

**Attachment I.1**  
**Assessment of Atmospheric Emissions**

*For inspection purposes only.  
Consent of copyright owner required for any other use.*

## Attachment I.1 – Assessment of Atmospheric Emissions

### I.1.A Description of existing environment in terms of air quality with particular reference to ambient air quality standards.

The attached Air Dispersion Model Report (Section 2.3.2) provides details on the existing air quality. Below is a summary outline of air quality.

There is no EPA ambient monitoring data for the Killybegs area. The area is considered rural/coastal and would experience predominately clean+Atlantic air masses. There is some light industry in the Killybegs area as well as residential and traffic-based sources, but the area would be classified as Zone D (rural) in terms of background air quality. There are some background residual odours from the fishing industry in the area.

From the EPA reports on ambient air quality from 2008 to 2009, the most representative monitoring station in terms of rural backgrounds is Kilkitt in Co. Monaghan. The annual average values recorded by the EPA at Kilkitt in the period 2008 to 2009 have been averaged and added to the air dispersion model results to give a total ground-level concentration. These background concentrations are considered representative of the Killybegs area and are presented in Table I.1(i).

There is no background data available on carbon monoxide at Zone D areas in 2009 so the annual mean from Letterkenny for 2008 and 2009 have been referenced to provide a background of 0.3mg/m<sup>3</sup>.

There is no available data on background odour concentrations or on background levels of individual substances. As such, background concentrations are set at zero for these substances.

Table I.1(i) Background concentrations added to modelled concentrations (averaged in the period 2008 -2009)

Parameter	Annual average µg/m <sup>3</sup>
Nitrogen Dioxide (as NO <sub>2</sub> )	3
Sulphur Dioxide (as SO <sub>2</sub> )	4
Particulates (as PM <sub>10</sub> )	9

### I.1.B Provide a statement of whether or not emissions of main polluting substances in the Schedule of EPA (Industrial Emissions)(Licensing) Regulations 2013, S.I. No. 137 of 2013) to the atmosphere to the atmosphere are likely to impair the environment.

The boilers and burner emit the following polluting substances listed in S.I. 137 of 2013:

- Sulphur dioxide and other sulphur compounds;
- Oxides of nitrogen and other nitrogen compounds;
- Carbon monoxide;
- Dust including fine particulate matter.

There are no other pollutants listed in S.I. 137 of 2013 emitted to atmosphere from the plant. Details of these boiler emissions are presented in Table E.1(i) of the main application form document.

Emissions of these pollutants have been modelled to determine the impact on the environment. A dispersion model was completed in 2011 as part of the previous licence application (P0416-03). A copy of this report on the dispersion model is included in this attachment.

An updated dispersion model of the impacts of all boilers is presented in Chapter 5 of the EIS, which is included in Attachment B.6(b). This updated dispersion model takes into account the

addition of a new HFO fuelled boiler (A1-4) which will replace the burner (A1-3) as part of the reconfigured plant.

**I.1.C Give summary details and an assessment of the impacts of any existing or proposed emissions on the environment, including environmental media other than those into which the emissions are to be made.**

A refined dispersion model assessment has been undertaken to simulate the emissions from the UFI facility in Killybegs, Co. Donegal. The modelling procedure has followed that presented by the EPA in Guidance Note AG4 and the report detailing the results of this model is included in Chapter 5 of the EIS, which is included in Attachment B.6(b).

Two scenario models have been produced to account for combustion gases and odours. The models have built-in a highly conservative operational scenario (continuous operations at IE/BAT emission levels) to ensure that the worst-case emissions have been quantified. As such, the results should be viewed as worst-case and emissions from normal operations will be significantly lower than those presented in this report.

Scenario A represents the combustion emissions from the facility comprising of boiler emissions (two boilers, one burner and one steam generator). Modelling was undertaken at BAT limits in the first instance (particulates only); and where there are no BAT limits, the licence limits were employed (nitrogen dioxide and sulphur dioxide); and where there are no BAT or licence limits the TA Luft Guidelines are employed (carbon monoxide).

In summary, the results of modelling of the existing combustion operations show that emissions at the prescribed levels do not breach any of the statutory limits for the protection of human health. This is true with a considerable background concentration built into the modelled results. As such, it can be concluded that even the worst-case operations of the site (all emission points operating continuously and at the emission rates outlined below) the combustion emissions are not having a significant impact on air quality in the area. The results are presented in Table 5.5 of Chapter 5 of the EIS.

As a result, the emission limit values presented in Table I.1(ii) are proposed for Stage 1, 2 and 3 of the Industrial Emissions Review Licence application. This model has demonstrated that these emission limits will not have an adverse impact on air quality or human health in the area.

Table I.1(ii): Proposed Combustion Emission Limits

Parameter	Limit Type	A1-1	A1-2	A1-3	A1-4	A1-5
Volume Flow	Volume Flow (Nm <sup>3</sup> /hr)	22,000	22,000	14,000	22,000	900
Nitrogen Oxides	Concentration (mg/m <sup>3</sup> )	1,000	1,000	1,400	1,000	200
Nitrogen Oxides	Mass Emission (kg/hr)	22.00	22.00	19.74	22.00	-
Sulphur Oxides	Concentration (mg/m <sup>3</sup> )	1,080	1,080	1,560	1,080	-
Sulphur Oxides	Mass Emission (kg/hr)	23.80	23.80	22.00	23.80	-
Carbon Monoxide	Concentration (mg/m <sup>3</sup> )	100	100	100	100	80
Carbon Monoxide	Mass Emission (kg/hr)	1.10	1.10	0.70	1.10	-
Particulates	Concentration (mg/m <sup>3</sup> )	50	50	50	50	-
Particulates	Mass Emission (kg/hr)	2.20	2.20	1.41	2.20	-

Scenario B represents the existing emissions points operating within the BAT limits for odour compounds (as set out in Table 2.1 of the 2011 Air Dispersion Model report) as well as the odour scrubber main emission point (A2-1). The concentration limits expressed in the existing licence for the boiler/burner emission points are largely in line with the BAT Guidance note. Only the ammonia limit differs with the licence limit stricter (27µg/m<sup>3</sup>) than the BAT limit (30µg/m<sup>3</sup>).

In summary, the results of the modelling exercise of the odour emissions from the boiler and main emission points shows that emissions at the prescribed levels do not exceed any of the short term or long term Environmental Assessment Levels (EALs) for the protection of human

health. As such, it can be concluded that even for the worst-case scenario (all emission points operating continuously and at the emission rates outlined below) the odour emissions will not have a significant impact on air quality in the area. It should be noted that ongoing monitoring at the facility indicates that emission points A1-1, A1-2 and A1-3 are in full compliance with the BAT emission limits (also the current licence limits in P0416-01).

As a result of the low impact of these emissions at BAT limits, the emission limit values presented in Table I.1(iii) are in this Industrial Emission Review Licence application. This model has demonstrated that these emission limits will not have an adverse impact on air quality or human health in the area.

Table I.1(iii): Proposed Odour Chemical Emission Limits

Parameter	Limit Type	A1-1	A1-2	A1-3	A2-1	A2-2	A2-3
Volume Flow	Volume Flow (Nm <sup>3</sup> /hr)	22,000	22,000	14,000	19,000	26,000	15,000
Ammonia	Concentration (mg/m <sup>3</sup> )	30	30	30	30	30	30
	Mass Emission (kg/hr)	0.15	0.15	0.15	0.15	-	-
Amines and Amides	Concentration (mg/m <sup>3</sup> )	5	5	5	5	5	5
	Mass Emission (kg/hr)	0.11	0.11	0.07	0.09	-	-
Total hydrogen Sulphide, sulphides and mercaptans (expressed as S)	Concentration (mg/m <sup>3</sup> )	5	5	5	5	5	5
	Mass Emission (kg/hr)	0.015	0.015	0.015	0.015	-	-
Total Organic Carbon (as C)	Concentration (mg/m <sup>3</sup> )	50	50	50	50	50	50
	Mass Emission (kg/hr)	0.50	0.50	0.50	0.50	-	-

In relation to the Stage 3 odour infrastructure, limits and impacts in the 2011 Air Dispersion Model Report for the previous licence application (P0416-01), this report highlighted a number of short-term and medium-term options which may be undertaken as part of the facility restructuring for the Stage 3 application to meet the BAT requirements.

To date the following recommendations have been implemented:

- *It would be an option to fit end of pipe treatment to the vents to atmosphere from the three raw material silos at the western boundary of the site. Given the nature of the emissions (amines and ammonia) and the moisture levels a possible option may be an activated carbon filter.*

These carbon filters have been installed in August 2011 and further technical details are presented in Attachment F.1.

In addition, a carbon scrubber (emission point reference A2-2) was installed in 2012 to draw headspace air from the LT Dryer Area through a custom designed carbon filter and discharged through a new stack at the northern façade of the production building. A new carbon abatement system (emission point reference A2-3) has been installed in 2013 for the abatement of odours from process airs in the facility. Currently, these odours are abated by

means of oxidation in the boilers before discharge through A1-1 and A1-2, however, for back up abatement in the event of a boiler failure this new system was installed.

With the improved operation of the site and the continued odour management at the facility, the impacts to air quality are considered negligible.

In summary, the existing operations of the UFI facility in Killybegs will not result in significant impacts off-site. Emissions to air were assessed using a refined air dispersion model and the results indicate that emissions of combustion gases and odour compounds will not breach statutory limits or standard guidelines for the protection of human health under the limits expressed in this conclusion.

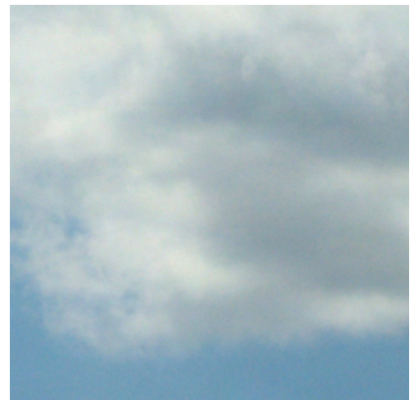
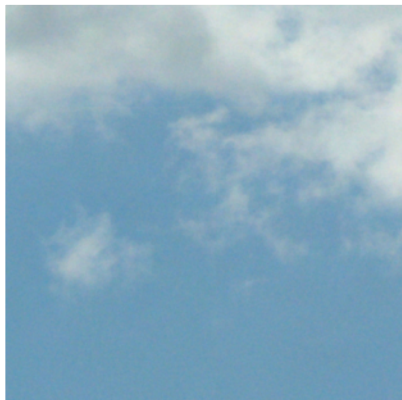
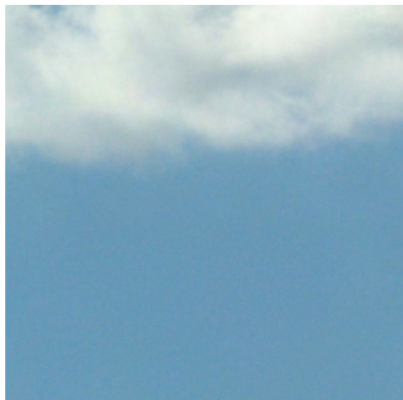
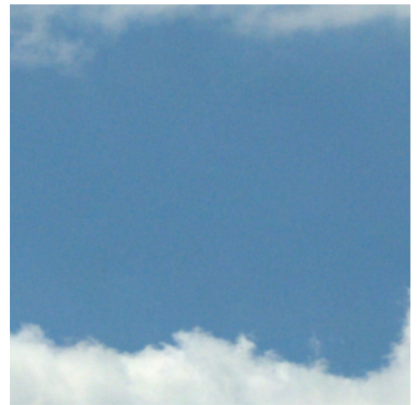
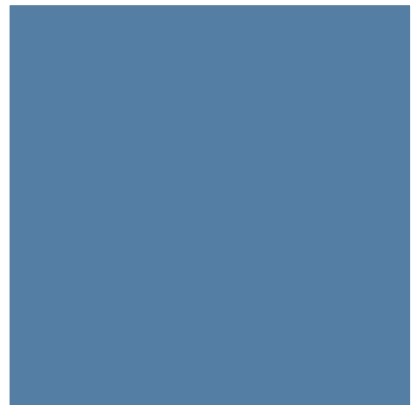
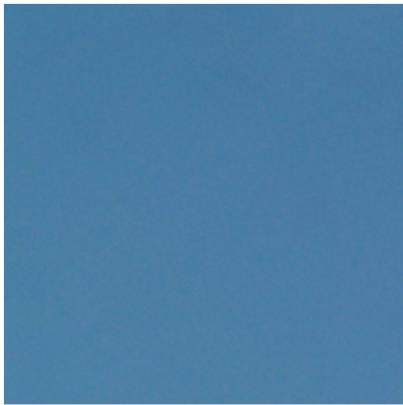
*For inspection purposes only.  
Consent of copyright owner required for any other use.*

# Air Dispersion Model Report

United Fish Industries

MDE1003Rp0001

June 2011



*For inspection purposes only.  
Consent of copyright owner required for any other use.*



# Air Dispersion Model Report for IPPC Application

## United Fish Industries Limited

### DOCUMENT CONTROL SHEET

Client	United Fish Industries Limited					
Project Title	United Fish Industries Limited IPPC Licence Review					
Document Title	Air Dispersion Model Report for IPPC Application					
Document No.	MDE1003R00001					
This Document Comprises	DCS	TOC	Text	List of Tables	List of Figures	No. of Appendices
	1	1	33	1	-	-

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
F01	Final	P. Chadwick	R. Murphy	C. Reilly	West Pier	02/06/11

# TABLE OF CONTENTS

<b>1</b>	<b>INTRODUCTION</b> .....	<b>1</b>
<b>2</b>	<b>EMISSIONS TO ATMOSPHERE</b> .....	<b>2</b>
2.1	ASSESSMENT OBJECTIVE.....	2
2.2	BAT GUIDANCE .....	3
2.3	DISPERSION MODELLING.....	4
2.3.1	Source Information.....	5
2.3.2	Background Concentrations.....	5
2.3.3	Pathway (Meteorological files).....	6
2.3.4	Receptors.....	6
2.3.5	Assessment Criteria .....	7
<b>3</b>	<b>MODELLING RESULTS</b> .....	<b>9</b>
3.1	SCENARIO A (COMBUSTION EMISSIONS).....	9
3.2	SCENARIO B: CURRENT ODOUR EMISSIONS FOR STAGE 1 AND 2 .....	20
3.3	OPTIONS FOR ODOUR EMISSIONS FOR STAGE 3.....	30
<b>4</b>	<b>CONCLUSION</b> .....	<b>32</b>

For inspection purposes only.  
Consent of copyright owner required for any other use.

--

## LIST OF TABLES

Table 2.1: BAT Emission Levels for Discharges to Air .....	3
Table 2.2: Existing IPPC licence limits for combustion gases.....	4
Table 2.3: Emission point details for dispersion model.....	5
Table 2.4 Background concentrations added to modelled concentrations (averaged in the period 2008 -2009) .....	5
Table 2.5: Ambient Air Quality Limits as expressed in S.I. 180 of 2011 .....	7
Table 2.6: Ambient Air Quality Guidelines from the UK Environment Agency .....	8
Table 3.1: Scenario A Combustion Emission Factors (based on existing limits) .....	9
Table 3.2: Scenario A Combustion Emission Factors (based on standard guidance) .....	9
Table 3.3: Results of modelling of Scenario A (Existing) Boiler Emissions .....	10
Table 3.4: Proposed Combustion Emission Limits .....	12
Table 3.5: Scenario B Odour Emission Factors (based on BAT limits) .....	20
Table 3.6: Results of modelling of Scenario B Odour Emissions .....	21
Table 3.7: Proposed Odour Chemical Emission Limits.....	23
Table 4.1: Proposed Combustion Emission Limits .....	32
Table 4.2: Proposed Odour Chemical Emission Limits.....	33

## LIST OF FIGURES

Figure 2.1 Windrose for the Belmullet Met Station for 2009. ....6

Figure 3.1: Scenario A Maximum 1-hour NO<sub>2</sub> Concentrations (Contours represent 42µg/m<sup>3</sup>, 40µg/m<sup>3</sup> and 38µg/m<sup>3</sup>). Backgrounds not included. Statutory limit for the protection of human health 200µg/m<sup>3</sup> (as NO<sub>2</sub>). ....13

Figure 3.2: Scenario A Annual Average NO<sub>2</sub> Concentrations (Contours represent 2.2µg/m<sup>3</sup>, 2.0µg/m<sup>3</sup> and 1.8µg/m<sup>3</sup>). Backgrounds not included. Statutory limit for the protection of human health 40µg/m<sup>3</sup> (as NO<sub>2</sub>). ....14

Figure 3.3: Scenario A Maximum 1-hour SO<sub>2</sub> Concentrations (Contours represent 130µg/m<sup>3</sup>, 120µg/m<sup>3</sup> and 110µg/m<sup>3</sup>). Backgrounds not included. Statutory limit for the protection of human health 350µg/m<sup>3</sup>. ....15

Figure 3.4: Scenario A Maximum 24-hour SO<sub>2</sub> Concentrations (Contours represent 80µg/m<sup>3</sup>, 60µg/m<sup>3</sup> and 40µg/m<sup>3</sup>). Backgrounds not included. Statutory limit for the protection of human health 125µg/m<sup>3</sup>. ....16

Figure 3.5: Scenario A Maximum 8 hour CO Concentrations (Contours represent 0.009mg/m<sup>3</sup>, 0.008mg/m<sup>3</sup> and 0.007mg/m<sup>3</sup>). Backgrounds not included. Statutory limit for the protection of human health 10mg/m<sup>3</sup>. ....17

Figure 3.6: Scenario A Maximum 24 hour Particulate Concentrations (Contours represent 3.0µg/m<sup>3</sup>, 2.5µg/m<sup>3</sup> and 2.0µg/m<sup>3</sup>). Backgrounds not included. Statutory limit for the protection of human health 50µg/m<sup>3</sup> (as PM<sub>10</sub>). ....18

Figure 3.7: Scenario A Annual Average Particulate Concentrations (Contours represent 0.30µg/m<sup>3</sup>, 0.25µg/m<sup>3</sup> and 0.20µg/m<sup>3</sup>). Backgrounds not included. Statutory limit for the protection of human health 40µg/m<sup>3</sup> (as PM<sub>10</sub>). ....19

Figure 3.8: Scenario B Maximum 1-hour Ammonia Concentrations (Contours represent 30µg/m<sup>3</sup>, 25µg/m<sup>3</sup> and 20µg/m<sup>3</sup>). Short Term EAL for the protection of human health 2500µg/m<sup>3</sup>. ....24

Figure 3.9: Scenario B Maximum 1-hour Amine/Amide Concentrations (Contours represent 20µg/m<sup>3</sup>, 15µg/m<sup>3</sup> and 10µg/m<sup>3</sup>). Short Term EAL for the protection of human health 3900µg/m<sup>3</sup> (as methylamine). ....25

Figure 3.10: Scenario B Maximum 1-hour Hydrogen Sulphide Concentrations (Contours represent 0.7µg/m<sup>3</sup>, 0.6µg/m<sup>3</sup> and 0.5µg/m<sup>3</sup>). Short Term EAL for the protection of human health 150µg/m<sup>3</sup>. ....26

Figure 3.11: Scenario B Maximum 1-hour Mercaptan Concentrations (Contours represent 0.7µg/m<sup>3</sup>, 0.6µg/m<sup>3</sup> and 0.5µg/m<sup>3</sup>). Short Term EAL for the protection of human health 300µg/m<sup>3</sup> (as methyl mercaptan).....27

Figure 3.12: Scenario B Maximum 1-hour Sulphide Concentrations (Contours represent  $0.7\mu\text{g}/\text{m}^3$ ,  $0.6\mu\text{g}/\text{m}^3$  and  $0.5\mu\text{g}/\text{m}^3$ ). Short Term EAL for the protection of human health  $100\mu\text{g}/\text{m}^3$  (as carbon disulphide). .....28

Figure 3.13: Scenario B Maximum 1-hour Total Organic Carbon (TOC) Concentrations (Contours represent  $20\mu\text{g}/\text{m}^3$ ,  $18\mu\text{g}/\text{m}^3$  and  $16\mu\text{g}/\text{m}^3$ ). Short Term EAL for the protection of human health  $3700\mu\text{g}/\text{m}^3$  (as acetic acid). .....29

*For inspection purposes only.  
Consent of copyright owner required for any other use.*

# 1 INTRODUCTION

United Fish Industries Ltd (UFI) operates a plant on the Donegal Road at the entrance to Killybegs town. This plant was built in 1957 and produces low temperature dried fishmeal which is then supplied to fish feed producers. UFI is the main supplier of organic fishmeal to the Irish aquaculture industry. Fishmeal is manufactured by cooking, pressing and drying fish, or fish trimmings, to produce a stable end product.

