tidal waters'.

effects on the water quality in the immediate vicinity, and if spill volumes are large at a significant distance from the site e.g. if fuels/oils enter coastal waters.

However, the area for construction is contained within the existing WWTP site. The surface water run-off from paved areas on Mutton Island goes into gullies that drain to individual high level surface water outfalls in the rock armour. There are tideflex valves on the outfalls and they are located intermittently between 15 and 25m around the perimeter of the works. This well contained environment allows for good control of any spillages which can easily be contained within this impermeable site and diverted to treatment tanks, if appropriate (e.g. for turbid water collected in excavations).

A range of site practices will be established to reduce the potential for pollution to reach Galway Bay to the lowest practicable level, including:

- any stockpiled material will be kept to a minimum and nearby drains will be temporarily isolated to remove pollutant pathways. Any turbid water will be collected and treated at the WWTP;
- refuelling and maintenance of equipment will be carried out within contained areas (e.g. on hardstanding) with nearby drains temporarily isolated and oil spill prevention kits available (with staff trained in their use); and
- any areas where cement or concrete use is being undertaken will have nearby drains identified and temporarily isolated to remove pollutant pathways.

Following best practice construction guidelines on this well contained site will ensure that no significant effects are likely during the construction phase.

### 10.2.2 Predicted Effects During Operation and Incorporated Mitigation

Sewage has a number of potential effects in receiving waters:

- nutrient enrichment leading to eutrophication;
- organic loading leading to oxygen depletion;
- bacterial loading leading to potential effects on users such as bathers and consumers of shellfish;
- toxic effects on aquatic biota, the most notable of which in sewage is that from high ammonia concentrations; and
- sediment loading leading to effects on ecology due to reduction in light penetration and (if excessive) abrasion and smothering.

The final treated effluent of the upgraded WWTP will be subject to strict quality standards that reflect the legislative status of the discharge and designed to be environmentally protective, to ensure that there are no significant adverse effects on the water quality of Galway Bay and the identified uses within it (e.g. bathing waters and shellfish waters).



### Urban Wastewater Treatment Regulations

The Urban Wastewater Treatment Regulations (UWWTR) implement Directive 91/271/EEC and govern the planning and design of all sewage infrastructure. The treated effluent discharged from Mutton Island WWTP must be compliant with the UWWTR, and the effluent concentrations in **Table 10.5** therefore continue to apply.

The UWWTR classifies several areas as sensitive to eutrophication and requires nutrient removal for those areas. As identified under the ‘eutrophication’ baseline description in **Section 10.1.4**, Galway Bay is not currently designated as sensitive and therefore the effluent concentrations in **Table 10.5** apply. However, Galway Bay may, at a future time, be designated as sensitive. Nevertheless the parameters listed in **Table 10.17** could additionally apply. Given that the treated effluent is discharged to the marine environment, it is likely that only the nitrogen limit would apply.

**Table 10.17 UWWTR effluent nutrient concentrations (Second Schedule, Part 2, S.I. 254/2001) if Galway Bay Designated as Sensitive**

| Parameter        | Concentration (mg/l)<br>(annual mean) | Minimum<br>% reduction <sup>1</sup> |
|------------------|---------------------------------------|-------------------------------------|
| Total nitrogen   | 10                                    | 70-80                               |
| Total phosphorus | 1                                     | 80                                  |

Adherence to the UWWTR standards is seen as the main mitigation measure for the operational phase.

### Avoidance / Reduction

**Table 10.18** summarises the incorporated mitigation measures.

**Table 10.18 Avoidance/reduction measures – likely effects**

| Receptor            | Changes and potential effects | Incorporated mitigation measures and rationale for their likely effectiveness |
|---------------------|-------------------------------|---|
| <b>Construction</b> |                               |   |