The facility operates under an existing IPPC licence (Register No. P0416-01) with technical amendments relating to emissions to foul sewer and surface water. The plant is undergoing a licence review and this report has been prepared to form part of the IPPC licence application in relation to emissions to atmosphere and assessing the impact of the existing and proposed changes to the atmospheric environment of the area.

RPS has followed the procedures presented in the EPA Guidance Note AG4 Air Dispersion Modelling for Industrial Installations in this assessment. RPS have employed the USEPA approved AERMOD Prime dispersion model to determine the impacts on the environment and at the nearest sensitive receptors. The results of the modelling are assessed against the relevant statutory limits, where available, and ambient air quality guidelines used internationally.

*For inspection purposes only.  
Consent of copyright owner required for any other use.*

## 2 EMISSIONS TO ATMOSPHERE

### 2.1 ASSESSMENT OBJECTIVE

There are two principle sources of emissions to atmosphere at the UFI facility as outlined below:

- **Combustion emissions** from boilers/burners (oxides of nitrogen, sulphur dioxide, carbon monoxide, particulates, etc) from the two on-site boilers (A1-1 and A1-2) and burner (A1-3).
- **Odour emissions** from boilers/burners (ammonia, amines, hydrogen sulphide, mercaptans, organo sulphides, total organic carbon, etc.) from the two on-site boilers (A1-1 and A1-2), the burner (A1-3) and the odour scrubber main emission point (A2-1).

The combustion gases are from the two existing boilers (A1-1 and A1-2) and the burner (A1-3) which operate continuously during the main production months. Both the boilers and burner are fired principally by heavy fuel oil with tallow as a support fuel. All monitoring carried out at these emission points in 2008 to 2010 indicate no breaches of the limits set in the IPPC licence (P0416-01). It is proposed to continue the operation of these boilers and burner throughout Stages 1 and 2 of the review application and there are no proposed changes to the existing regime. As such the following model scenario is presented for the combustion emissions:

- **Scenario A:** Combustion emissions for Stages 1 and 2 of the review application

For Stage 3 combustion emissions, the proposed plant upgrade may necessitate the installation of a new boiler on site (A1-4). Details of the emissions and impact of this additional boiler are not addressed in this report but will be reported as part of the planning process for Stage 3 and issued to the EPA prior to the Stage 3 commencement date.

All emissions of odour compounds that are captured in the enclosed process system are routed through three wet seawater scrubbers to remove the condensable fraction of odour compounds (ammonia, amines) typically followed by combustion where the non-condensable fraction is oxidised and emitted to atmosphere. There are three separate sources of odour emissions to atmosphere on the site:

- Boilers (A1-1 and A1-2) which treat the foul air collected from the cooking, straining, decanting, evaporator and press stages of the operations. This air is routed through a direct sea water scrubber before the air is routed to the boilers as make up air. These emission points are licensed through the existing IPPC licence and emission limits are as per BAT and monitoring in 2009 and 2010 indicates full compliance.
- Burner (A1-3) which treats the foul air from the driers. In both streams of the plant the air is initially discharged through cyclones or bag filters before routing through a direct sea water scrubber following which the air is routed to the burner as make up air. This emission point is licensed through the existing IPPC licence and emission limits are as per BAT and monitoring in 2009 and 2010 indicates full compliance.
- A previous minor emission point has been upgraded to a main emission point (A2-1) in this application. This odour scrubber treats the high volume low odours from the coolers and grinder operations. In both streams the foul air is routed through bag filters before discharge through a direct sea water scrubber. There is no tertiary treatment (i.e. combustion) on this emission point.

It is proposed to continue the operation of these emission points in this licence review. As such the following model scenario is presented for the odour emissions:

- **Scenario B:** Current odour emissions for Stage 1 and 2 of the application (excluding fugitive odours)

There is the potential for fugitive odours on the site from a number of areas (raw material intake, storage silos, etc.) and the site has received a low number of odour related complaints in the last number of years. Section 5.2.3 of the BAT Guidance note identifies the need for enclosure of all odour generating process using negative pressure extraction prior to treatment of odours before discharge. While this is not feasible for introduction throughout the plant in the short term (Stages 1 and 2) UFI commit to achieving BAT in the medium term and propose a number of measures to mitigate fugitive odours.

The broad outline of a number of such measures are presented in Section 3.3 of this report. A detailed engineering description of the proposed work and accompanying odour dispersion model for the detailed design will be issued to the EPA in advance of the Stage 3 commencement date.

This assessment examines the impact of the existing emissions in relation to the relevant BAT Guidance Note. The following sections outline the methodology undertaken, BAT guidance adopted and the relevant assessment criteria employed in modelling the above scenarios.

## 2.2 BAT GUIDANCE

The UFI facility operates in the following IPPC Class as listed under the First Schedule of the Environmental Protection Agency Acts 1992 to 2007:

*Class 7.5 The manufacture of fish-meal and fish-oil, not included in paragraph 7.8.*

The relevant BAT Guidance Note to this sector is listed below:

- BAT Guidance Note on the Best Available Techniques for the Manufacturing of Fish Meal and Fish Oil (EPA 2008).

Sections 6.1 of this guidance document provides emission levels for discharges to air that apply to this sector and these limits are presented in Table 2.1.

Parameter	BAT Concentration Limit	BAT Mass Emission Limit
Ammonia	30 mg/m <sup>3</sup>	0.15 kg/hr
Amines and Amides	5 mg/m <sup>3</sup>	-
Total Hydrogen Sulphide, sulphides and mercaptans (expressed as S)	5 mg/m <sup>3</sup>	0.015 kg/hr
Total Organic Carbon (as C)	50 mg/m <sup>3</sup>	0.5 kg/hr
Total Particulate Matter (including emissions from material handling)	5-50 150	>0.2 kg/hr <0.2 kg/hr

Table 2.1: BAT Emission Levels for Discharges to Air

In terms of the main combustion gases (oxides of nitrogen, sulphur dioxide, carbon monoxide) there is no specified BAT limit. However, the BAT note states that, as these combustion gases are listed in the Schedule to S.I. 394 of 2004, limits may be applied to these substances. The existing IPPC licence specifies limits for combustion gases and these limits are presented in Table 2.2.

Parameter	Emission Point	Concentration Limit	Mass Emission Limit
Carbon Monoxide	All	NA	NA
Nitrogen Oxides	A1-1 and A1-2	1,000 mg/m <sup>3</sup>	-
	A1-3	1,400 mg/m <sup>3</sup>	
Sulphur Oxides	A1-1 and A1-2	-	47.6 kg/hr
	A1-3	-	22 kg/hr

Table 2.2: Existing IPPC licence limits for combustion gases

## 2.3 DISPERSION MODELLING

RPS has followed the procedures presented in the EPA Guidance Note AG4 Air Dispersion Modelling for Industrial Installations in this assessment. The model used for Air Dispersion Modelling was the US EPA approved AERMOD Prime model, which is the current regulatory model in the US and a recommended model under the EPA guidance. This model is a third generation model utilising advanced boundary-layer physics. AERMOD is run with a sequence of hourly meteorological conditions to predict concentrations at receptors for averaging times of one hour up to a year. It is necessary to use many years of hourly data to develop a better understanding of the statistics of calculated short-term hourly peaks or of longer time averages.

Any physical structure (such as a building) that is in close proximity to the exhaust point may hinder the dispersion characteristics through a phenomenon known as building downwash. The potential for building downwash is dependent on the relative differences in height between the stack and the building. In air dispersion modelling terms the good engineering practice for stack height to prevent building downwash is based on the following calculation (source US EPA):

$$h_s \geq h_b + 1.5L_b$$

Where

$h_s$  is the stack height (in this case 30m and 26m)

$h_b$  is the building height (in this case 10 m)

$L_b$  is the lesser of either the building height or maximum projected building width (10m building height)

In this assessment the analysis suggests that the stack heights are sufficient to meet the good engineering practice (GEP) recommendation of the US EPA. Based on the calculation, there is no potential for building downwash to occur at these stack heights for emissions from the three boiler/burner stacks. However, the main emission point (the scrubber for the cooler/grinder A2-1) is at a height of 10 metres so building downwash has been incorporated in to all models from this sources (i.e. Scenario B odour emissions).

Given the relatively low elevations of the emission points (less than 30m) in relation to the upper boundary mixing layer the potential for shoreline fumigation is low and this aspect as been scoped out of this assessment as per the AG4 Guidance Note.

### 2.3.1 Source Information

Site specific data such stack height, cross sectional areas, emission temperatures etc. have been derived from the site engineers and on-site measurements. This information is presented in Table 2.3. The locations of the boiler and main emission points are presented in **Attachment E.1** of the application.

Emissions from the boilers, burner and scrubber were modelled assuming 24 hours, 365 days a year operations. In reality, operations will be on a shift basis and not for a full 24 hours. In addition, operations occur for only six months of the year. This assumption is therefore very conservative and the model results should be treated as such.

Source	Reference	Diameter (m)	Height (m)	Temp. (°C)	Flow (Nm <sup>3</sup> /hr)
Boiler B1A	A1-1	0.86	30	200	22,000
Boiler B1B	A1-2	0.86	30	200	22,000
Burner B2	A1-3	0.79	26	320	14,000
Odour Scrubber Stack	A2-1	0.60	10	25	19,000

Table 2.3: Emission point details for dispersion model

### 2.3.2 Background Concentrations

There is no EPA ambient monitoring data for the Killybegs area. The area is considered rural and would experience predominately clean+ Atlantic air masses. There is some light industry in the Killybegs area as well as residential and traffic based sources, but the area would be classified as Zone D (rural) in terms of background air quality.

From the EPA reports on ambient air quality from 2008 to 2009 the most representative monitoring station in terms of rural backgrounds is Kilkitt in Co. Monaghan. The annual average values recorded by the EPA at Kilkitt in the period 2008 to 2009 have been averaged and added to the model results to give a total ground level concentration. These background concentrations are considered representative of the Killybegs area and are presented in Table 2.4.

There is no background data available on carbon monoxide at Zone D areas in 2009 so the annual mean from Letterkenny for 2008 and 2009 have been referenced to provide a background of 0.3mg/m<sup>3</sup>.

There is no available data on background odour concentrations or on background levels of individual substances. As such, background concentrations are set at zero for these substances.

Parameter	Annual average µg/m <sup>3</sup>
Nitrogen Dioxide (as NO <sub>2</sub> )	3
Sulphur Dioxide (as SO <sub>2</sub> )	4
Particulates (as PM <sub>10</sub> )	9

Table 2.4 Background concentrations added to modelled concentrations (averaged in the period 2008 -2009)

### 2.3.3 Pathway (Meteorological files)

The most important parameters governing dispersion in the atmosphere are wind speed, wind-direction and the stability or turbulence of the atmosphere. These parameters along with the ambient temperature and inferred mixing heights for each hour were included in the modelling using data from an appropriate met station with validated met data.

The nearest met stations to Killybegs are the Main Head Station to the north east and the Belmullet Met Station to the south west. Both are over 100km from the Killybegs area. Given the nature of the location of the site on the western Atlantic coast, it is considered that the Belmullet met station is the most appropriate for use at the Killybegs area. Five years (2005 to 2009) of met data from Belmullet have been employed in the model as per the AG4 guidance note and the year that predicted the highest results for the key averaging periods was 2009. The 2009 data has been used throughout the model assessment and a windrose for Belmullet 2009 is presented in Figure 2.1.

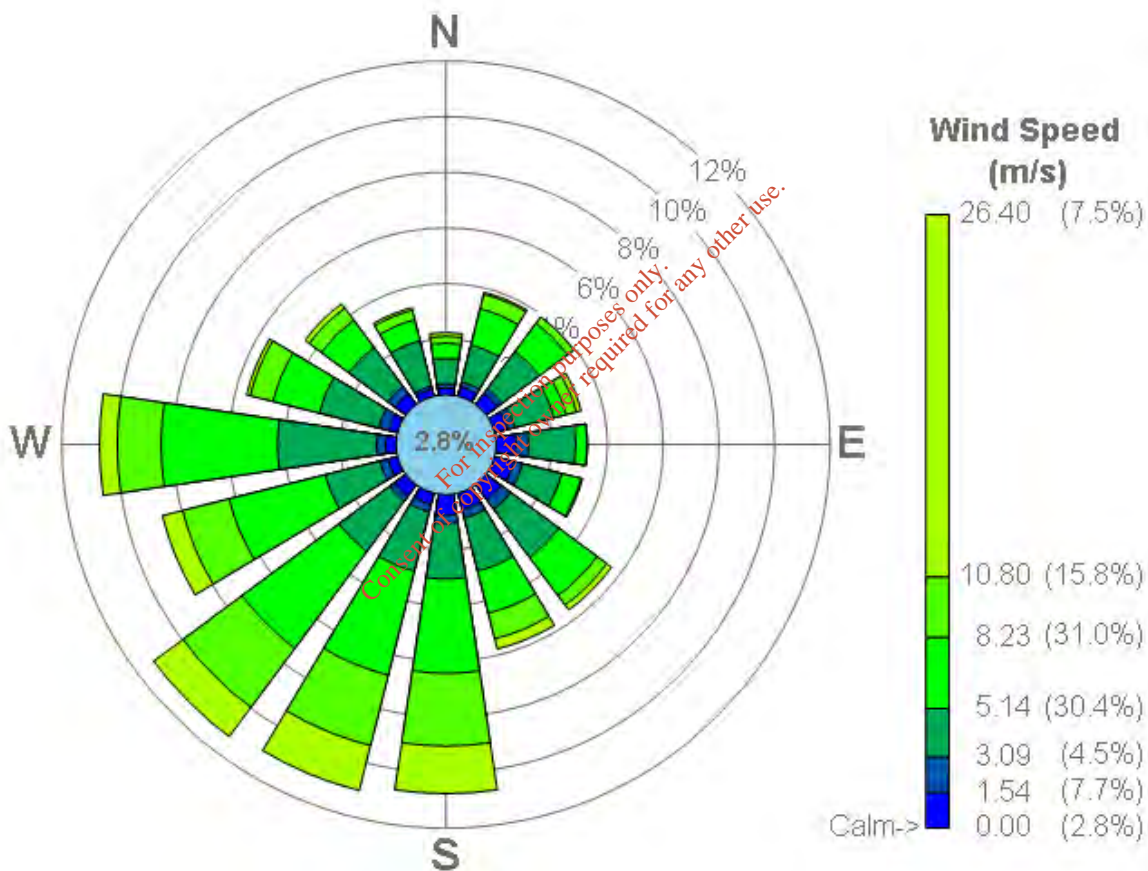


Figure 2.1 Windrose for the Belmullet Met Station for 2009.

### 2.3.4 Receptors

A 3km x 3km Cartesian receptor grid has been incorporated into the model to simulate the spatial emissions trends from the UFI facility. The resultant ground level concentrations are presented as contour plots (isopleths) to demonstrate the impact and location of emissions.

In terms of ecological receptors, the nearest designated site is St. John's Point SAC (site code 000191), which is located approximately 5 kilometres south of Killybegs. Emissions from the plant will not have an impact on the SAC at this distance so this has been scoped out of this assessment.

### 2.3.5 Assessment Criteria

The key legislation in Ireland relating to ambient air quality is the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011), which set limit concentrations for various pollutants for the protection of human health. A summary of the limits applicable to this assessment are presented in Table 2.5.

Pollutant	Limit Type	Value
Nitrogen Dioxide	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 $\mu\text{g}/\text{m}^3$ NO <sub>2</sub>
	Annual limit for protection of human health	40 $\mu\text{g}/\text{m}^3$ NO <sub>2</sub>
	Annual limit for protection of vegetation	30 $\mu\text{g}/\text{m}^3$ NO + NO <sub>2</sub>
Sulphur Dioxide	Hourly Limit Value for the Protection of human health not to be exceeded more than 24 times a calendar year	350 $\mu\text{g}/\text{m}^3$ SO <sub>2</sub>
	Daily Limit Value for the protection of human health not to be exceeded more than 3 times a calendar year	125 $\mu\text{g}/\text{m}^3$ SO <sub>2</sub>
	Annual limit value for the protection of ecosystems	20 $\mu\text{g}/\text{m}^3$ SO <sub>2</sub>
Carbon Monoxide	Limit value for the protection of human health Maximum daily 8-hour mean	10 mg/m <sup>3</sup> CO
Particulate Matter (PM <sub>10</sub> )	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 $\mu\text{g}/\text{m}^3$ PM <sub>10</sub>
	Annual limit for protection of human health	40 $\mu\text{g}/\text{m}^3$ PM <sub>10</sub>
Particulate Matter (PM <sub>2.5</sub> )	Annual target value for protection of human health	25 $\mu\text{g}/\text{m}^3$ PM <sub>2.5</sub>

Table 2.5: Ambient Air Quality Limits as expressed in S.I. 180 of 2011

There are no Irish legislative ambient limits for total particulates or individual odorous substances. In the absence of such statutory limits, it is common practice to reference other suitable authorities such as the Environment Agency of England and Wales H1 BAT Guidance.

The Environment Agency has published an IPPC H1 Guidance note Horizontal Guidance Note H1-Annex (f) which includes methods for quantifying environmental impacts from industrial facilities. This guidance note (and earlier versions) presents the relevant legislation applicable to the main pollutants as well as a series of Environmental Assessment Levels (EALs) for all other pollutants that act as guidelines for the impact assessment of licensed facilities. It is common practice to use these EALs to determine the environmental impact in terms of human health of air emissions from industrial facilities and the relevant EALs (short term and long term) are presented in Table 2.6. As a number of the targeted pollutants are grouped chemicals (e.g. Total Amines or Total VOCs), suitable reference compounds have been included for the purposes of assessment criteria.

<b>Pollutant</b>	<b>Environment Agency Long Term EAL (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>Environment Agency Short Term EAL(<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>Reference Compound</b>
Ammonia	180	2500	NA
Total Amines/Amides	130	3900	Methylamine
Hydrogen Sulphide	140	150	NA
Total Sulphides	64	100	Carbon Disulphide
Total Mercaptans	10	300	Methyl Mercaptan
Total Organic Carbon (as C)	250	3700	Acetic Acid

Table 2.6: Ambient Air Quality Guidelines from the UK Environment Agency

For inspection purposes only.  
Consent of copyright owner required for any other use.

### 3 MODELLING RESULTS

#### 3.1 SCENARIO A (COMBUSTION EMISSIONS)

Scenario A of this modelling assessment represents the existing emission boiler points operating within the current IPPC limits (as set out in Schedule 1(i) of the licence). Where no mass emission limit is stated in the licence an inferred limit (noted in italics) is expressed based on the volume flow limit. The emission factors employed in the model are based on these limits as set out in Table 3.1. The emission limits set out in the licence for B1 have been equally split to apply to B1A and B1B (A1-1 and A1-2).

Parameter	Emission Point	Volume Flow (m <sup>3</sup> /hr)	Concentration Limit (mg/m <sup>3</sup> )	Mass Emission Limit (kg/hr)	Model Emission Factor (g/s)
Nitrogen Oxides	A1-1	22,000	1000	22.00	6.12
	A1-2	22,000	1000	22.00	6.12
	A1-3	14,000	1400	19.74	5.48
Sulphur Oxides	A1-1		-	23.80	6.61
	A1-2		-	23.80	6.61
	A1-3		-	22.00	6.11

Table 3.1: Scenario A Combustion Emission Factors (based on existing limits)

There are no existing emission limit values for the other principle combustion gases (carbon monoxide and particulates). For particulate matter the BAT limit as specified in Table 2.1) is applied. Given that ongoing monitoring indicates that the mass emission rate exceeds 0.2kg/hr on these stacks, a concentration limit of 50mg/m<sup>3</sup> should be applied to these emission points as per the BAT Guidance.

In the absence of BAT specific limits for carbon monoxide the TA Luft Guidelines 2002 are referenced (the principle sources of BAT emission limits to atmosphere in Ireland). In relation to Inorganic Gaseous Substances (paragraph 5.2.4), the TA Luft Guidelines set a general guideline concentration for carbon monoxide of 100 mg/m<sup>3</sup>, and this limit has been applied to the combustion emission in the dispersion model.