| Receptor             | Changes and potential effects   | Incorporated mitigation measures and rationale for their likely effectiveness  |
|----------------------|---|--|
| Waters of Galway Bay | Increase in polluting matter discharged to receiving waters with subsequent deterioration of water quality.                                       | High certainty of effectiveness:<br><br>Construction will be limited to within the existing WWTP site which is a highly controllable environment where pollution can be contained and subsequently treated.<br><br>A range of best practice mitigation measures will be employed to reduce the likelihood of pollution reaching Galway Bay.  |
| <b>Operation</b>     |   |  |
| Waters of Galway Bay | Increase in treated effluent discharge leading to deterioration of water quality and failure of mandatory (or guideline) water quality standards. | High certainty of effectiveness:<br><br>Design of the sewage treatment processes to achieve the UWWTR quality standards will prevent any significant adverse effects on the water quality of the receiving water.<br><br>Standards are designed to be environmentally protective and to comply with the relevant legislation.<br><br>Water quality modelling of the residual effects is presented in <b>Section 10.3</b> . |

## Compensation

No compensation has been identified or is relevant.

### 10.2.3 Implementation of mitigation and enhancement measures

The implementation mechanisms for the identified mitigation measures are given in **Table 10.19**

**Table 10.19 Implementation of incorporated mitigation and enhancement measures**

| Description of measures including any monitoring requirement  | Responsibility for implementation | Implementation mechanism |
|---|-----------------------------------|--------------------------|
| <b>Construction</b>   |                                   |                          |
| A range of best practice mitigation measures will be employed to reduce the likelihood of pollution reaching Galway Bay.  | Contractor                        | Contract documents       |
| <b>Operation</b>  |                                   |                          |
| Design and operation of the sewage treatment processes to achieve the UWWTR quality standards will prevent any adverse effects on the water quality of the receiving water. | Site Designer and Operator        | Contract Documents       |

## 10.3 Assessment of Effects

### 10.3.1 Scope and Methodology

#### Construction

As identified in **Table 4.1** no assessment has been carried out in relation to construction effects on the water environment. However, **Section 10.2** identifies that the current WWTP site (which is well contained), along with the proposed construction scale will not result in significant, adverse effects on water quality in Galway Bay (or elsewhere).

#### Operation

Operational effects comprise those associated with the treated effluent discharge from the upgraded works. Following the adoption of the UWWTR standards (presented in **Table 10.5**) the discharge from the site has the potential to cause degradation of water quality in Galway Bay and this has been assessed.

Within the bay there are many designations in place to protect water quality for a variety of users and reasons, and these are set out in **Section 10.1** (in the baseline case). A two-dimensional hydraulic dispersion model has been used to predict the effect of the increased discharges to Galway Bay (specifically the identified receptors and their associated water quality standards) under a variety of conditions, in particular to identify the extent and scale of the plume's influence and its potential to cause breaches of identified standards. A more complete description of the modelling is contained in **Appendix E**.

### 10.3.2 Significance evaluation methodology

The following significance descriptors are used in this section of the ES:

- Major – effects of the development which cause breaches of statutory EU or national water quality standards; or which provide the basis for undesirable disturbance of associated marine ecosystems (e.g. with respect to eutrophication); or are important on a scale greater than local (in this context 'local' is defined as Galway Bay) that cannot be mitigated;
- Minor – effects of the development which cause breaches of guideline EU or national water quality standards that cannot be mitigated; and
- Non-Significant: effects that cause changes to water quality in a localised area which are perceptible but do not breach any mandatory or guideline standards; or any effects which are below normal levels of detection.

The following terms are used to identify the time scale of effects

- Short term - < 12 months
- Medium term – 1-5 years

- Long term - > 5 years

### 10.3.3 Predicted effects and their significance

#### Construction

No significant effects have been identified.

#### Operation

As stated in **Section 3.3**, effluent will be secondary treated to a standard designed to comply with the UWWTR and protect the receiving water environment (associated users and ecology). Assessment of the residual effects of the discharge have been made using the modelling process outlined in **Appendix E**. As for the future situation, modelling has assumed 3DWF through full treatment at the WWTP, a maximum concentration of 25mg/l BOD<sub>5</sub> allowed under the UWWTR and an effluent concentration of 25mg/l (as N) for ammonia. This represents a realistic worst-case situation and has been used as the basis for this assessment. Realistically, the flows will not reach 3DWF very often and the quality of the treated effluent will be better than the licenced limits. These factors will combine so that the effect of the discharge will be much reduced from that outlined here on a more normal, daily basis.