The guidelines that have been applied to carbon monoxide (TA Luft) and particulates (BAT), as described above, are presented in Table 3.2 and it is proposed that these levels are adopted as limits on these combustion emission points.

Parameter	Emission Point	Concentration Limit (mg/m <sup>3</sup> )	Mass Emission Limit (kg/hr)	Emission Factor (g/s)
Particulate Matter	A1-1	50	1.10	0.31
	A1-2	50	1.10	0.31
	A1-3	50	0.70	0.19
Carbon Monoxide	A1-1	100	2.20	0.61
	A1-2	100	2.20	0.61
	A1-3	100	1.41	0.39

Table 3.2: Scenario A Combustion Emission Factors (based on standard guidance)

Emissions for each of the three combustion points have been simulated emitting at the levels presented in Tables 3.1 and 3.2. It has been assumed that all boilers will be operating continuously (24 hours per day, 365 days per year). This represents a significant worst case assessment as monitoring results indicate that levels are significantly lower than these levels and the boilers operate on a process need basis with significant seasonal variation and typically do not operate simultaneously. As such, the results presented in this section are an overestimation of the actual impact allowing a significant margin of tolerance.

The results of the Scenario A Combustion Emissions are presented in Table 3.3 and presented graphically as contoured isopleths in Figures 3.1 to 3.7. Background concentrations have been included in the tabulated results but not in the graphical results. It should also be noted that the results presented in Table 3.1 represent the maximum ground level concentrations (GLC) and all other areas will be lower than those presented in Table 3.3.

Parameter	Averaging Period	Background	Maximum GLC (incl Background)	Limit as per SI 271 of 2002
Nitrogen Dioxide (as NO <sub>2</sub> ) (µg/m <sup>3</sup> )	1-hour <sup>Note 1</sup>	6	40.7	200
	Annual	3	5.23	40
Sulphur Dioxide (µg/m <sup>3</sup> )	1-hour <sup>Note 2</sup>	8	137	350
	24-hour <sup>Note 3</sup>	4	67	125
Particulates (µg/m <sup>3</sup> )	24-hour <sup>Note 4</sup>	9	10.2	50
	Annual	9	9.37	40
Carbon Monoxide (mg/m <sup>3</sup> )	8-hour	0.3	0.309	10

Table 3.3: Results of modelling of Scenario A (Existing) Boiler Emissions

Note: 1. 1-hour average is presented as the 99.8<sup>th</sup> percentile of averages as per the limit value.  
 2. 1-hour average is presented as the 99.7<sup>th</sup> percentile of averages as per the limit value.  
 3. 24-hour average is presented as the 99.1<sup>th</sup> percentile of averages as per the limit value.  
 4. 24-hour average is presented as the 90.4<sup>th</sup> percentile of averages as per the limit value.

The results of the modelling assessment indicate that emissions at the proposed limit values will not have an adverse impact on air quality in the area. All levels will remain within the statutory ambient limits for the protection of human health at all ground locations, including residential areas. Each combustion gas is discussed in the following paragraphs:

#### *Nitrogen Dioxide (NO<sub>2</sub>)*

In terms of NO<sub>2</sub>, the highest annual average ground level concentration is only 2.23µg/m<sup>3</sup> which, on top of a background of 3µg/m<sup>3</sup>, results in an overall impact of 5.23µg/m<sup>3</sup>. This is approximately 13% of the annual limit for the protection of human health. This maximum impact is predicted to occur within the inner harbour to the north east of the facility, consistent with the south-westerly prevailing winds. This is also demonstrated by the spatial plume in Figure 3.2 for annual average NO<sub>2</sub> which indicates the location of the maximum ground level concentration. There are no sensitive receptors in this maximum area and the highest concentrations that will affect local residents are of the order of 2.0-2.5 µg/m<sup>3</sup> (i.e. the dark green section of Figure 3.2) in the townland of Carricknagore. However, these levels will not breach the annual limit for the protection of human health even under these worst case simulated conditions (i.e. 24 hour continuous operation with emissions at BAT limits and a worst case year for dispersion).

The maximum 1-hour  $\text{NO}_2$  shows a similarly compliant level ( $40.7\mu\text{g}/\text{m}^3$  including background) and will not breach the annual limit for the protection of human health ( $200\mu\text{g}/\text{m}^3$ ) at any location. The spatial trend shown in Figure 3.1 indicates that the maximum impact will be dispersed to the east and west of the site with the maximum impact predicted to be to the north of the town of Killybegs. This is primarily due to the fact that as a 1-hour maximum the prevailing wind is less of dominant force and typically the 1-hour maximum is associated with calmer conditions when the plume lingers in an area and disperses in all directions. It should be noted that the maximum 1-hour result presented in Table 3.3 is the 99.8<sup>th</sup> percentile to allow for direct comparison with the limit, whereas the levels presented in Figure 3.1 are maximum 1-hour levels with no statistical representation. Hence the variation in the results and Figure 3.1 is presented as an illustration of the spatial variation only.

It should also be borne in mind that this is a worst case assessment, whereby the combustion emission points are operating both continuously and simultaneously (which does not happen) and at the IPPC limit where monitoring for 2009 indicates that emissions are typically less than 50% of this limit.

### *Sulphur Dioxide ( $\text{SO}_2$ )*

The  $\text{SO}_2$  levels predicted at the nearest receptors are also below the limits for the protection of human health at the relevant 1-hour and 24-hour limits. The maximum 1-hour average GLC is predicted to be  $129\mu\text{g}/\text{m}^3$  on top of a background of  $8\mu\text{g}/\text{m}^3$  leading to levels approximately 40% of the limit for the protection of human health. The maximum impacts presented in Figure 3.3 indicate that the area north of the facility in the townland of Corporation will experience the maximum impact, albeit well below the limit for the protection of human health.

The 24-hour averages presented in Table 3.3 and Figure 3.4 show a similar trend. The maximum 24-hour GLC ( $67\mu\text{g}/\text{m}^3$ ) is approximately half of the limit for the protection of human health ( $125\mu\text{g}/\text{m}^3$ ). The spatial trends shown in Figure 3.4 indicate that the areas of maximum GLC will be north of the facility in the townland of Corporation and to a lesser extent to areas south west of the facility on the northern outskirts of the town of Killybegs.

Again, the slight variation in the tabulated and plotted results is a result of the use of percentile reporting in the tables in line with the limits.

### *Carbon Monoxide (CO)*

The results for carbon monoxide, as presented in Table 3.3 and Figure 3.5, indicate that only trace levels (less than 1% of the 8-hour limit) will be experienced at the maximum GLCs. As such, the operation of the boilers/burner at the BAT limit will have a negligible impact on carbon monoxide levels. The maximum impact is predicted to be to the north of the facility but this impact is considered negligible at the emission level.

### *Particulates*

The predicted levels of particulate are very low and indicate no breaches of the annual or 24-hour limits for the protection of human health. The predicted levels are less than 25% of the limit and this is principally a result of the naturally high background. The maximum 24-hour impact, as presented in Figure 3.6, indicates that the maximum impact will be experienced principally to the north of the facility in the townland of Corporation but also to the south of the facility in the northern outskirts of Killybegs. The annual spatial trend (Figure 3.7) is similar to the annual trend for  $\text{NO}_2$  in that it is in line with the prevailing wind and disperses the plume in a north easterly direction. This data is modelled at the BAT emission limit of  $50\text{mg}/\text{m}^3$  and results for 2009 and 2010 indicate that all emission points operate within this limit. The spatial distribution of the annual average particulate concentrations is presented in Figure 3.7.

### Summary

In summary, the results of the modelling exercise of the existing combustion operations (Scenario A) shows that emissions at the prescribed levels do not breach any of the statutory limits for the protection of human health. This is true with a considerable background concentration built into the modelled results. As such, it can be concluded that even the worst case operations of the site (all emission points operating continuously and at the emission rates outlined below) the combustion emissions are not having a significant impact on air quality in the area.

As a result, the emission limit values presented in Table 3.4 are proposed for Stages 1 and 2 of the IPPC application. This model has demonstrated that these emission limits will not have an adverse impact on air quality or human health in the area.

Parameter	Limit Type	A1-1	A1-2	A1-3
Volume Flow	Volume Flow (Nm <sup>3</sup> /hr)	22,000	22,000	14,000
Nitrogen Oxides	Concentration (mg/m <sup>3</sup> )	1,000	1,000	1,400
Nitrogen Oxides	Mass Emission (kg/hr)	22.00	22.00	19.74
Sulphur Oxides	Concentration (mg/m <sup>3</sup> )	1,080	1,080	1,560
Sulphur Oxides	Mass Emission (kg/hr)	23.80	23.80	22.00
Carbon Monoxide	Concentration (mg/m <sup>3</sup> )	100	100	100
Carbon Monoxide	Mass Emission (kg/hr)	1.10	1.10	0.70
Particulates	Concentration (mg/m <sup>3</sup> )	50	50	50
Particulates	Mass Emission (kg/hr)	2.20	2.20	1.41

Table 3.4: Proposed Combustion Emission Limits

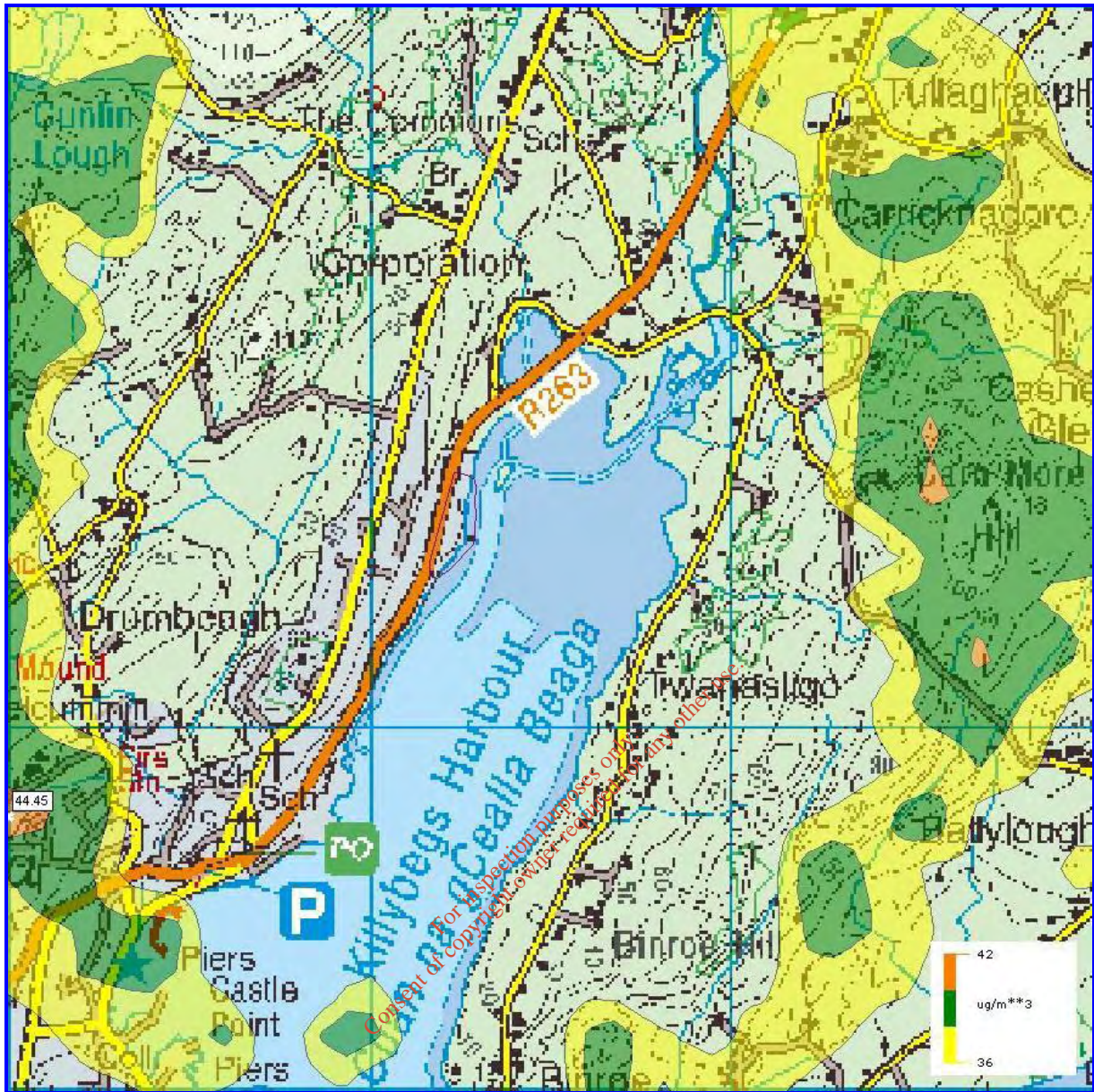


Figure 3.1: Scenario A Maximum 1-hour NO<sub>2</sub> Concentrations (Contours represent 42µg/m<sup>3</sup>, 40µg/m<sup>3</sup> and 38µg/m<sup>3</sup>). Backgrounds not included. Statutory limit for the protection of human health 200µg/m<sup>3</sup> (as NO<sub>2</sub>).

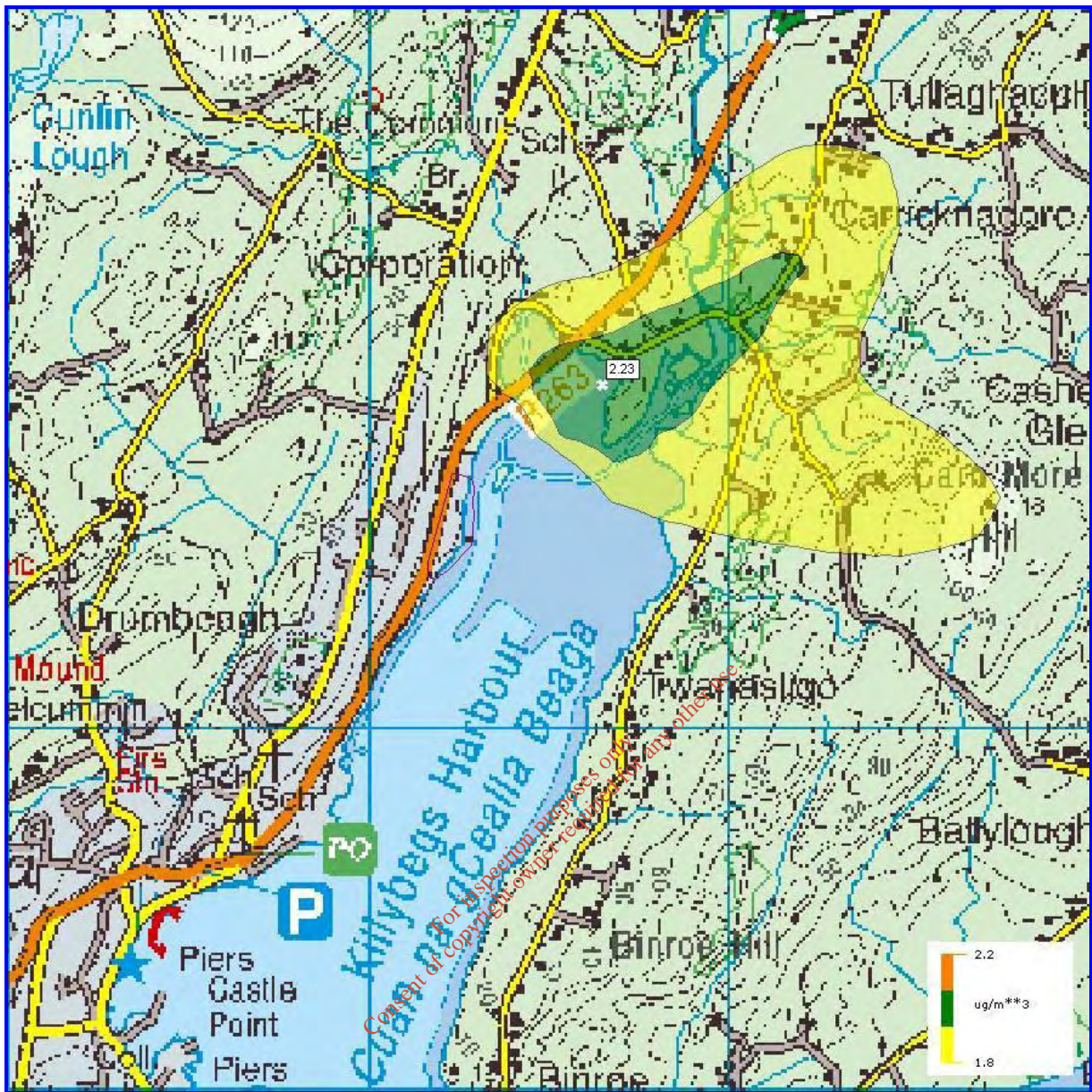


Figure 3.2: Scenario A Annual Average NO<sub>2</sub> Concentrations (Contours represent 2.2µg/m<sup>3</sup>, 2.0µg/m<sup>3</sup> and 1.8µg/m<sup>3</sup>). Backgrounds not included. Statutory limit for the protection of human health 40µg/m<sup>3</sup> (as NO<sub>2</sub>).



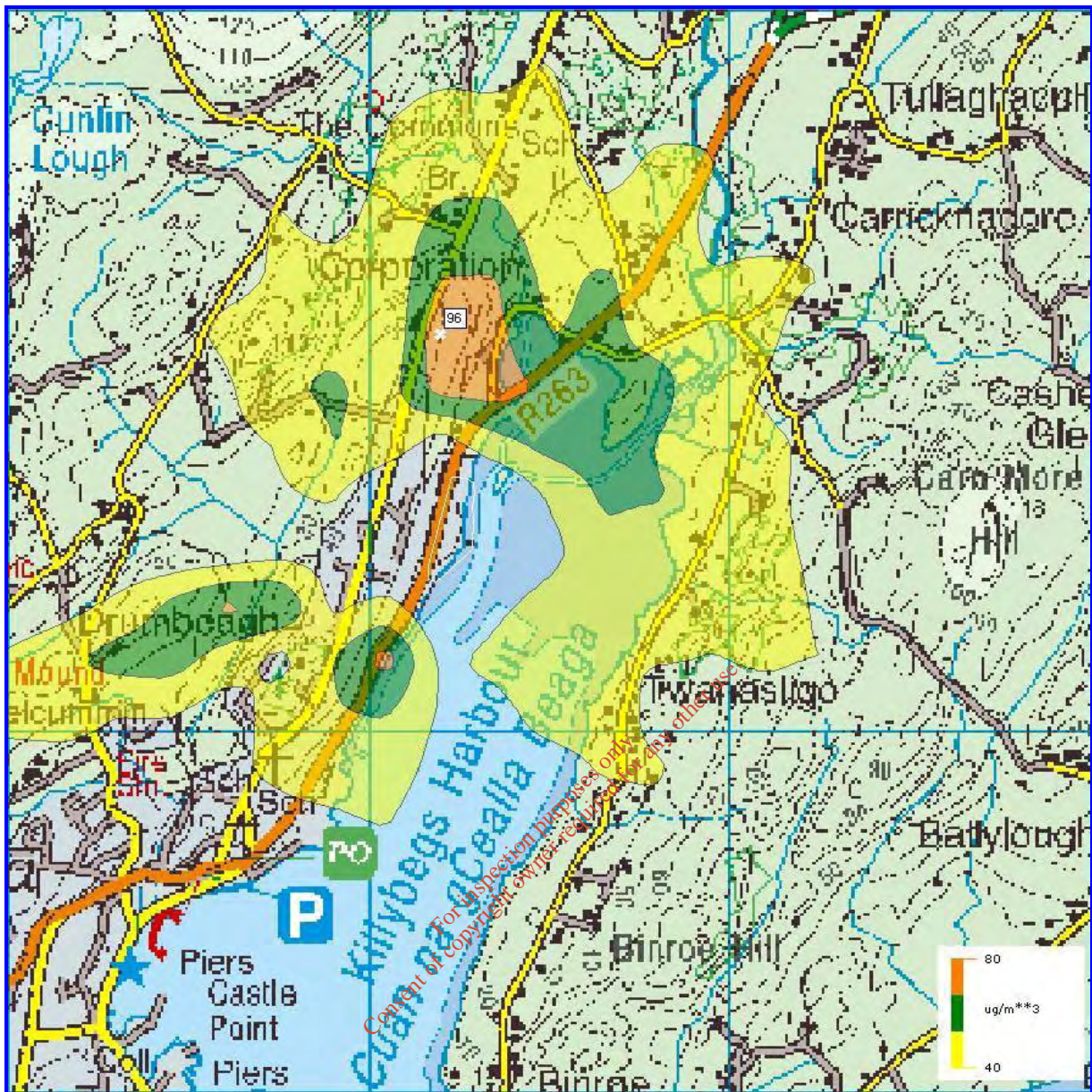


Figure 3.4: Scenario A Maximum 24-hour SO<sub>2</sub> Concentrations (Contours represent 80µg/m<sup>3</sup>, 60µg/m<sup>3</sup> and 40µg/m<sup>3</sup>). Backgrounds not included. Statutory limit for the protection of human health 125µg/m<sup>3</sup>.

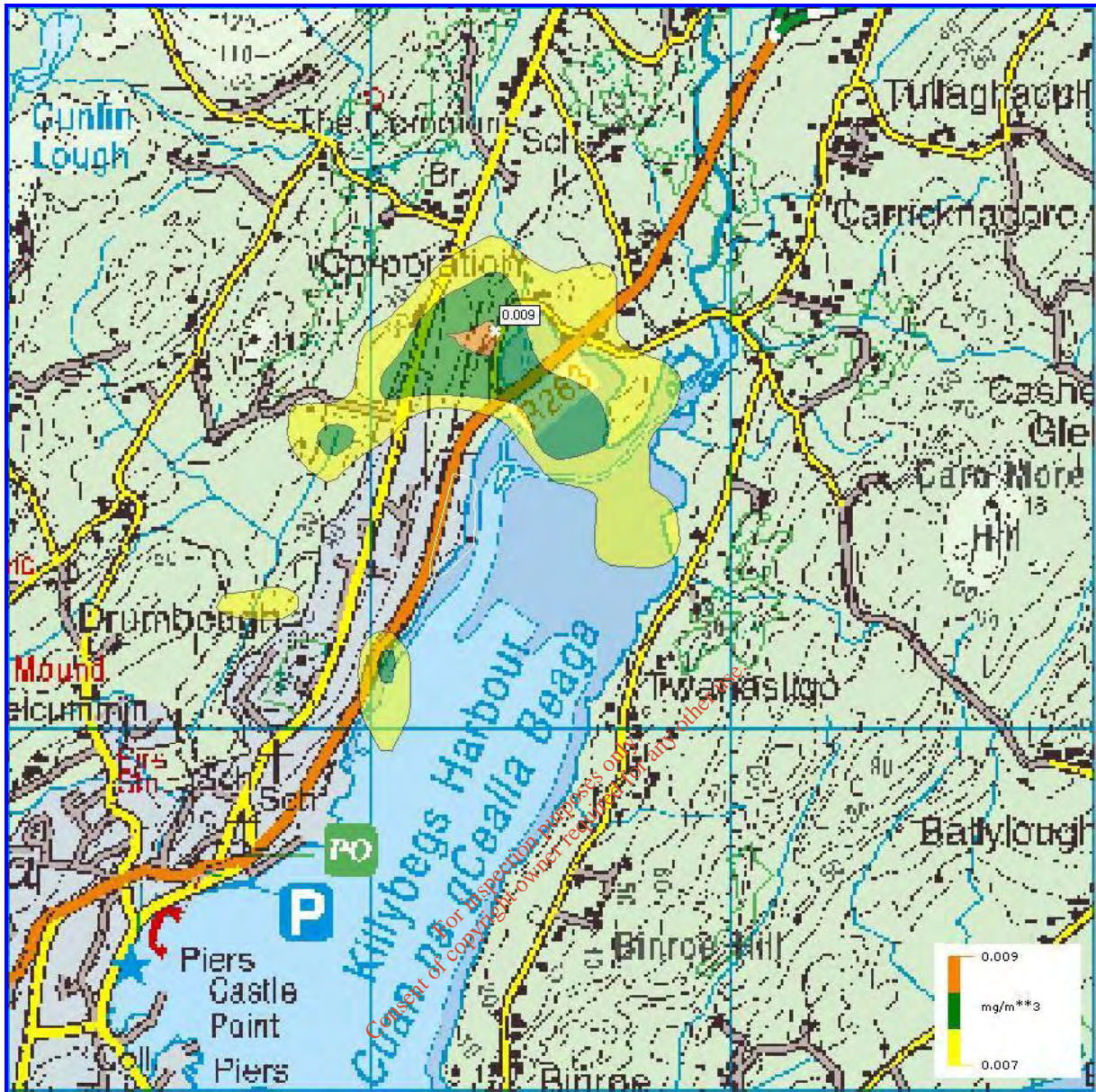


Figure 3.5: Scenario A Maximum 8 hour CO Concentrations (Contours represent **0.009mg/m<sup>3</sup>**, **0.008mg/m<sup>3</sup>** and **0.007mg/m<sup>3</sup>**). Backgrounds not included. Statutory limit for the protection of human health 10mg/m<sup>3</sup>.

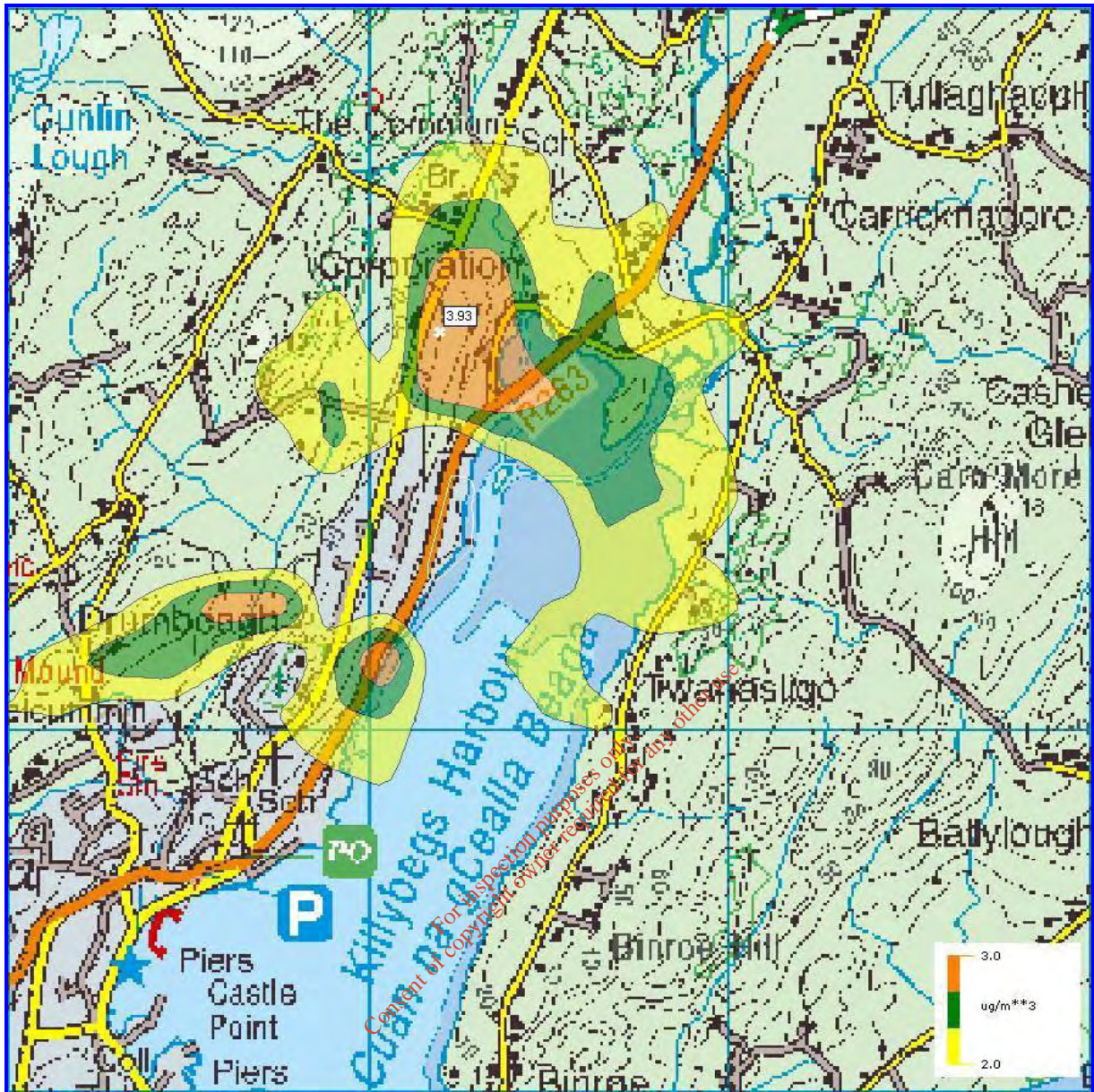


Figure 3.6: Scenario A Maximum 24 hour Particulate Concentrations (Contours represent 3.0µg/m<sup>3</sup>, 2.5µg/m<sup>3</sup> and 2.0µg/m<sup>3</sup>). Backgrounds not included. Statutory limit for the protection of human health 50µg/m<sup>3</sup> (as PM<sub>10</sub>).

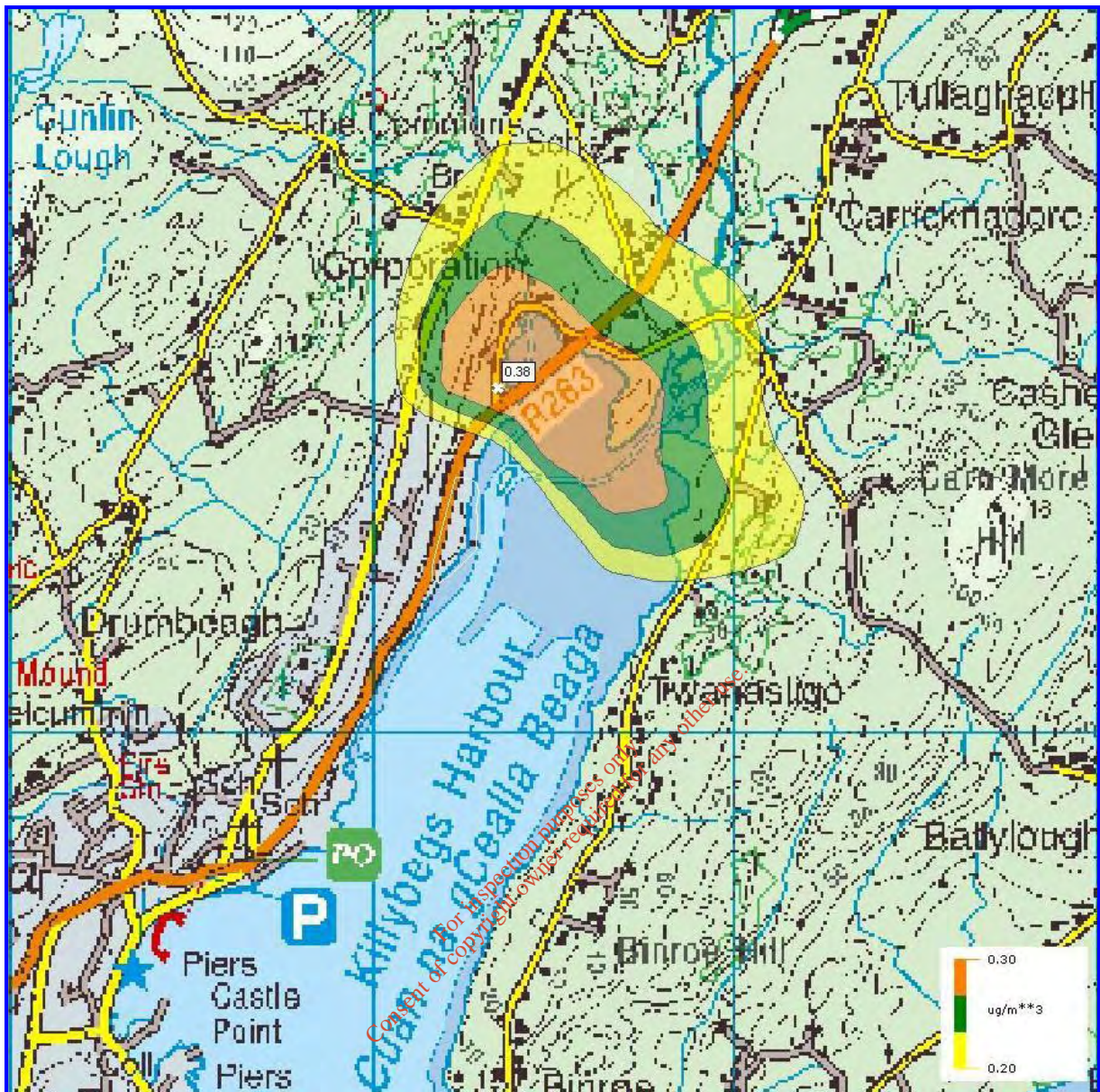


Figure 3.7: Scenario A Annual Average Particulate Concentrations (Contours represent  $0.30\mu\text{g}/\text{m}^3$ ,  $0.25\mu\text{g}/\text{m}^3$  and  $0.20\mu\text{g}/\text{m}^3$ ). Backgrounds not included. Statutory limit for the protection of human health  $40\mu\text{g}/\text{m}^3$  (as  $\text{PM}_{10}$ ).

### 3.2 SCENARIO B: CURRENT ODOUR EMISSIONS FOR STAGE 1 AND 2

Scenario B of this modelling assessment represents the existing emissions points operating within the BAT limits for odour compounds (as set out in Table 2.1 of this report). The concentration limits expressed in the existing IPPC licence for the boiler/burner emission points are largely in line with the BAT Guidance note. Only the ammonia limit differs with the IPPC limit stricter ( $27\mu\text{g}/\text{m}^3$ ) than the BAT limit ( $30\mu\text{g}/\text{m}^3$ ).

This assessment assumes all emission sources will operate to the BAT limits and that future emission limit values will be based on the BAT limits. The relevant limits and emission factors are presented in Table 3.5. For all parameters where a BAT concentration and mass emission rate are presented in the sector guidance note, these are applied in Table 3.5. Amines/Amides do not have a specified BAT mass emission rate so the rate is derived from the BAT concentration and the flows of each emission point. All model emission factors are derived from the mass emission limits presented below.

Parameter	Emission Point	Concentration Limit ( $\text{mg}/\text{m}^3$ )	Mass Emission Limit ( $\text{kg}/\text{hr}$ )	Model Emission Factor ( $\text{g}/\text{s}$ )
Ammonia	A1-1	30	0.15	0.04167
	A1-2		0.15	0.04167
	A1-3		0.15	0.04167
	A2-1		0.15	0.04167
Amines and Amides	A1-1	5	0.11	0.03059
	A1-2		0.11	0.03059
	A1-3		0.07	0.019566
	A2-1		0.09	0.026109
H <sub>2</sub> S, Sulphides, Mercaptan	A1-1	5	0.015	0.004167
	A1-2		0.015	0.004167
	A1-3		0.015	0.004167
	A2-1		0.015	0.004167
Total Organic Carbon	A1-1	50	0.5	0.138889
	A1-2		0.5	0.138889
	A1-3		0.5	0.138889
	A2-1		0.5	0.138889

Table 3.5: Scenario B Odour Emission Factors (based on BAT limits)

Emissions for each of the four emission points have been simulated emitting at the levels presented in Table 3.5. It has been assumed that all emission sources will be operating continuously (24 hours per day, 365 days per year). This represents a significant worst case assessment as monitoring results indicate that levels are significantly lower than these levels and the plant operates sporadically and with significant seasonal and daily variation. As such, the results presented in this section are an overestimation of the actual impact allowing a significant margin of tolerance.

The results of the Scenario B Odour Emissions are presented in Table 3.6 and presented graphically as contoured 1-hour maximum isopleths in Figures 3.8 to 3.13. Background concentrations have not been included in the results as these compounds are typically absent from ambient air quality. It should also be noted that the results presented in Table 3.6 represent the maximum ground level concentrations (GLC) and all other areas will be lower than those presented.

Parameter	Averaging Period	Maximum GLC	Environment Agency EAL
Ammonia ( $\mu\text{g}/\text{m}^3$ )	1-hour	36	2500
	Annual	2.34	180
Amines/Amides ( $\mu\text{g}/\text{m}^3$ )	1-hour	23	3900
	Annual	1.47	130
H <sub>2</sub> S ( $\mu\text{g}/\text{m}^3$ )	1-hour	0.77	150
	Annual	0.04	140
Mercaptans ( $\mu\text{g}/\text{m}^3$ )	1-hour	0.77	300
	Annual	0.04	10
Sulphides ( $\mu\text{g}/\text{m}^3$ )	1-hour	0.77	100
	Annual	0.04	64
Total Organic Carbon (as C) ( $\mu\text{g}/\text{m}^3$ )	1-hour	25.73	3700
	Annual	1.34	250

Table 3.6: Results of modelling of Scenario B Odour Emissions

For guidance purposes both the short term and long terms EALs (source: Environment Agency) have been shown for reference.

The results of the modelling assessment indicate that, in general, emissions at the proposed limit values will not have an adverse impact on air quality in the area. All levels will remain within the relevant guidelines for the protection of human health at the nearest sensitive receptors. Each compound is discussed in the following paragraphs:

#### *Ammonia*

Both the 1-hour maximum and annual average predicted GLCs of ammonia are less than 2% of the corresponding Environment Agency EAL. This indicates that there will be no significant adverse health impacts associated with the worst case assessment of continuous operation of the emission points under poor dispersion conditions. The spatial trend shown in Figure 3.8 indicates that the maximum 1-hour impact will be to the west of the site in the direction of the Parkhead housing estate. The plume shows a relatively consistent trend in all directions consistent with low wind speeds and poor dispersion, i.e. worst case conditions.

#### *Amines/Amides*

As with ammonia the predicted levels of Amines/Amides are less than 1% of the relevant EAL for a representative target compound (methylamine). As such, the potential for health impacts from these emissions at BAT limits is minimal. The spatial trend (Figure 3.9) is generally in all directions with a slight peak to the west of the facility.

#### *Hydrogen Sulphide (H<sub>2</sub>S), Mercaptans and Sulphides*

The plumes for H<sub>2</sub>S/Sulphides/Mercaptans are similar as the emission factor employed is identical. The modelling of H<sub>2</sub>S emissions at the BAT emission limit value indicates that the maximum 1-hour

predicted GLC ( $0.77 \mu\text{g}/\text{m}^3$ ) will be less than 1% of the short term EAL. Again, the plume is to the west of the facility (Figure 3.10).

Furthermore the World Health Organisation state that *in order to avoid substantial complaints about odour annoyance among the exposed population, hydrogen sulfide concentrations should not be allowed to exceed  $7 \mu\text{g}/\text{m}^3$ , with a 30-minute averaging period* (WHO Air Quality Guidelines for Europe 2000). The results of this model indicate that the maximum 1-hour average  $\text{H}_2\text{S}$  concentration will be approximately 10% of this odour annoyance criteria. This is consistent with the low levels of odour complaint at the facility.

The predicted 1-hour levels of Sulphides and Mercaptans are also less than 1% of the relevant EAL for representative targeted compounds (methyl mercaptan and carbon disulphide). As such, the potential for health impacts from these emissions at BAT limits is minimal. The targeted representative compounds are typical emissions from rendering type operations so are considered suitable for use as comparators in this assessment.

#### Total Organic Carbon (TOC)

Total Organic Carbon is a generic term that includes all hydrocarbons (alkanes, alkanes, aromatics, etc.) as well as other organic compounds (alcohols, carboxylic acids, esters, ethers, etc.). There are only low volumes of organic compounds used on the UFI facility. For the purposes of comparison the predicted levels are compared against acetic acid, one of the compounds most used on site.

The predicted annual average TOC concentration ( $25.73 \mu\text{g}/\text{m}^3$ ) is less than 1% of the short term EAL for acetic acid. These results indicate that the impact to human health from operations at these limits will be minimal.

#### Summary

In summary, the results of the modelling exercise of the odour emissions from the existing and new sources shows that emissions at the prescribed levels do not exceed any of the short term or long term Environmental Assessment Levels (EALs) for the protection of human health. As such, it can be concluded that even the worst case operations of the site (all emission points operating continuously and at the emission rates outlined below) the odour substances will not have a significant impact on air quality in the area. It should be noted that ongoing monitoring at the facility indicates that emission points A1-1, A1-2 and A1-3 are in full compliance with the BAT emission limits (also the current IPPC licence limits).