Predicted initial dilutions achieved by the WWTP (under future 3DWF flow conditions) over the tidal range experienced at the outfall location indicate that under near worst case conditions (95 percentile) a dilution of 18:1 will be achieved, with an initial dilution of >32:1 achieved for 50% of the time. A maximum dilution of 136:1 has been calculated under a spring tide scenario.

An initial discussion is presented in relation to the movement of the plume followed by a discussion of the effects broken down by component.

The results of the modelling are generally presented as ‘maximum concentration plots’ for a whole tidal cycle. It should be noted that this does not therefore represent the situation for any one point in time but represents the worst case concentration of the substance being modelled over a whole semi-diurnal tide. This representation allows determination of the influence of the whole plume without resorting to assessment of individual scenarios for differing times during the tidal cycle. If an issue arises, as evidenced by the maximum concentration plot, further assessment can be made.

#### ***Biochemical Oxygen Demand (BOD<sub>5</sub>) and Dissolved Oxygen***

**Figure 10.2b** presents the maximum concentration plot for BOD based on a predicted discharge from 170,000 p.e. under 3 times the dry weather conditions (3DWF) (over a whole tidal cycle). This result is directly comparable to the baseline (current) scenario shown in **Figure 10.2a**.

It can be seen that although the influence of the discharge increases BOD concentrations in the area under the influence of the discharge, concentrations still remain below 1mg/l

(as O) except in the surface boil itself under near worst case (95-percentile) predicted initial dilutions with flows of 3DWF<sup>31</sup>. Under the best operating and environmental conditions these levels of BOD are significantly below both of the BOD standards highlighted in **Table 10.7** and it can therefore be considered unlikely that the discharge will significantly alter the dissolved oxygen in the area immediately outside of the initial dilution mixing zone. No significant effects are therefore predicted on dissolved oxygen levels in Galway Bay above the baseline scenario (i.e. considering the current discharge).

### *Ammonia*

**Figure 10.3b** presents the maximum concentration plot for total ammonia based on a predicted discharge from 170,000 p.e. under dry weather conditions (over a whole tidal cycle). This result is directly comparable to the baseline (current) scenario shown in **Figure 10.3a**.

It can be seen that higher total ammonia concentrations arise in Galway Bay as a result of the upgrade compared to the current situation. This is a result of a higher ammonia loading, which is a function of a higher p.e. load and the decision to increase throughput of the WWTP by changing the treatment from a nitrifying to non-nitrifying plant (see **Section 3.3.1**).

In terms of environmental effect, a number of standards are set out in **Table 10.9**. It is considered that those recently identified by the UK's Environment Agency (UK Environment Agency, 2005) to assist in assessment of discharges in relation to the EU Habitats Directive (92/43/EEC) are the most useful. These standards are shown below:

- total ammonia annual average concentration of 1.1 mg/l (as N);
- total ammonia maximum concentration of 8.0 mg/l (as N); and
- un-ionised ammonia annual average concentration of 21 µg/l (as N).

If it is assumed that the maximum concentration plot presented in **Figure 10.3b** represents annual average conditions<sup>32</sup>, then no significant effects are identified with respect to the total ammonia standards. Concentrations approaching 8.0mg/l (as N) will only be present in, or very close to, the surface boil and the 1.1mg/l (as N) annual average concentration is present over a very small area surrounding the surface boil. Indeed, concentrations of total ammonia decrease rapidly away from the discharge point so that at the entrance to the Corrib Estuary (at Nimmo's Pier) levels are below 10% of the annual average standard (i.e. <0.11mg/l (as N)).

<sup>31</sup> The UWWR standard of 25mg/l diluted by 18 parts of water from Galway Bay results in a surface concentration of 1.31 mg/l BOD. Under the best dilutions available 25mg/l diluted by 136 parts of water from Galway Bay results in a surface concentration of 0.18 mg/l BOD.

<sup>32</sup> This represents a worst case assessment as the plot represents maximum concentrations not averages.

The residual total ammonia concentrations can be considered therefore not to breach the chosen criteria away from the surface boil of the discharge and no significant effects have therefore been identified.