As a result of the low impact of these emissions at BAT limits, the emission limit values presented in Table 3.7 are proposed for Stage 1 and 2 of the IPPC application. This model has demonstrated that these emission limits will not have an adverse impact on air quality or human health in the area.

Parameter	Limit Type	A1-1	A1-2	A1-3	A2-1
Volume Flow	Volume Flow (Nm <sup>3</sup> /hr)	22,000	22,000	14,000	19,000
Ammonia	Concentration (mg/m <sup>3</sup> )	30	30	30	30
	Mass Emission (kg/hr)	0.15	0.15	0.15	0.15
Amines and Amides	Concentration (mg/m <sup>3</sup> )	5	5	5	5
	Mass Emission (kg/hr)	0.11	0.11	0.07	0.09
Total hydrogen Sulphide, sulphides and mercaptans (expressed as S)	Concentration (mg/m <sup>3</sup> )	5	5	5	5
	Mass Emission (kg/hr)	0.015	0.015	0.015	0.015
Total Organic Carbon (as C)	Concentration (mg/m <sup>3</sup> )	50	50	50	50
	Mass Emission (kg/hr)	0.50	0.50	0.50	0.50

Table 3.7: Proposed Odour Chemical Emission Limits

For inspection purposes only.  
Consent of copyright owner required for any other use.



**Figure 3.8: Scenario B Maximum 1-hour Ammonia Concentrations (Contours represent  $30\mu\text{g}/\text{m}^3$ ,  $25\mu\text{g}/\text{m}^3$  and  $20\mu\text{g}/\text{m}^3$ ). Short Term EAL for the protection of human health  $2500\mu\text{g}/\text{m}^3$ .**



**Figure 3.9: Scenario B Maximum 1-hour Amine/Amide Concentrations (Contours represent  $20\mu\text{g}/\text{m}^3$ ,  $15\mu\text{g}/\text{m}^3$  and  $10\mu\text{g}/\text{m}^3$ ). Short Term EAL for the protection of human health  $3900\mu\text{g}/\text{m}^3$  (as methylamine).**



Figure 3.10: Scenario B Maximum 1-hour Hydrogen Sulphide Concentrations (Contours represent  $0.7\mu\text{g}/\text{m}^3$ ,  $0.6\mu\text{g}/\text{m}^3$  and  $0.5\mu\text{g}/\text{m}^3$ ). Short Term EAL for the protection of human health  $150\mu\text{g}/\text{m}^3$ .



Figure 3.11: Scenario B Maximum 1-hour Mercaptan Concentrations (Contours represent  $0.7\mu\text{g}/\text{m}^3$ ,  $0.6\mu\text{g}/\text{m}^3$  and  $0.5\mu\text{g}/\text{m}^3$ ). Short Term EAL for the protection of human health  $300\mu\text{g}/\text{m}^3$  (as methyl mercaptan).



Figure 3.12: Scenario B Maximum 1-hour Sulphide Concentrations (Contours represent  $0.7\mu\text{g}/\text{m}^3$ ,  $0.6\mu\text{g}/\text{m}^3$  and  $0.5\mu\text{g}/\text{m}^3$ ). Short Term EAL for the protection of human health  $100\mu\text{g}/\text{m}^3$  (as carbon disulphide).

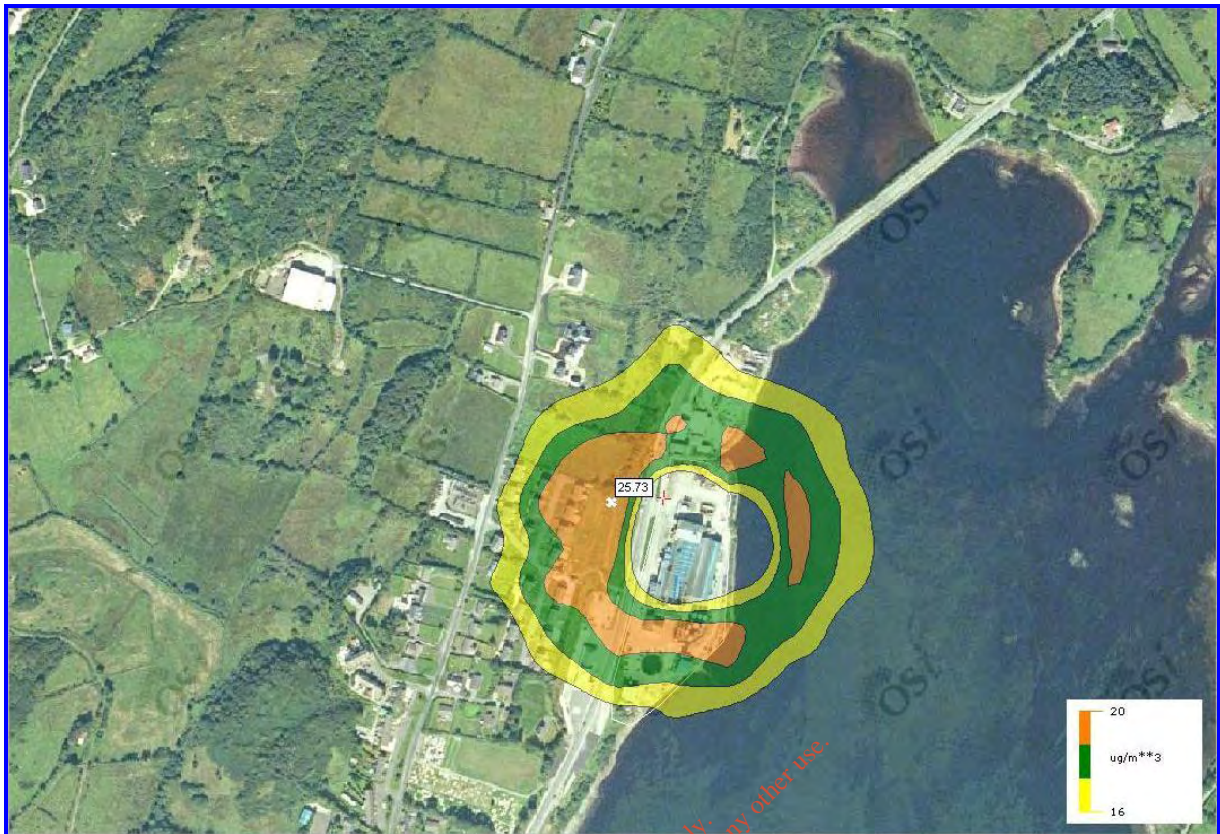


Figure 3.13: Scenario B Maximum 1-hour Total Organic Carbon (TOC) Concentrations (Contours represent  $20\mu\text{g}/\text{m}^3$ ,  $18\mu\text{g}/\text{m}^3$  and  $16\mu\text{g}/\text{m}^3$ ). Short Term EAL for the protection of human health  $3700\mu\text{g}/\text{m}^3$  (as acetic acid).

For inspection purposes only.  
Consent of copyright owner required for any other use.

### 3.3 OPTIONS FOR ODOUR EMISSIONS FOR STAGE 3

Section 3.2 of this report outlines the significance of the scheduled emissions of odour compounds in terms of human health. The results indicate that for the most part scheduled emissions from the plant will not have a significant impact on the atmosphere in terms of human health. However, no assessment of unscheduled (fugitive) emissions has been undertaken.

Given the age and nature of the buildings and site infrastructure, it is evident that there are a number of potential fugitive sources on site such as raw material storage, processing areas, product storage, etc. and these may be emitted through building vents, roof areas, open doors, etc. BAT for the sector specifies the following requirements in relation to mitigating fugitive odours:

- *Enclose all odour generating process activities using negative pressure extraction units in such processing, handling and storage areas; contain potentially odourous materials in enclosed containers, maintain short storage times, and use cold storage as deemed necessary; clean material storage areas frequently.*

Further to this collection system, the BAT requirements for a treatment system are listed as follows:

*For all fish meal and fish oil manufacturing plants, BAT is to minimise the formation of air emissions and odours using the measures outlined in section 5.2 and 5.3 of this document, and then, if necessary, use:*

- *A thermal oxidiser (see BREF Section 4.3.3.10)*
- *A biofilter (see BREF Section 4.1.33)*
- *A bioscrubber (see BREF Section 4.3.3.8)*
- *An absorption system such as wet scrubbing with chloride dioxide to remove odour (see BREF Sections 4.3.3.9, 4.3.3.12 and 4.3.3.13)*
- *An activated carbon filter (see BREF Section 4.1.34)*

In order to meet these BAT requirements, UFI will require considerable time and expenditure to upgrade the existing plant. As such, the proposed upgrade is scheduled for completion as part of Stage 3 of the application process and is not addressed in detail in this assessment. The following are a list of potential medium to long term solutions that may be investigated as part of the proposed upgrade and these options should be reviewed with the design engineers and architects for the proposed upgrade:

- A detailed odour audit of the facility should be undertaken by a suitably qualified expert. The audit should identify all sources on site together with nature and scale of the odour release and associated production details. In addition, quantified emission data should be taken from each source. All data should be compiled in an audit report with more detailed options for future upgrades that are feasible and operational.
- In the short term, if odour nuisance becomes an issue on the site there is the option to route the existing scrubber emission point (A2-1) through the boiler (A1-1 or A1-2) emission stacks. This may be prior to combustion to provide secondary treatment followed by improved dispersion or after combustion to simply facilitate better dispersion. The modelling exercise indicates that A2-1 is having the greatest localised impact in the area due to the low stack height and potential for building downwash grounding the plume close to residential receptors. Increasing the emission release height of this air stream to 30m would significantly reduce ground level impact.

- Also in the short term, it would be an option to fit end of pipe treatment to the vents to atmosphere from the three raw material silos at the western boundary of the site. Given the nature of the emissions (amines and ammonia) and the moisture levels a possible option may be an activated carbon filter. UFI have carried out a number of technical assessments on this option and have purchased the necessary carbon filters which are due to be installed in Summer 2011.
- In the medium term, the building fabric (aluminium cladding on a steel structure) is offering little or no containment from general processes in the building. As a result, when reconfiguring the building a suitable material should be investigated.
- One of the principle sources of fugitive odours on the site appears to be the raw material intake area. While the intake chute is typically covered, this is open for the restocking operation and open to the atmosphere. Pending the outcome of the odour audit, this section of the plant should be enclosed as per BAT and held under negative pressure or similar with all foul air diverted to a suitable abatement process.
- The above approach should be repeated for all other principle sources of odour on the site as identified on the odour audit. This should include both indoor and outdoor areas.
- Rapid roller doors (automated self closing) should be fitted at all entrance and exits to the site but in particular to the raw material intake and product delivery sections of the site.
- A detailed analysis of air intake volumes and potential concentrations should be undertaken as part of the design to identify the volume and concentration of treated air that will be derived from this air handling system. This will be critical for the identification and specification of suitable abatement plant. Typically the abatement required for treating headspace air involves a technique suitable for high volume low odour concentration. Other factors, such as the seasonality of the process, may make certain abatement techniques (such as biological treatment, bio-scrubbers and bio-filters) unsuitable for the UFI plant.
- Suitable options for the UFI plant may involve an extension of the existing wet scrubbing followed by incineration in the boilers/burners. However, as with all options a detailed feasibility study and assessment will be required in advance of any detailed design.
- Following detailed design, a refined air dispersion model should be undertaken in line with the procedures presented in EPA Guidance Note AG4 to determine the potential impacts of new abatement.

This model report and detailed design will be issued to the EPA in advance of the Stage 3 commencement data for approval.

## 4 CONCLUSION

A refined dispersion model assessment has been undertaken to simulate the emissions from the UFI facility in Killybegs, Co. Donegal. The modelling procedure has followed that presented by the EPA in Guidance Note AG4. The models have built in a highly conservative operational scenario (continuous operations at IPPC/BAT emission levels) to ensure that the worst case emissions have been quantified. As such, these results presented should be viewed as worst case and emissions from normal operations will be significantly lower than those presented in this report.

Scenario A represents the combustion emissions from the facility comprising of boiler emissions (two boilers and one burner). Modelling was undertaken at BAT limits in the first instance (particulates only) and where there are no BAT limits, the IPPC limits were employed (nitrogen dioxide and sulphur dioxide) and where there are no BAT or IPPC limits the TA Luft Guidelines are employed (carbon monoxide).

In summary, the results of the modelling exercise of the existing combustion operations shows that emissions at the prescribed levels do not breach any of the statutory limits for the protection of human health. This is true with a considerable background concentration built into the modelled results. As such, it can be concluded that even the worst case operations of the site (all emission points operating continuously and at the emission rates outlined below) the combustion emissions are not having a significant impact on air quality in the area.

As a result, the emission limit values presented in Table 4.1 are proposed for Stage 1 and 2 of the review application. This model has demonstrated that these emission limits will not have an adverse impact on air quality or human health in the area.

Parameter	Limit Type	A1-1	A1-2	A1-3
Volume Flow	Volume Flow (Nm <sup>3</sup> /hr)	22,000	22,000	14,000
Nitrogen Oxides	Concentration (mg/m <sup>3</sup> )	1,000	1,000	1,400
Nitrogen Oxides	Mass Emission (kg/hr)	22.00	22.00	19.74
Sulphur Oxides	Concentration (mg/m <sup>3</sup> )	1,080	1,080	1,560
Sulphur Oxides	Mass Emission (kg/hr)	23.80	23.80	22.00
Carbon Monoxide	Concentration (mg/m <sup>3</sup> )	100	100	100
Carbon Monoxide	Mass Emission (kg/hr)	1.10	1.10	0.70
Particulates	Concentration (mg/m <sup>3</sup> )	50	50	50
Particulates	Mass Emission (kg/hr)	2.20	2.20	1.41

Table 4.1: Proposed Combustion Emission Limits

It is not envisaged that these emission points and limits will change as part of Stage 3. However, there may be the addition of a new boiler on site (Reference A1-4). An updated model will be issued to the EPA demonstrating the impact of this boiler in advance of Stage 3.

Scenario B of this modelling assessment represents the existing emissions points operating within the BAT limits for odour compounds (as set out in Table 2.1 of this report) as well as an odour scrubber main emission point (A2-1). The concentration limits expressed in the existing IPPC licence for the boiler/burner emission points are largely in line with the BAT Guidance note. Only the ammonia limit differs with the IPPC limit stricter ( $27\mu\text{g}/\text{m}^3$ ) than the BAT limit ( $30\mu\text{g}/\text{m}^3$ ).

In summary, the results of the modelling exercise of the odour emissions from the existing and new source shows that emissions at the prescribed levels do not exceed any of the short term or long term Environmental Assessment Levels (EALs) for the protection of human health. As such, it can be concluded that even the worst case operations of the site (all emission points operating continuously and at the emission rates outlined below) the odour emissions will not have a significant impact on air quality in the area. It should be noted that ongoing monitoring at the facility indicates that emission points A1-1, A1-2 and A1-3 are in full compliance with the BAT emission limits (also the current IPPC licence limits).

As a result of the low impact of these emissions at BAT limits, the emission limit values presented in Table 4.2 are proposed for Stage 1 and 2 of the IPPC application. This model has demonstrated that these emission limits will not have an adverse impact on air quality or human health in the area.

Parameter	Limit Type	A1-1	A1-2	A1-3	A2-1
Volume Flow	Volume Flow ( $\text{Nm}^3/\text{hr}$ )	22,000	22,000	14,000	19,000
Ammonia	Concentration ( $\text{mg}/\text{m}^3$ )	30	30	30	30
	Mass Emission ( $\text{kg}/\text{hr}$ )	0.15	0.15	0.15	0.15
Amines and Amides	Concentration ( $\text{mg}/\text{m}^3$ )	5	5	5	5
	Mass Emission ( $\text{kg}/\text{hr}$ )	0.11	0.11	0.07	0.09
Total hydrogen Sulphide, sulphides and mercaptans (expressed as S)	Concentration ( $\text{mg}/\text{m}^3$ )	5	5	5	5
	Mass Emission ( $\text{kg}/\text{hr}$ )	0.015	0.015	0.015	0.015
Total Organic Carbon (as C)	Concentration ( $\text{mg}/\text{m}^3$ )	50	50	50	50
	Mass Emission ( $\text{kg}/\text{hr}$ )	0.50	0.50	0.50	0.50

Table 4.2: Proposed Odour Chemical Emission Limits

In relation to the Stage 3 odour infrastructure, limits and impacts this report has highlighted a number of short term and medium term options which may be undertaken as part of the facility restructuring for the Stage 3 application to meet the BAT requirements. Once this detailed design and abatement process is known, a revised odour dispersion model should be undertaken to simulate the impacts of the emissions and to predict the potential for nuisance. It is proposed that the Stage 3 Odour Model Report will be issued to the EPA for approval at least six months in advance of the Stage 3 inception date.

In summary, the existing operations of the UFI facility in Killybegs will not result in significant impacts off-site. Emissions to air were assessed using a refined air dispersion model and the results indicate that emissions of combustion gases and odour compounds will not breach statutory limits or standard guidelines for the protection of human health under the limits expressed in this conclusion.

## **Attachment I.2**

### **Assessment of Impact on Receiving Surface Water**

*For inspection purposes only.  
Consent of copyright owner required for any other use.*

## Attachment I.2 – Assessment of Impact on Receiving Surface Water

### I.2.A Emissions to Surface Water

There are five emission points to surface waters on the site including one discharge of sea water used in the process and four discharges of surface water run-off.

The main emission to surface water is the sea water discharge, designated emission point SW1. This discharge is comprised mainly of the sea water used to condense process vapours but it also includes the condensate from the evaporation process, drier vapours and water from the vacuum pumps. This emission point is presented below:

- SW1 - (formerly W1) surface water discharges into Killybegs Harbour at a point east of the plant.

The location of this emission point is illustrated in Map E.2(i) in Attachment E.

The four additional discharges to surface water are comprised of uncontaminated rainwater run-off from the buildings and hard standing areas. Seven discharges are noted in Schedule 5(i) of the current licence (P0416-01) but three of these discharges (W5, W6 and W7) have been discontinued. The remaining discharges are:

- SW2 (formerly W2);
- SW3 (formerly W3);
- SW4 (formerly W4);
- SW5 (formerly W8);

The discharges are into Killybegs Harbour at points around the perimeter of the site. The location of these storm water emission points are illustrated in Map E.2(i) in Attachment E.

### I.2.B Receiving water

Killybegs Harbour is a small sheltered inlet located at the head of McSwyne's Bay (which itself is an inlet of Donegal Bay) on the southern coast of County Donegal. It is a deep, fjord-like inlet which forms a natural sheltered deepwater harbour. It is approximately 4 km in length with an area of 10 km<sup>2</sup>.

The main freshwater input into the harbour is the Bungosteen River. There are several other small freshwater inputs including Cunlin Lough Stream. However, the waters of the harbour are classified as euhaline, i.e. sea water. The tidal range of 2 to 4 metres and the harbour is characterised by poor flushing and mixing characteristics.

Killybegs Harbour is designated as a sensitive area under national regulations implementing the urban waste water treatment directive (S.I. 254 of 2001 and S.I. 440 of 2004). This is the only protected area designation associated with Killybegs Harbour.

Killybegs Harbour is Ireland's largest fishing port and supports a large number of fish processing factories and associated industries. It is one of the safest, most sheltered, deep-water harbours on the Irish coast.

### **Current state of the water environment**

The quality of estuarine and coastal waters is monitored by a number of government and regulatory agencies, including the Environmental Protection Agency, local authorities, the Marine

Institute, National Parks and Wildlife Service, various government departments, the Radiological Protection Institute of Ireland, the Sea Fisheries Protection Authority and Inland Fisheries Ireland.

This section presents surface water quality information for the waters in the vicinity of Killybegs Harbour. The sources of the water quality information summarised in this chapter are:

- Water body status information arising from the Water Framework Directive monitoring programme and outlined in the *North Western International River Basin Management Plan (2009-2015)*.
- Water quality information outlined in the EPA's most recent water quality report, *Water Quality in Ireland 2007-2009*.

#### Overall Water Framework Directive Status

Water Framework Directive (WFD) status classifications from the WFD monitoring programme apply at the water body scale and are generally based on several samples/surveys targeting a variety of parameters including biological, physico-chemical, chemical and hydromorphological elements. The monitoring information on which the marine status classifications are based was collected between 2005 and 2008.

The overall WFD status of the Killybegs Harbour water body is moderate or less and therefore unsatisfactory. This unsatisfactory status is attributable to the levels of dissolved oxygen measured within the water body (Table I2.1).

Table I2.1 WFD status elements

Status Element	Killybegs Harbour
Dissolved Inorganic Nitrogen status	Good
Molybdate Reactive Phosphorus status	Good
Dissolved oxygen as per cent saturation status	Moderate
Biochemical Oxygen Demand (5-days) status	High
Macroalgae - phytobiomass status	High
Macroalgae - opportunistic algae status	-
Macroalgae - reduced species list status	-
Angiosperms - Seagrass and Saltmarsh status	-
Benthic Invertebrates status	-
Fish status	-
Hydrology status	-
Morphology status	-
Specific Pollutant Status	-
Overall protected area status	Less than good
Ecological Status	Moderate
Chemical Status	-
Surface Water Status	-
Confidence level in status	High
Monitored / Extrapolated	Monitored

The overall WFD status of the adjacent McSwynes Bay water body is yet to be determined due to an inadequate amount of monitoring data available between 2005 and 2008 to classify this water body.

The overall WFD status of the Bungosteen River which discharges to Killybegs Harbour is poor and therefore unsatisfactory. This is due to the results of macroinvertebrate sampling.

### EPA Water Quality Report

The EPA Water Quality Report 2007-2009 was published in 2010 and presents a review of Irish ambient water quality for the years 2007 to 2009 and as such includes more recent data than the WFD status designations. The water quality information is presented on a water body scale in line with the WFD. However, it is also presented in the manner of previous EPA reports so that trends over time can be seen.

The water quality information in relation to transitional and coastal waters outlined in the report was generated by the EPA as well as other organisations including:

- Central and Regional Fisheries Boards (now Inland Fisheries Ireland);
- Marine Institute;
- Sea Fisheries Protection Authority (SFPA);
- National Parks and Wildlife Service (NPWS);
- Waterways Ireland; and
- Irish Coast Guard.

Table I.2.2 EPA water quality

Relevant quality indicators	Killybegs Harbour
Trophic status	Intermediate
Nitrogen levels	
Salinity-related thresholds	Compliant
WFD EQS	Compliant
Phosphorus levels	
Salinity-related assessment levels	Compliant
WFD EQS	Compliant
DO levels	Sufficient
BOD levels (WFD EQS)	Compliant
Oil pollution incidents	None since 2008

#### *Trophic status*

The trophic status of transitional and coastal water bodies is assessed using the EPA's Trophic Status Assessment Scheme (TSAS). This assessment is required for the Urban Waste Water Treatment Directive and Nitrates Directive. The scheme compares the compliance of individual parameters against a set of criteria indicative of trophic state (DIN, MRP, chlorophyll, macroalgae, dissolved oxygen). These criteria fall into three different categories which broadly capture the cause-effect relationship of the eutrophication process, namely nutrient enrichment, accelerated plant growth, and disturbance to the level of dissolved oxygen normally present;

- **Eutrophic** water bodies are those in which criteria in each of the categories are breached, i.e. where elevated nutrient concentrations, accelerated growth of plants and undesirable water quality disturbance occur simultaneously;
- **Potentially Eutrophic** water bodies are those in which criteria in two of the categories are breached and the third falls within 15 per cent of the relevant threshold value;
- **Intermediate** status water bodies are those which breach one or two of the criteria;
- **Unpolluted** water bodies are those which do not breach any of the criteria in any category.

The Killybegs Harbour water body is classed as intermediate in the most recent water quality report.

### *Nitrogen levels*

Levels of Dissolved Inorganic Nitrogen (DIN) are monitored in winter, when levels are expected to be at their seasonal maximum due to the absence of any significant plant or algal growth, and in the summer, to capture the potential effect of seasonal changes in river flow which can have an effect on concentrations.

Each water body is assessed against salinity-related thresholds and the WFD EQS for DIN. The Killybegs Harbour water body was compliant with both.

### *Phosphorus levels*

Levels of Molybdate Reactive Phosphorus (MRP) are monitored in winter, when levels are expected to be at their seasonal maximum due to the absence of any significant plant or algal growth, and in the summer, to capture the potential effect of seasonal changes in river flow which can result in higher phosphate concentrations in some estuaries.

Each water body is assessed against salinity-related assessment levels and the WFD EQS for MRP. The Killybegs Harbour water body was compliant with both.

### *Dissolved oxygen levels*

Low levels of Dissolved Oxygen (DO) can have adverse effects on aquatic organisms including slower growth rates, impaired immune response and, in severe cases, mortality. DO levels are classified as follows:

- Anoxic (0 - 0.5 mg l<sup>-1</sup>)
- Hypoxic (0.5 - 2.0 mg l<sup>-1</sup>)
- Deficient (2.0 - 6.0 mg l<sup>-1</sup>)
- Sufficient (6.0 - 10.0 mg l<sup>-1</sup>)

The Killybegs Harbour water body is classified as sufficient.

### *Biological Oxygen Demand*

Biological Oxygen Demand (BOD) was compared with the WFD EQS for BOD. The Killybegs Harbour water body was compliant with the EQS.

### *Oil pollution incidents*

There were no oil pollution incidents recorded in Killybegs Harbour since November 2008 when a vessel sunk 30 meters outside the Killybegs Harbour limit with 1,000 litres of diesel, 200 litres of hydraulic oil and 50 litres of lube oil on board.

### *Quality of Shellfish Waters - Shellfish Flesh Quality*

There is a designated shellfish area in the adjacent McSwynes Bay. The Sea-Fisheries Protection Authority (SFPA) is the competent authority in Ireland responsible for classifying shellfish production areas. A shellfish sanitation monitoring program for classifying shellfish-growing waters (based on a number of parameters including microbiological criteria and levels of E. coli), has been in operation in Ireland since 1985. The scheme of classification has four categories: Class Aq whereby no treatment is required before the shellfish can be consumed; Class Bq whereby purification is required before the shellfish can be consumed; Class Cq whereby relaying for a period of 2 months of heat treatment is required before the shellfish can be consumed; and Class Dq whereby shellfish cannot be harvested for human consumption.

The licensed areas within the designated areas for mussels are classified as ~~Class A~~ meaning that live bivalve molluscs may be collected for direct human consumption and meet the health standards for live bivalve molluscs laid down in the EC Regulation on food safety (Regulation (EC) No 853/2004). However, this is a seasonal classification and it reverts to Class B from the 1st of July to the 30th of November, meaning that shellfish may be placed on the market for human consumption only after treatment in a purification centre or after relaying so as to meet the health standards.

Shellfish flesh classifications (carried out under the European Communities (Live Bivalve Molluscs) (Health Conditions for Production and Placing on the Market) Regulations, 1996 (S.I. No. 147 of 1996)) are an indicator of faecal contamination in shellfish flesh. Sampling is carried out by the Sea Fisheries Protection Authority (SFPA) on at least a monthly basis. McSwynes Bay shellfish area is in compliance with the shellfish guideline value for faecal coliforms.

#### *Quality of Shellfish Waters - Water Quality*

Shellfish water quality parameter mandatory and guideline values are outlined in Annex I of the Shellfish Waters Directive (2006/113/EC) and Schedule 2 and 4 of the Quality of Shellfish Waters Regulations (S.I. No. 268 of 2006).

The Marine Institute carries out shellfish monitoring at designated shellfish areas. This dedicated shellfish monitoring program involves analysing for general components, metals and organics in both water and biota samples.

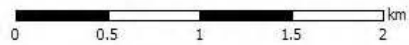
For McSwynes Bay (Map I.2(i)), 1 water sample and 6 biota samples were available from between 2004 and 2008. The shellfish mandatory and guideline values were not breached in any of these samples.

For inspection purposes only.  
Consent of copyright owner required for any other use.



**Map I.2(i)**  
**Location of McSwynes Bay shellfish area**

Map prepared - May 2011



### *Bathing Water Quality Status*

Local authorities are responsible for bathing water quality in their areas. Sampling at these bathing areas must be undertaken on a fortnightly basis during the bathing season which extends from the 1 June until the end of August each year. The five microbiological and physicochemical parameters considered for EU compliance purposes are: total coliforms; faecal coliforms; mineral oils; surface active substances; and phenols. Over the bathing season, the water quality at each designated bathing area must comply with minimum EU mandatory values and should endeavour to achieve stricter EU guide values. To achieve a Blue Flag award, bathing areas must also comply with the EU guide value for an additional microbiological parameter, faecal streptococci.

The nearby Fintra designated bathing area is classified as being of good bathing water quality.

*For inspection purposes only.  
Consent of copyright owner required for any other use.*

## I.2.E Assessment of Impacts

The Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009) establish environmental quality standards (EQSs) for surface waters. The potential impacts of the surface water discharge were measured against compliance with these EQSs.

Following the implementation of the planned program of improvement, the water discharged from SW1 will be the same quality as when it was taken into the process apart from a slight temperature increase (circa 20°C).

The EQS for temperature in transitional waters is as follows:

Thermal conditions      Not greater than a 1.5°C rise in ambient temperature outside the mixing zone

Computational modelling techniques were used to assess the effect of the heated sea water on the marine environment of Killybegs Harbour and its environs and to assess whether the discharge would effect compliance with the EQS for temperature. The modeling report forms part of this attachment.

The model considered 2 possible outfall locations for the new SW1 discharge point:

- Outfall location to the east of the landing pier.
- Outfall location to the west of the landing pier.

Both locations are presented graphically in Figure 1.1 of the attached report.

The assessment of the proposed thermal discharge was undertaken using numerical techniques using a 3D flexible mesh model capable of incorporating the thermally driven currents and the effect of feedback. Two potential locations are presented in this document and compared with respect to the background levels. Both scenarios were found to achieve mixing which resulted in excess temperatures of less than 1.5°C in the immediate vicinity of the discharge location and were therefore deemed to comply with the thermal condition limit of the EQS (presented above) as well as the limits specified in the Freshwater Fish Life Directive.

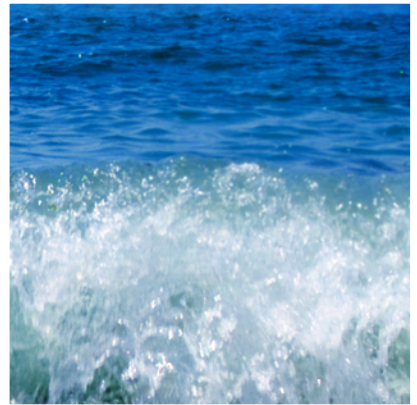
A discharge location sited to the west of the pier showed a slight reduction in the effect of feedback when compared with the eastern site; however in both cases the feedback was found to be limited even after prolonged discharge at the highest production rates. The site to the east was shown to experience the greatest level of dispersion; taking advantage of the increased water depth resulting with the larger plume with the lowest excess temperatures.

In conclusion, the modeling demonstrates that the discharge from SW1 at the new outfall location east of the landing pier, after the planned program of improvement has been implemented, will not effect achievement of the EQS for temperature in Killybegs Harbour.

# Killybegs Seawater Outfall Modelling

## Thermal Discharge

IBE0481 R01 Rev1 NS July 11





# Killybegs Seawater Outfall Modelling

## Thermal Discharge

### DOCUMENT CONTROL SHEET

Client	United Fish Industries Killybegs (UFI)					
Project Title	Killybegs Seawater Outfall Modelling					
Document Title	Thermal Discharge					
Document No.	IBE0481/R01_01					
This Document Comprises	DCS	TOC	Text	List of Tables	List of Figures	No. of Appendices
	1	1	27	0	1	0

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
0	Draft	AG	NS	-	Belfast	Mar 2011
1	Draft	AG/NS	CR	NS	Belfast	Jul 2011

# TABLE OF CONTENTS

<b>1</b>	<b>BACKGROUND .....</b>	<b>3</b>
<b>2</b>	<b>DATA &amp; MODELS.....</b>	<b>5</b>
2.1	OVERVIEW.....	5
2.2	AMBIENT TIDAL AND FLOW CONDITIONS .....	7
2.3	DISCHARGE PARAMETERS AND CLIMATIC CONDITIONS .....	10
<b>3</b>	<b>MODELS RESULTS .....</b>	<b>12</b>
3.1	DISCHARGE EAST OF PIER .....	12
3.2	DISCHARGE WEST OF PIER .....	19
<b>4</b>	<b>THERMAL DISCHARGE STUDY RESULTS .....</b>	<b>26</b>
<b>5</b>	<b>SUMMARY &amp; CONCLUSIONS.....</b>	<b>27</b>

*For inspection purposes only.  
Consent of copyright owner required for any other use.*

## LIST OF FIGURES

Figure 1.1: Existing and proposed outfall locations and intake location .....	4
Figure 2.1: Killybegs Harbour Model extent and bathymetry .....	6
Figure 2.2: Predicted tidal elevation for Killybegs in modelled period (February and March 2006).....	7
Figure 2.3 a & b: Spring (left) and Neap (right) Tidal Elevation .....	7
Figure 2.4: Bungosteen River (Stragar) Catchment.....	9
Figure 2.5: Assumed fresh water inflow by volume in [ %].....	10
Figure 3.1: Pier East Maximum Temperature – Spring Tide Mid-depth.....	13
Figure 3.2: Pier East Average Temperature – Spring Tide Mid-depth.....	13
Figure 3.3: Pier East Maximum Excess Temperature – Spring Tide Surface.....	14
Figure 3.4: Pier East Average Excess Temperature – Spring Tide Surface.....	14
Figure 3.5: Pier East Maximum Excess Temperature – Spring Tide Bed.....	15
Figure 3.6: Pier East Average Excess Temperature – Spring Tide Bed.....	15
Figure 3.5: Pier East Maximum Temperature – Neap Tide Mid-depth .....	16
Figure 3.5: Pier East Average Temperature – Neap Tide Mid-depth.....	16
Figure 3.5: Pier East Maximum Excess Temperature – Neap Tide Surface .....	17
Figure 3.5: Pier East Average Excess Temperature – Neap Tide Surface.....	17
Figure 3.5: Pier East Maximum Excess Temperature – Neap Tide Bed .....	18
Figure 3.5: Pier East Maximum Excess Temperature – Neap Tide Bed .....	18
Figure 3.13: Pier West Maximum Temperature – Spring Tide Mid-depth.....	20
Figure 3.14: Pier West Average Temperature – Spring Tide Mid-depth.....	20
Figure 3.15: Pier West Maximum Excess Temperature – Spring Tide Surface.....	21
Figure 3.16: Pier West Average Excess Temperature – Spring Tide Surface.....	21
Figure 3.17: Pier West Maximum Excess Temperature – Spring Tide Bed.....	22
Figure 3.18: Pier West Average Excess Temperature – Spring Tide Bed.....	22
Figure 3.19: Pier West Maximum Temperature – Neap Tide Mid-depth .....	23
Figure 3.20: Pier West Average Temperature – Neap Tide Mid-depth.....	23
Figure 3.21: Pier West Maximum Excess Temperature – Neap Tide Surface .....	24
Figure 3.22: Pier West Average Excess Temperature – Neap Tide Surface.....	24
Figure 3.23: Pier West Maximum Excess Temperature – Neap Tide Bed .....	25
Figure 3.24: Pier West Maximum Excess Temperature – Neap Tide Bed .....	25

# 1 BACKGROUND

United Fish Industries Killybegs (UFI) are currently exploring the possibility of increasing their production at the Fishery Harbour Centre. The proposed new fishmeal plant will use an indirect scrubbing process which would result in a significant improvement in the quality of the effluent. This would involve an additional discharge of the UFI's thermal effluent of up to 800m<sup>3</sup>/h of sea water at the peak of the fishmeal processing season (January – April). The cooling process would raise the temperature to a similar level as currently used with direct scrubbing but no other contaminants will be released with this cooling water discharge.

The key objective of this study is to identify the most suitable location for the outfall, providing a lesser impact on water quality from the current discharge location and therefore also complying with the discharge licence. As part of its improvement programme, the UFI have commissioned RPS Consulting Engineers to carry out an assessment of the thermal effluent discharge. A number of outfall locations were investigated and the need to discharge into deeper water than at the current location was established in order for water quality standards to be met.

It is feasible to lay an outfall pipe along the road from the Fish Meal Factory to the Harbour, enabling discharge into deeper water near the berths therefore two potential discharge locations were identified and investigated:

- **Option 1:** East of the Landing Pier: at co-ordinates 536184E, 6054480W UTM-29
- **Option 2:** West of the Landing Pier: at co-ordinates 536120E, 6054455W UTM-29

The location of the current intake is: 536489E, 6054856N UTM-29. Figure 1.1 below shows the location of the existing outfall and intake along with the two proposed outfall locations.