With respect to the un-ionised ammonia standard of 21 µg/l (as N), by averaging out the winter and summer proportions the average un-ionised ammonia proportion is 6.22% of the total. Using these data, the 21 µg/l (as N) un-ionised ammonia standard equates to a total ammonia concentration of 0.337 mg/l (as N) for an annually averaged scenario.

**Figure 10.3b** shows that this concentration is exceeded for a very small area around the discharge's surface boil and therefore no extensive breaches of the standard have been identified. No significant effects are therefore predicted in relation to un-ionised ammonia within Galway bay as a result of the discharge.

#### ***Other toxic contaminants***

It is important that input of persistent toxic contaminants to the WWTP are minimised, as some compounds/chemicals can have a deleterious effect on the effectiveness of the biological secondary treatment stage, as well as causing potential ecological damage in the receiving environment. The dilutions of very small concentrations of substances within the treatment processes will reduce residual concentrations even further. There is no evidence that the treated effluent from the WWTP is likely to contain elevated levels of any particular toxic and persistent substances, so this aspect has not been considered further.

#### ***Bacterial levels in relation to Bathing Waters***

A 'maximum concentration envelope' of faecal coliforms over a complete tidal cycle has been produced (**Figure 10.5**) with the individually modelled scenarios presented in **Appendix G**.

The standards for assessment are set out in **Table 10.11** and show that the most stringent mandatory standard for faecal coliforms is the 1,000/100ml National Bathing Water standard (to be confirmed by 95% of samples and not exceeded by any two consecutive samples). **Figure 10.5** shows that maximum faecal coliform concentrations soon reduce to below this level due to secondary dilution and dispersion. The area where maximum concentrations exceed this level extends in a north-easterly direction (on a flood tide) less than 1 km from the discharge point and to the west (on an ebb tide) for approximately 1 km, with no portion of coastline on the mainland affected.

A guideline concentration under the EU bathing waters directive of 100/100ml exists (to be confirmed by 80% of samples and not exceeded by any two consecutive samples). This standard also applies to Blue Flag beaches but as a mandatory standard. **Figure 10.5** shows that this value can be exceeded (as a maximum) along a small portion of the coastline to the north of Mutton Island (to the east and west of the causeway). This area includes Grattan Beach which is designated as a National Bathing Water. With reference to the scenarios shown in **Appendix G**, it can be seen that it is only when a strong (Force 6) southerly or south-easterly wind prevails that concentrations of faecal coliforms increase at Grattan Beach as a result of the discharge. It is considered highly

unlikely that anyone would actually be bathing at this location under these high wind conditions.

To determine the effect of the discharge on the Grattan Beach bathing water further, a probability assessment of the 100/100ml faecal coliform standard being breached has been undertaken. The frequency of wind strength and direction combinations was determined using data from Belmullet and this was then multiplied with the number of hours that the standard would be breached per tidal-cycle under the differing conditions. This was then converted into compliance as a proportion of a year. The results of this assessment are presented in **Table 10.20**

**Table 10.20 Probability of faecal coliforms exceeding 100/100ml at Grattan Beach**

| Wind Condition  | % Occurrence | Time 100/100ml exceeded during one tidal cycle (h) |      |         |                  |              |
|---|--------------|--|------|---------|------------------|--------------|
|   |              | Spring   | Neap | Average | % of Tidal Cycle | % of Year    |
| Calm  | 32.03        | 0.00   | 0.00 | 0.00    | 0.00             | 0.00         |
| F3 East   | 4.59         | 0.00   | 0.00 | 0.00    | 0.00             | 0.00         |
| F6 East   | 0.75         | 0.00   | 0.00 | 0.00    | 0.00             | 0.00         |
| F3 South East   | 5.24         | 0.00   | 0.00 | 0.00    | 0.00             | 0.00         |
| F6 South East   | 1.63         | 3.75   | 3.50 | 3.63    | 29.39            | 0.48         |
| F3 South  | 6.66         | 0.00   | 0.00 | 0.00    | 0.00             | 0.00         |
| F6 South  | 6.33         | 3.75   | 3.00 | 3.38    | 27.36            | 1.73         |
| F3 South West   | 9.51         | 0.00   | 0.00 | 0.00    | 0.00             | 0.00         |
| F6 South West   | 8.76         | 0.00   | 0.00 | 0.00    | 0.00             | 0.00         |
| F3 West   | 9.50         | 0.00   | 0.00 | 0.00    | 0.00             | 0.00         |
| F3 West   | 5.77         | 0.00   | 0.00 | 0.00    | 0.00             | 0.00         |
| F3 North West   | 6.63         | 0.00   | 0.00 | 0.00    | 0.00             | 0.00         |
| F6 North West   | 2.60         | 0.00   | 0.00 | 0.00    | 0.00             | 0.00         |
| <b>Percent of time 100/100ml exceeded in a typical year</b> |              |  |      |         |                  | <b>2.21</b>  |
| <b>Compliance during a typical year</b>                     |              |  |      |         |                  | <b>97.79</b> |