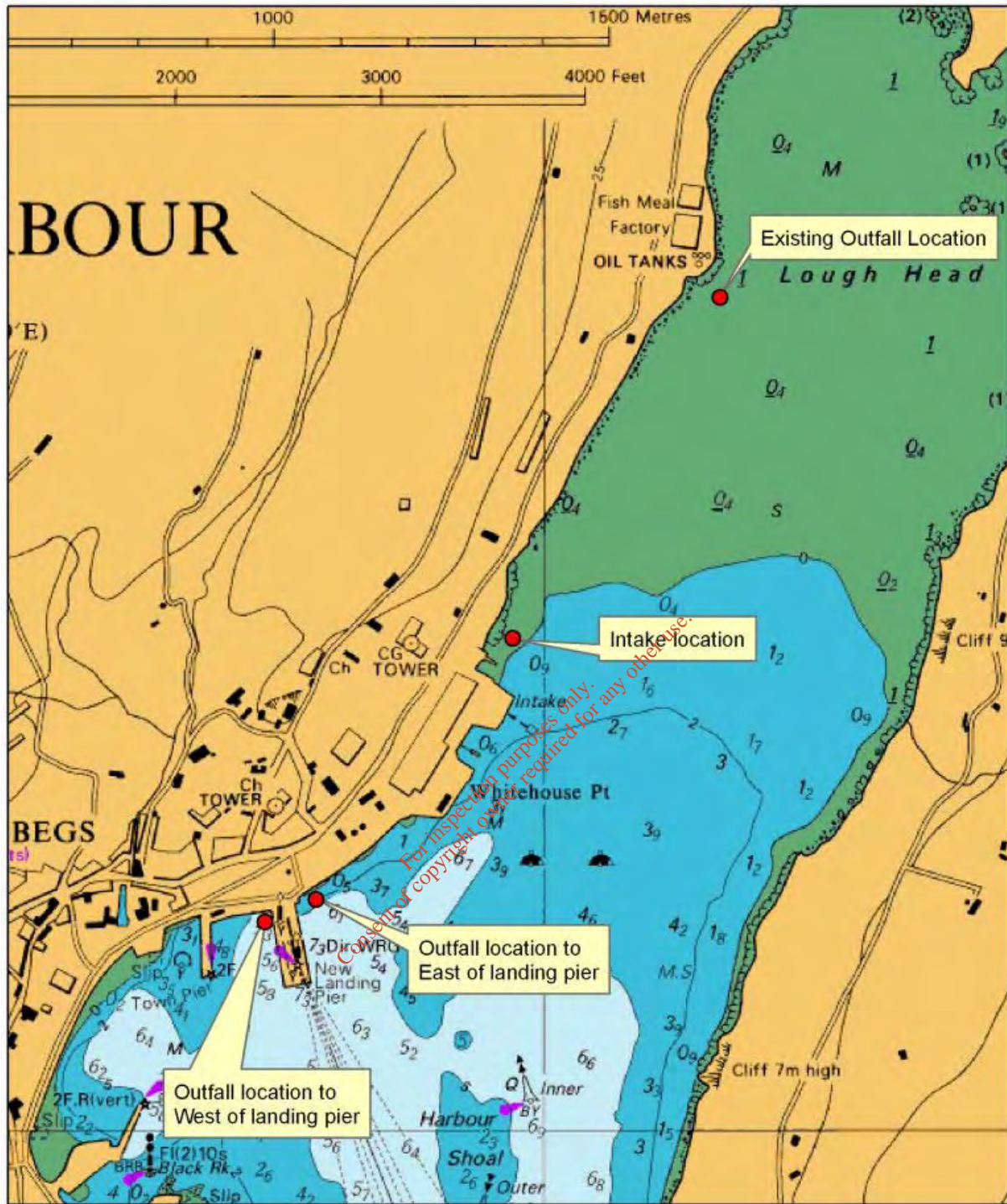


Figure 1.1: Existing and proposed outfall locations and intake location

## 2 DATA & MODELS

### 2.1 OVERVIEW

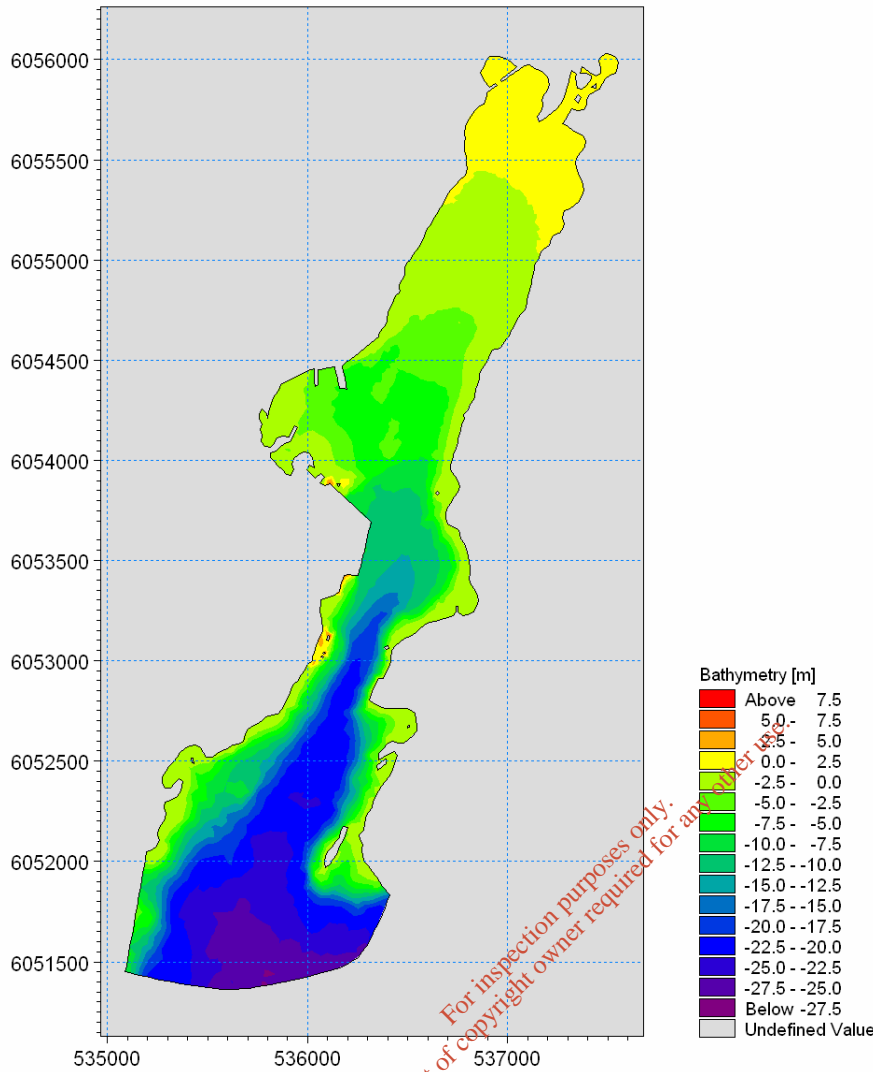
The model simulations for the flow regime of the Killybegs Harbour were completed using a 3-dimensional MIKE3 HD flexible mesh flow model. The MIKE software is recognised worldwide and used by a number of consultants and research institutions internationally and offers the benefit of enabling the simulation of flows in both two and three dimensions using the same model set-up. For this study the model was deployed with the vertical water column split into five layers, equally distributed over the full water depth.

MIKE 3 Flow Model can be used to simulate a wide range of hydraulic and related processes, including:

- fluvial flows with stratification
- tidal exchange with fresh water inflow
- heat and recirculation
- water quality assessments.

The water level and flow computations are resolved on a flexible mesh covering the area of interest when provided with the bathymetry, bed resistance coefficient; wind field, hydrographic boundary conditions etc. The model employed was based on a flexible mesh approach allowing the representation of the Harbour as triangular cells. The use of flexible mesh technology enables the resolution of the model to be varied spatially over the model domain thus allowing very fine grid resolution to be incorporated where necessary e.g. around the discharge locations, whilst retaining computational efficiency. The use of the MIKE 3 flexible mesh model permits the incorporation of three dimensional effects i.e. density dominated plume behaviour and stratification.

The model used for this study was adapted from a previous modelling project undertaken for UFI in relation to a proposed new plant with the bathymetry updated accordingly for the current study. The model was to Chart Datum. Extent of the model used in this study and the bathymetry are shown in Figure 2.1 below:

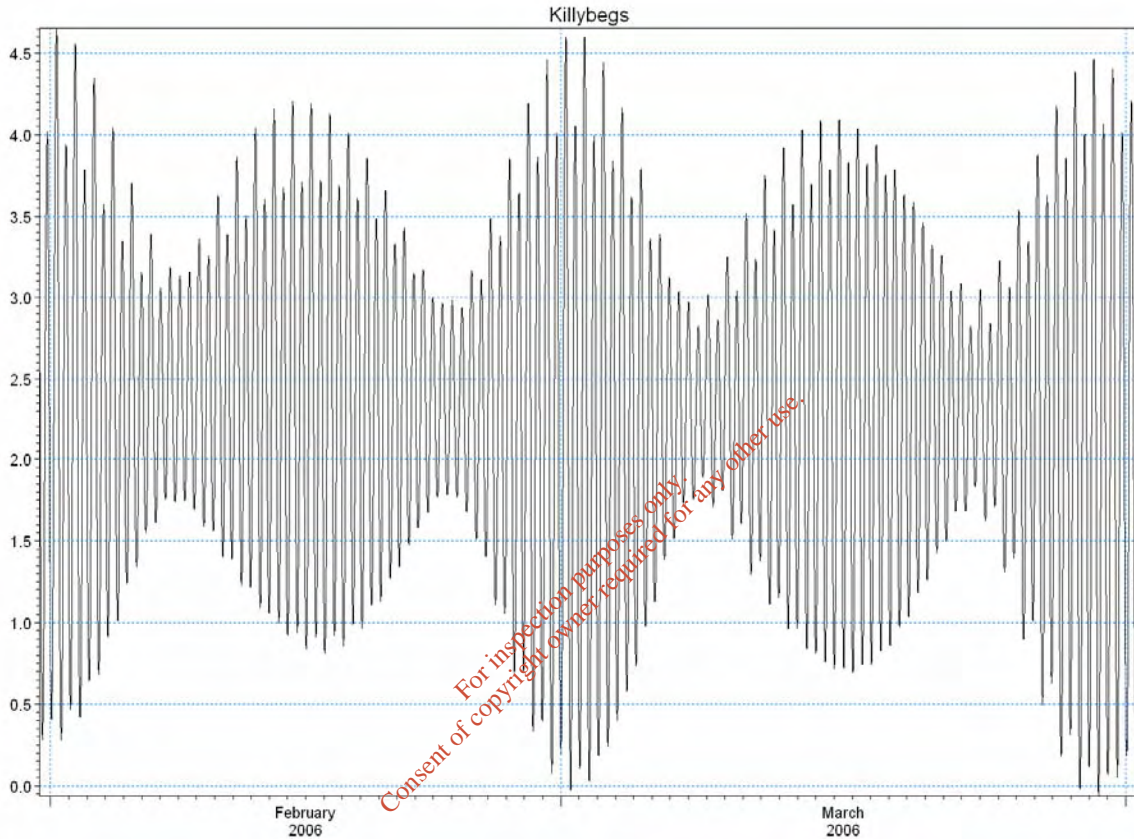


**Figure 2.1: Killybegs Harbour Model extent and bathymetry**

The study required the dispersion characteristics of the plume to be established for the thermal discharge. The extent to which dispersion takes place is a function of the buoyancy of the effluent with respect to the ambient surroundings into which it is discharged. The difference in density is related to both the salinity and the temperature of each fluid. In the case of the plant’s thermal discharge the initial dilution is also governed by the volume and trajectory of the discharge along with water depth and any ambient current into which it may be discharged. The following section outlines the ambient conditions which were established as part of the study.

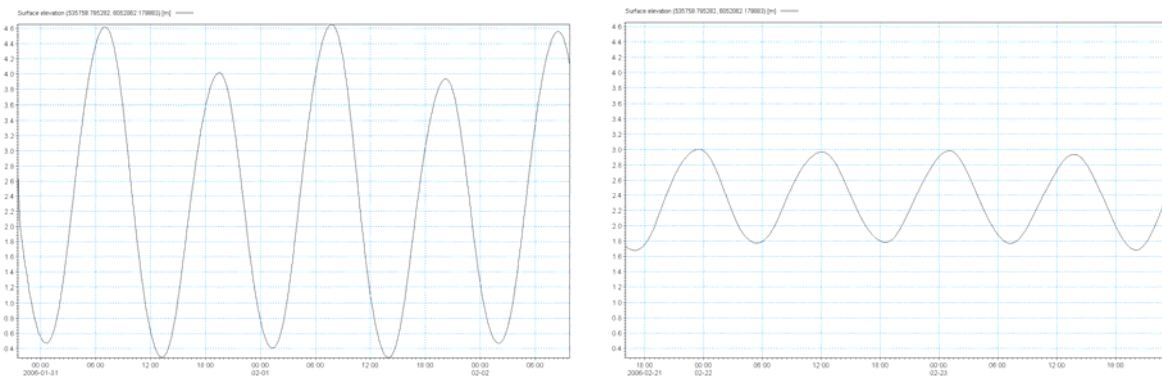
## 2.2 AMBIENT TIDAL AND FLOW CONDITIONS

The scope of the commission required that the plume extent be established over a period of 2 months with the influence of the proposed discharge. For this study the period of February and March 2006 was modelled; incorporating a range of both spring and neap tidal ranges. The predicted tidal elevation (Figure 2.2) was derived from Admiralty tide tables and applied at the South boundary of the model to drive the flow in the Harbour.



**Figure 2.2: Predicted tidal elevation for Killybegs in modelled period (February and March 2006)**

The mean spring tidal range is approximately 3.5m whilst the mean neap range is 1.5m, as illustrated in Figure 2.3 a & b respectively. This gives rise to a large range in current velocity therefore high levels of mixing was expected in the harbour.



**Figure 2.3 a & b: Spring (left) and Neap (right) Tidal Elevation**

The Fishery Harbour is continuously monitored by the Environment Agency and UFI in terms of a range of water quality parameters, there are however some shortcomings in relation to the completeness of the information available for this study. For example, the flow rates of the fresh water are not monitored at all locations and some assumptions were required regarding inflows for the purpose of modelling. It was assumed that the Killybegs Harbour had only two significant sources of inflow of the fresh water in the model. The first of which is from the Bungosteen (Stragar) River along with its associated tributaries (at north-eastern tip of the harbour. The second being from the head of the Lough at north-western tip of the harbour. Total catchment area for these rivers is 42.89km<sup>2</sup>. In order to estimate the inflow to the Harbour three adjacent catchments with available flow records were analysed:

- **Glenaddragh River** (catchment - 14.0km<sup>2</sup>). February average flow for 1979-2010 = 0.8158m<sup>3</sup>/s which equates to 0.05827m<sup>3</sup>/s per km<sup>2</sup> of the catchment. March flow average for 1979-2010 = 0.7805m<sup>3</sup>/s which equates to 0.05575m<sup>3</sup>/s per km<sup>2</sup> of catchment.
- **Lough Eske** (catchment - 80.1km<sup>2</sup>). February average flow for 1978-2010 = 4.9504m<sup>3</sup>/s which equates to 0.06180m<sup>3</sup>/s per km<sup>2</sup> of the catchment. March flow average for 1978-2010 = 4.9884m<sup>3</sup>/s which equates to 0.06228m<sup>3</sup>/s per km<sup>2</sup> of catchment.
- **Owenea River** (catchment - 111.2km<sup>2</sup>). February average flow for 1973-1998 = 6.1984m<sup>3</sup>/s which equates to 0.05574m<sup>3</sup>/s per km<sup>2</sup> of the catchment. March flow average for 1973-1998 = 6.3943m<sup>3</sup>/s which equates to 0.05750m<sup>3</sup>/s per km<sup>2</sup> of catchment.

The above data, for Glenaddragh River and Lough Eske River, was acquired from the EPA website whilst the OPW website was the source for the Owenea River data. Figure 2.4 below shows the Bungosteen River catchment extent.



**Figure 2.4: Bungosteen River (Stragar) Catchment**

Statistical analysis was carried out to provide an estimate of flows which are likely to occur for the two fresh water sources in the Killybegs Harbour model. An average flow for the February and March period was established at approximately  $0.036\text{m}^3/\text{s}$  per  $\text{km}^2$  of the catchment; which gives a fresh water input for the  $42.89\text{km}^2$  catchment of  $1.53\text{ m}^3/\text{s}$ . It was assumed that 10% of the flow by volume entered the Harbour through the head of the Lough and 90% through the Bungosteen River (Figure 2.5).



**Figure 2.5: Assumed fresh water inflow by volume in [%]**

Data published on the Met Eireann website indicated that the temperature of the inflow was oscillating between 4.8°C and 6.5°C during February and March thus it was assumed in the models that a constant temperature of 6°C would be relevant. This is 2°C lower than the water temperature in the harbour and may have an impact on the plume temperature and mixing conditions.

## 2.3 DISCHARGE PARAMETERS AND CLIMATIC CONDITIONS

UFI estimates that the cooling water used in the indirect scrubbing process would be increased in temperature of 20°C and the plant is expected to run at the following rates of production:

- A.** full production over 24hrs from the last week of January to the first week of April with a peak discharge of approximately 1500 m<sup>3</sup>/h
- B.** for 12hrs/day over 5 days and 24hrs/day over 2 days - per week throughout October to January with reduced flow rate – typically 600m<sup>3</sup>/h of sea water will be used

**C. for 12 hrs/day over 7 days – per week through August and September**

Production between April and July is very sporadic with only a 12hr shift on occasional days, possibly once a fortnight. Again assumptions had to be made regarding ambient temperature and humidity as there is no meteorological station close to Killybegs Harbour. Air temperature and humidity are important factors for cooling surface layers of the water thus establishing correct values was critical for accurate results. The ambient temperature for water and air were derived from records obtained from data published on the Met Eireann website.

To be conservative the air temperature and humidity were assumed to be the average of those recorded at Belmullet and Malin Head, as the Killybegs Harbour lies approx mid-way between these locations. Mean air temperature in years 1961-1990 for February and March (peak production period months) ranged between 5.2°C and 6.8°C. Therefore 6°C was used as an average in the modelling. Average air humidity fluctuated between 75% and 84% in the same period therefore 80% humidity was assumed as being appropriate for the Killybegs Harbour area. Initial water temperature in all models was taken as a typical winter value of 8°C with salinity at a level of 32 PSU - average for Irish coastal areas. Continuous discharge rate of processed water from the outfall at each of the locations was set at 1500 m<sup>3</sup>/h which was chosen as the worst case scenario and applied in each case.

The existing licence was granted on the basis that the discharge complies with the Freshwater Fish Life Directive which provides cooling water discharge limits in salmonid waters. The directive states that the temperature:

- must not exceed (at the edge of mixing zone as determined by the local authority) the unaffected temperature by more than 1.5°C
- during winter months (November to April) must not exceed 10°C (where species which need cold water for reproduction are present)
- must not exceed 21.5°C during the rest of the year.

The temperature limits should be conformed with for 98% of the time.

The following section presents results of the modelling for the scenarios outlined.

### 3 MODELS RESULTS

To illustrate discharge impact of the processed water, statistical analysis has been carried out. One spring tide and one neap tide cycle were extracted at the end of the modelled period to produce maximum and average temperature maps. In addition to the outfall discharge scenarios, a baseline scenario was run (with no effluent discharge) in order that excess temperature above the background level could be established; this is referred to as unaffected temperature in the Freshwater Fish Life Directive. The maximum and average excess values were established by subtracting the baseline results for each cell, in each layer for each time step through the tide cycle of the scenario under scrutiny before carrying out the statistical analysis.

In the following section the figures relating to maximum temperature envelope are presented, it should be noted that they are the highest temperature experienced in each particular model cell over the course of the analysis. This situation is statistical and it is very unlikely that maximum temperatures would occur over the whole modelled area at the same time. These temperatures may also only persist for a short period and should be considered in concert with the average results presented alongside.

For each of the two scenarios the absolute temperature plots for only the mid-depth layer are presented, as very little variation is evident across the water depth due to the plotting scale. In the case of the excess temperature the surface and bed layers are presented. Spring and neap results are presented for both options.

#### 3.1 DISCHARGE EAST OF PIER

The maximum and average spatial distribution of temperature at the outfall located to the east of the landing pier in Killybegs Harbour is illustrated in Figure 3.1 to Figure 3.6 for the spring tide. Similarly the series of figures showing neap temperature values are presented in Figure 3.7 to Figure 3.12.