It can be seen that in a typical year compliance with the 100/100ml faecal coliform standard is 97.79%. This exceeds the requirement for the standard to be complied with, of 80% of the time, by a large margin.

Although there will be other influences on bacterial concentrations at the Grattan bathing water it can be seen that the proposed Mutton Island discharge will meet the

requirements of the mandatory and guideline / Blue Flag standards. Overall, compliance with all guideline and mandatory standards is expected following upgrading of the WWTP.

### *Viruses*

No information on sewage related viruses in Galway Bay has been identified, either for the enteroviruses typically measured in relation to the Bathing Water Directive or for norovirus, the most common cause of gastric upsets after sea bathing. However, the high level of compliance predicted with the most stringent bacterial standards suggests that risks of elevated levels of any sewage derived viruses at the bathing waters will be very low.

### ***Bacterial levels in relation to Shellfish Waters***

It is considered that the oyster and mussel beds at Mweeloon Bay are the most sensitive shellfish bed receptors in relation to treated effluent discharged from Mutton Island due to their proximity to the discharge compared to other beds which are located in the side embayments of Galway Bay which are probably influenced by other, local sources of contamination.

A 'maximum concentration envelope' of faecal coliforms over a complete tidal cycle using contours based on the Shellsan Classification System has been produced (**Figure 10.6**). It can be seen that in Mweeloon Bay (the most sensitive shellfish water in relation to Mutton Island WWTP) the maximum predicted faecal coliform concentrations are well below the allowable 99-percentile level of 46/100ml and also below the allowable geometric mean of 14/100ml. Therefore the predicted influence of the future 170,000 p.e. treated discharge is deemed not to significantly affect shellfish concerns in Mweeloon Bay, or indeed any other designated area within Galway Bay.

### ***Suspended sediments***

**Table 10.14** shows that, under the baseline case, the current Mutton Island WWTP contributes 0.802 tonnes/day of suspended sediment to Galway Bay (4.9% of the combined loading with the River Corrib). Undertaking the same calculations for the proposed WWTP up to its design maximum of 170,000 p.e. increases the loading to 1.488 tonnes/suspended sediment day. This equates to 8.8% of the combined loading with the River Corrib. Overall the total loading of suspended sediment from these two sources will increase by 4.2% over the current baseline situation. Other inputs will occur but no data is available on these and they are likely to be small in comparison.

As the discharge will be limited to the UWWTR standard of 35mg/l, residual suspended sediment contributions at the surface will be <2mg/l above background levels (under 3DWF 95-percentile initial dilution conditions) and this level will rapidly reduce due to secondary dilution and dispersion. This is a low level compared with the 20mg/l EC Freshwater Fish Directive Standard used as a guideline for assessing impacts. Additionally, the dominant Corrib loading and natural background (marine sourced) concentrations within Galway Bay will mean that no significant effects in relation to suspended sediment are likely from the upgrading of the WWTP.

### ***Trophic status and nutrients***

**Figure 10.4b** shows the modelling results of the combined discharge from the River Corrib and the proposed Mutton Island WWTP on total nitrogen concentrations within Galway Bay. In comparison with the River Corrib's contribution alone (**Figure 10.4a**), which is not quite the baseline case, it can be seen that only a very slight increase in the spatial area of Galway Bay affected is apparent due to the proposed upgrade of the WWTP, specifically the area to the west of Mutton Island.

**Table 10.16** identifies that under the baseline case the current Mutton Island WWTP contributes 0.37 tonnes/Nitrogen day to Galway Bay (9.77% of the combined loading with the River Corrib). Undertaking the same calculations for the proposed WWTP up to its design maximum of 170,000 p.e. increases the loading to 0.70 tonnes/nitrogen day. This equates to 16.8% of the combined loading with the River Corrib. Overall the total loading of nitrogen from these two sources will increase by 8.6% over the current baseline situation. Other inputs will occur but no data is available on these and they are likely to be small in comparison.

**Table 10.15** shows that the water quality indicators for eutrophication are, at present, easily complied with in inner Galway Bay (and the Corrib Estuary) even considering the large loading of nitrogen from the river. If the dissolved inorganic nitrogen (DIN) were to increase by 8.6% from those presented in **Table 10.15** in inner Galway Bay, due to the Mutton Island WWTP upgrade then the winter concentration would rise to 0.203 mg/l N (the winter limit is 0.519mg/l N) and the summer concentration would rise to 0.020 mg/l N (the summer limit is 0.499mg/l N). Neither the winter nor summer limit would be breached, or even approached, and it is considered highly unlikely that the trophic status of inner Galway Bay will change.

No significant effects are therefore predicted in relation to changes in nutrient concentrations and the trophic status of Galway Bay.

### ***Water Framework Directive***

The proposed upgrade at Mutton Island has the capacity to change the risk of the Corrib Estuary transitional water achieving its good status by the year 2015. The assessment criterion with respect to point source pollution pressures is compliance with emission control standards set by the Urban Waster-water Treatment Directive (91/271/EEC). As identified in **Section 10.2.2** the Urban Wastewater Treatment Regulations (UWWTR), which implement the Directive in Ireland, will be complied with and as such the risk of failing the WFD remains at the current level with respect to point source pollution i.e. "probably not at risk". No significant change is therefore predicted in the potential to conform with the requirements of the Directive.

### **10.3.4 Cumulative Effects**

With regard to cumulative effects, the only significant factor identified is the contribution of dominant loads of nitrogen and suspended sediment from the River Corrib. Modelling studies have identified the cumulative effect on nitrogen

concentrations and assessment shows that in relation to suspended sediments the Corrib inflow to the Bay will dominate.

Local bathing waters will be influenced by bacterial concentrations other than those from the Mutton Island WWTP but modelling has shown that only under highly limited wind and tide conditions will the Mutton Island WWTP affect any identified bathing water (i.e. Grattan). The large margin of compliance with the guideline faecal coliform standard predicted identifies that the influence of the Mutton Island discharge is not significant in terms of causing guideline level breaches in a typical year.

In relation to bacterial concentrations at designated shellfish waters, other inputs from local watercourses around Galway Bay are likely to have a greater affect on bacterial concentrations in shellfish waters than the Mutton Island discharge.

### 10.3.5 Compensation

No compensation has been identified.

### 10.3.6 Additional mitigation/enhancement measures

No additional mitigation or enhancement measures have been identified.

### 10.3.7 Summary of significance evaluation

Table 10.21 Effects on water quality and evaluation of significance

| Environmental effect  | Type of effect | Probability of effect occurring | Policy importance (or sensitivity) | Magnitude of effect | Significance Level | Rationale   |
|---|----------------|---------------------------------|------------------------------------|---------------------|--------------------|---|
| <b>Construction</b>   |                |                                 |                                    |                     |                    |   |
| Exceedance of water quality standard caused by a pollution event from construction operations   | -              | Unlikely                        | Local                              | Minor               | Not Significant    | The small scale of construction and the constraining of construction to within the existing WWTP reduces the risk of a pollution event occurring to a low level.  |
| <b>Operation</b>  |                |                                 |                                    |                     |                    |   |
| Increase in organic pollution leading to increased BOD and reduced dissolved oxygen in Galway Bay causing failure to comply with identified standards | -              | Unlikely                        | Local                              | Minor               | Not Significant    | Water quality modelling has shown that the influence of the proposed discharge is small and that the identified BOD standard will not be breached apart from in the discharge boil itself. No associated significant effects on dissolved |

| Environmental effect   | Type of effect | Probability of effect occurring | Policy importance (or sensitivity) | Magnitude of effect | Significance Level | Rationale   |
|--|----------------|---------------------------------|------------------------------------|---------------------|--------------------|---|
|  |                |                                 |                                    |                     |                    | oxygen are therefore likely.  |
| Increase in ammonia leading to increased ammonia in Galway Bay and exceedance of identified standards                  | -              | Unlikely                        | Local                              | Minor               | Not Significant    | Water quality modelling has shown that the influence of the proposed discharge is small and that the identified ammonia standards (total and unionised) will not be breached apart from in a small area surrounding the discharge location. |
| Increase in toxic contamination within Galway Bay and exceedance of identified standards                               | -              | Unlikely                        | Local                              | Minor               | Not Significant    | Toxic contaminants are restricted at entry to the sewerage system under a strict licensing regime   |
| Increase in bacterial loading leading to breaches of bathing water standards at identified locations within Galway Bay | -              | Unlikely                        | International                      | Minor               | Not Significant    | Water quality modelling has shown that no identified bathing water will have the mandatory or guideline / Blue Flag faecal coliform standard breached at any time as a result of the proposals.   |
| Increase in bacterial loading leading to a fall in shellfish standards at identified locations within Galway Bay       | -              | Unlikely                        | International                      | Minor               | Not Significant    | The contribution of Mutton Island WWTP to faecal coliform concentrations in designated shellfish waters is predicted to be very small and is unlikely to cause deterioration in current standards.  |
| Increase in suspended sediment loading leading to detrimental suspended sediment concentrations in Galway Bay          | -              | Unlikely                        | Local                              | Minor               | Not Significant    | Compliance with the UWWTR standard and the high initial dilutions from the outfall will ensure no issues arise. The Corrib provides the dominant, local loading of sediment.  |
| Increase in the loading of nutrients to Galway Bay causing an unacceptable change to its trophic status.               | -              | Unlikely                        | International                      | Minor               | Not Significant    | The River Corrib provides the dominant nitrogen loading to Galway Bay and assessment of the predicted DIN levels show easy compliance with identified eutrophication limits. The increased load is  |

| Environmental effect  | Type of effect | Probability of effect occurring | Policy importance (or sensitivity) | Magnitude of effect | Significance Level  | Rationale  |
|---|----------------|---------------------------------|------------------------------------|---------------------|---------------------|--|
|   |                |                                 |                                    |                     |                     | unlikely to cause a change of trophic status.  |
| No-compliance with the Water Framework Directive due to point source pollution effects. | -              | Unlikely                        | International                      | Minor               | Not Significant     | The WWTP will conform to the UWWTR standards and as such it has been identified that the WFD's target of 'good status' is probably not at risk from this point source pollution. |
| <b>Key:</b>   | <b>Type</b>    | <b>Probability</b>              | <b>Policy Importance</b>           | <b>Magnitude</b>    | <b>Significance</b> |  |
|   | - = Negative   | Certain                         | International                      | Major               | Major               |  |
|   | + = Positive   | Likely                          | National                           | Medium              | Minor               |  |
|   | ? = Unknown    | Unlikely                        | Regional                           | Minor               | Not Significant     |  |
|   |                |                                 | District                           | None                |                     |  |
|   |                |                                 | Local                              |                     |                     |  |

## 10.4 References

Environment Agency, 2005, *Ammonia Standards in Estuaries* (a paper for the Habitats Directive Technical Advisory Group on Water Quality).

Environmental Protection Agency, July 1997, *Hydrological Data*.

Environmental Protection Agency, 2001, *An assessment of the Trophic Status of Estuaries and Bays in Ireland*

MacGarvin, M., 1995, *Marine Eutrophication in the UK: A Discussion Document* – Report for the WWF.

Ospar Commission, 2004, *Data report on the Comprehensive Study of Riverine Inputs and Direct Discharges 2002*.

USEPA, 1989, *Ambient water quality criteria for ammonia (salt water) –1989*. Springfield VA

USEPA, 1999, *Update of ambient water quality criteria for ammonia (salt water) – 1999*. EPA-823-F99024. Washington DC.

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