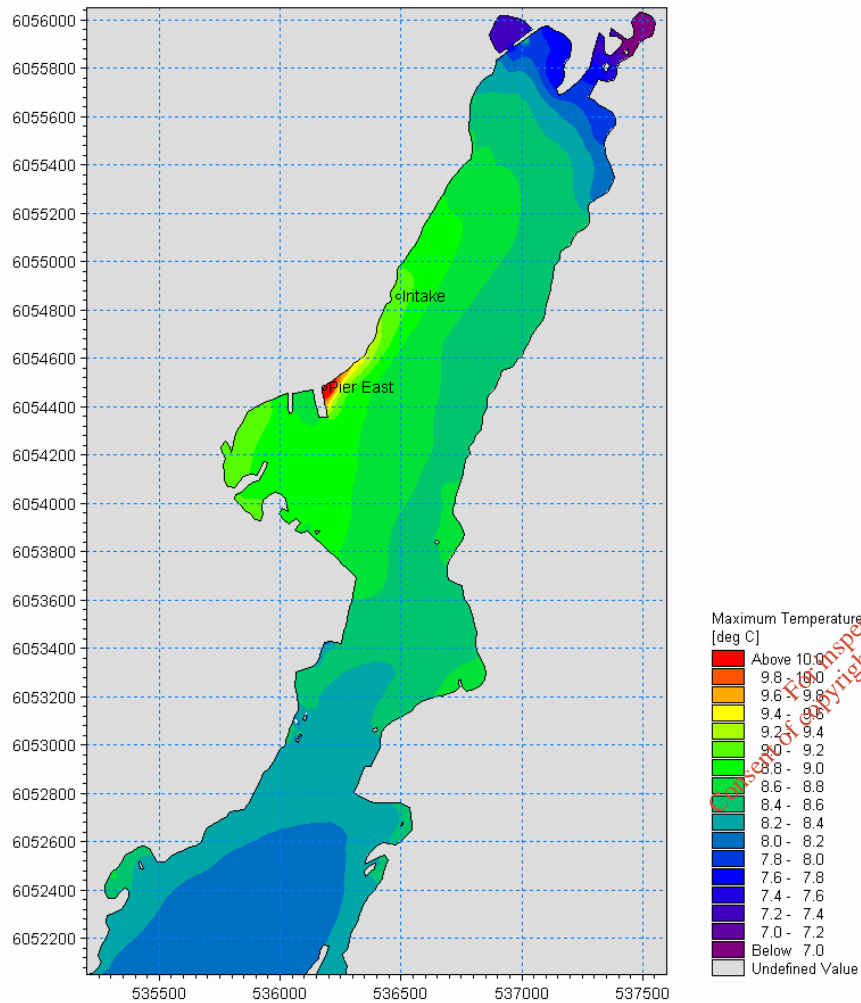


Figure 3.1: Pier East Maximum Temperature – Spring Tide Mid-depth

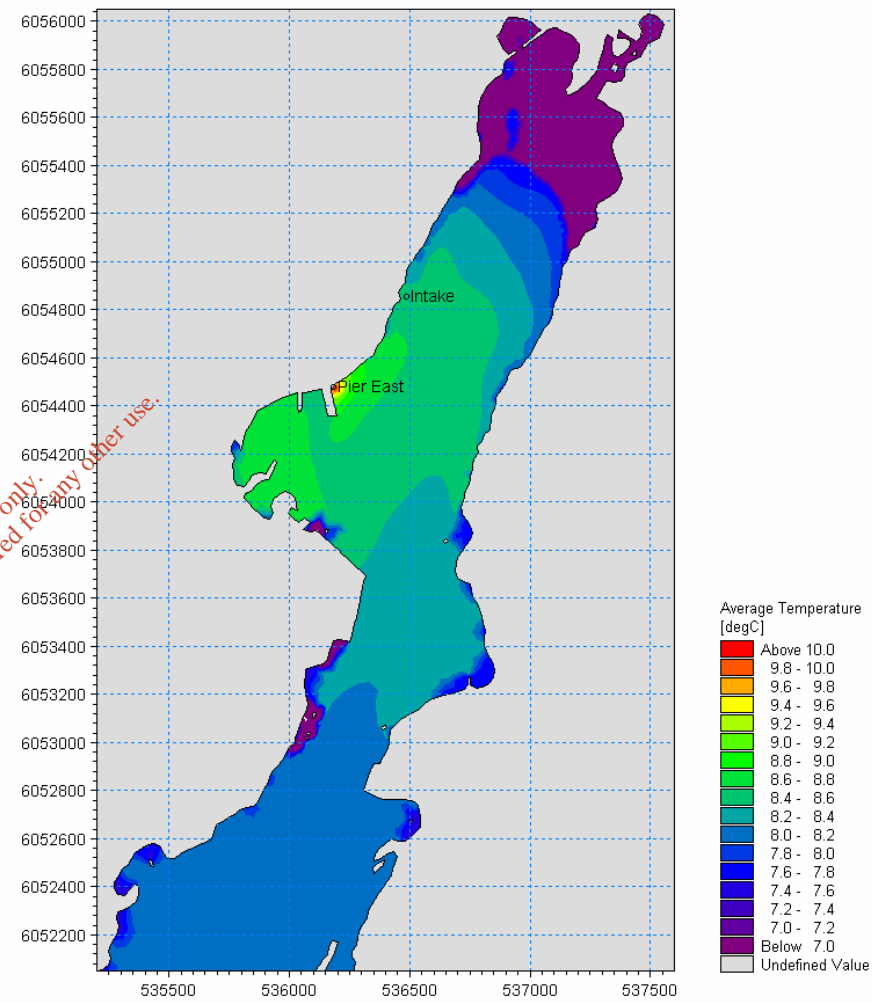


Figure 3.2: Pier East Average Temperature – Spring Tide Mid-depth

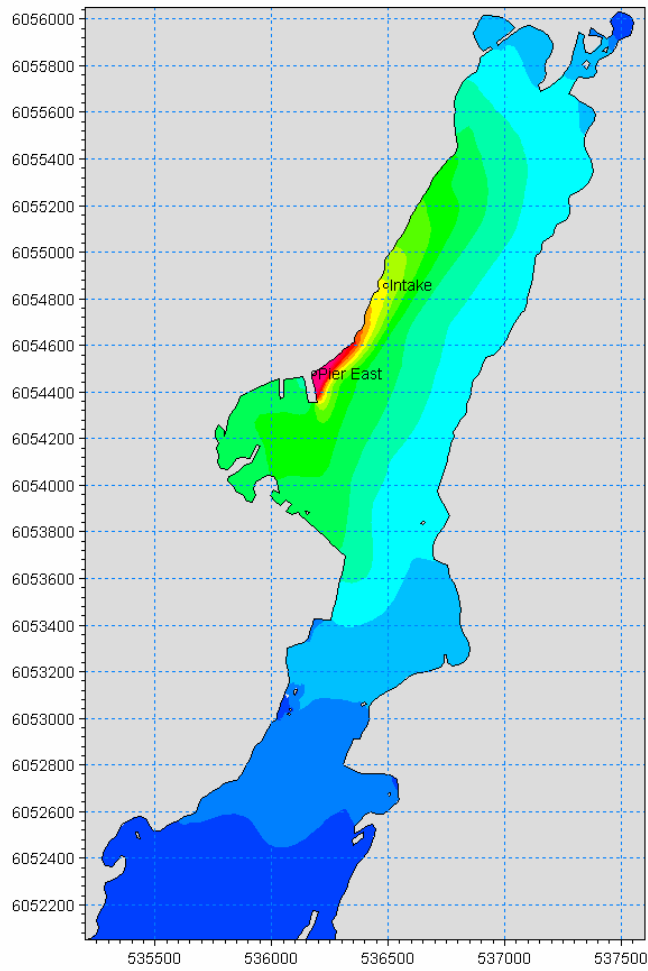


Figure 3.3: Pier East Maximum Excess Temperature – Spring Tide Surface

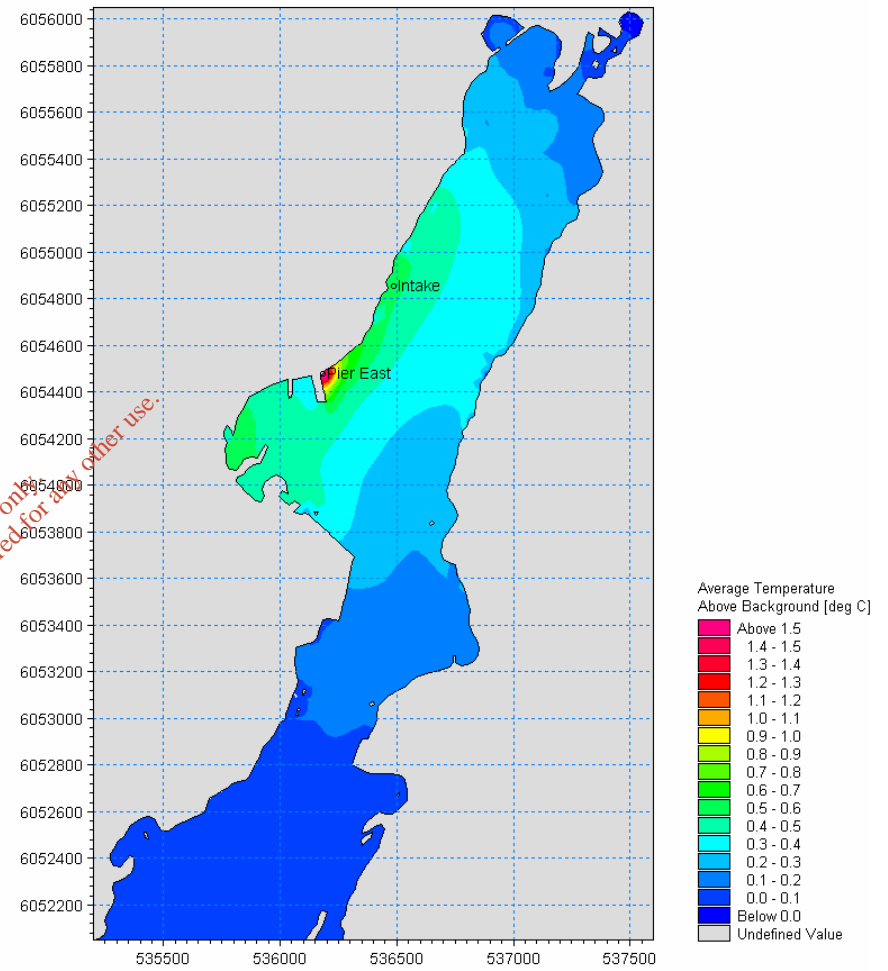


Figure 3.4: Pier East Average Excess Temperature – Spring Tide Surface

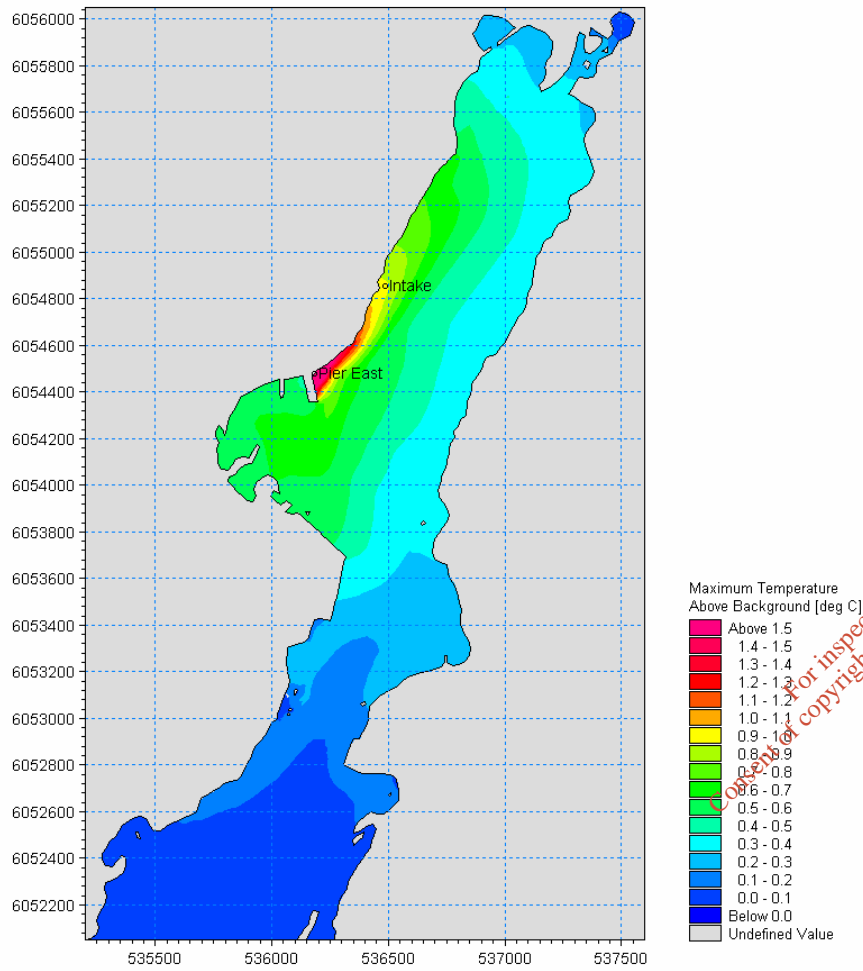


Figure 3.5: Pier East Maximum Excess Temperature – Spring Tide Bed

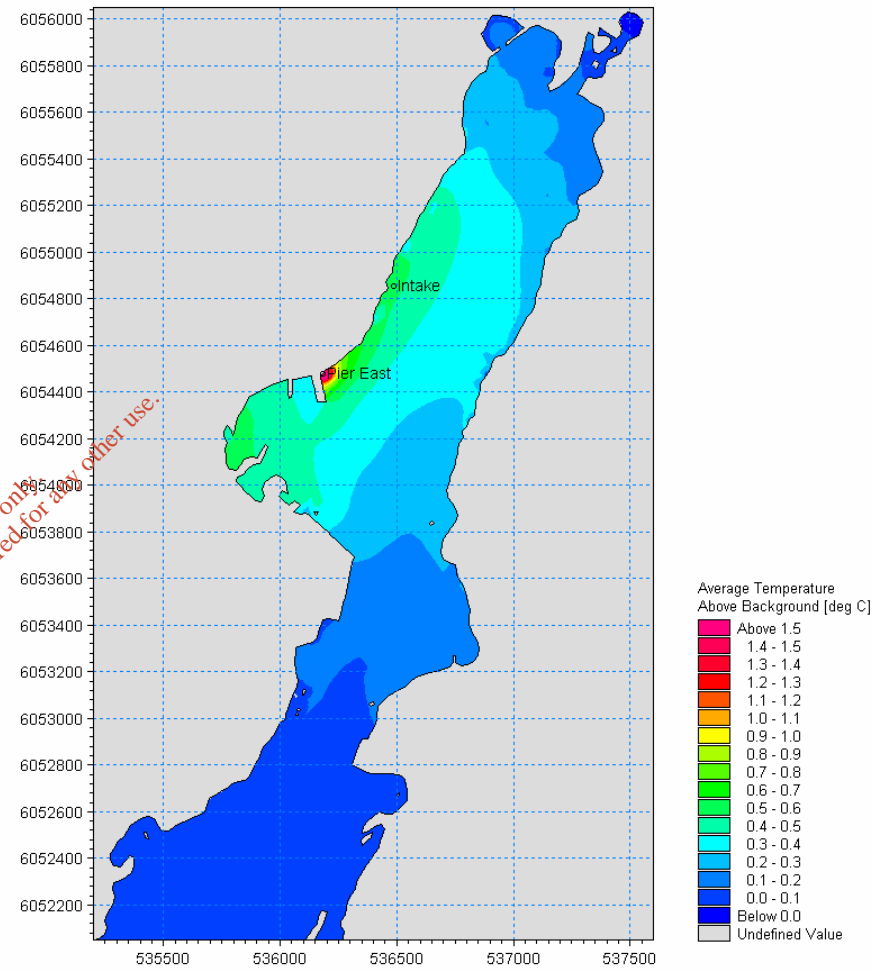


Figure 3.6: Pier East Average Excess Temperature – Spring Tide Bed

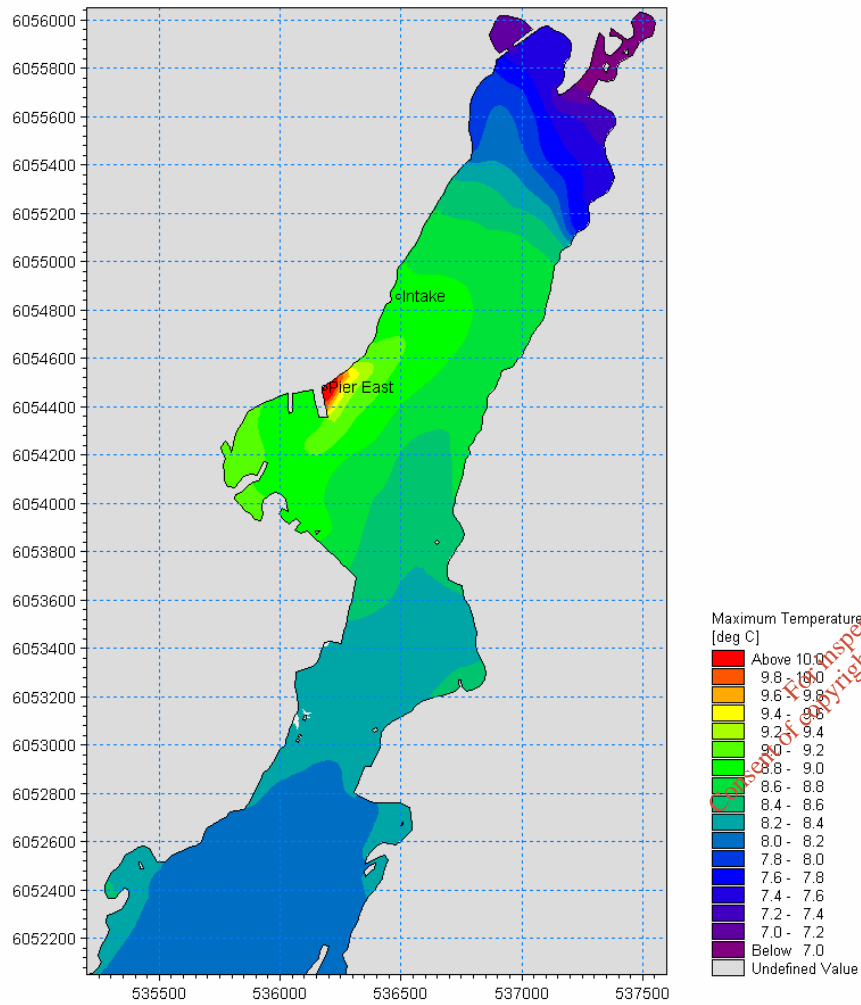


Figure 3.7: Pier East Maximum Temperature – Neap Tide Mid-depth

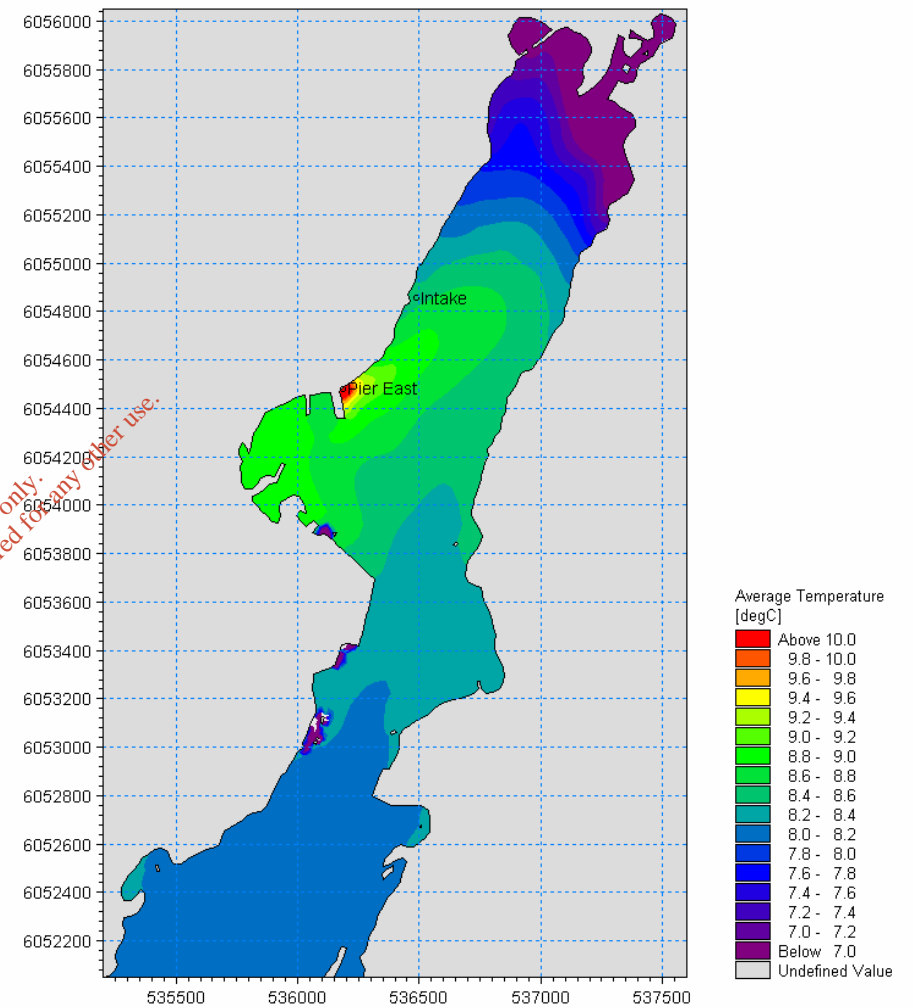


Figure 3.8: Pier East Average Temperature – Neap Tide Mid-depth

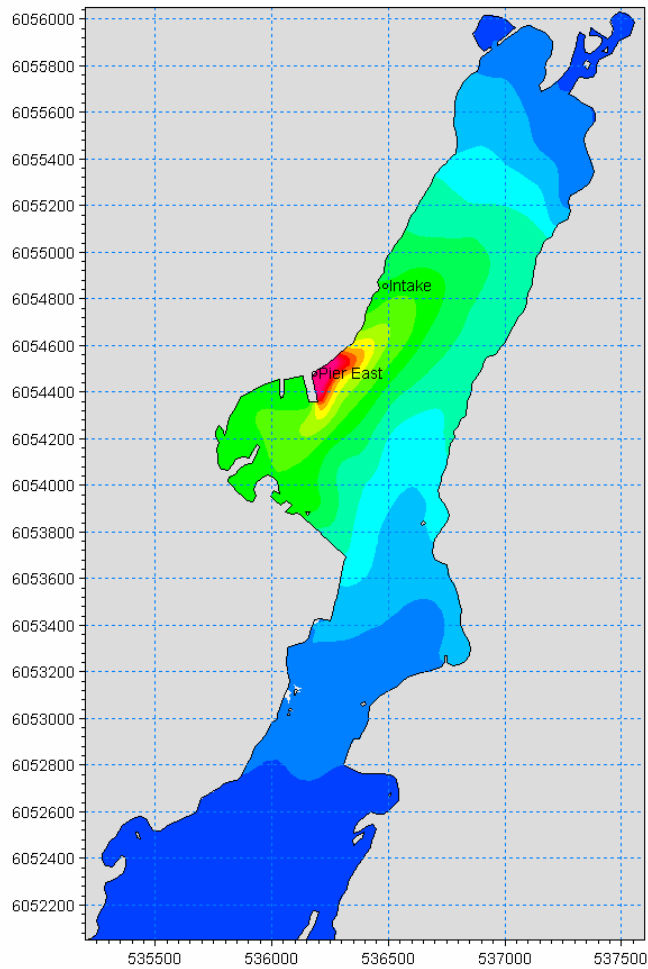


Figure 3.9: Pier East Maximum Excess Temperature – Neap Tide Surface

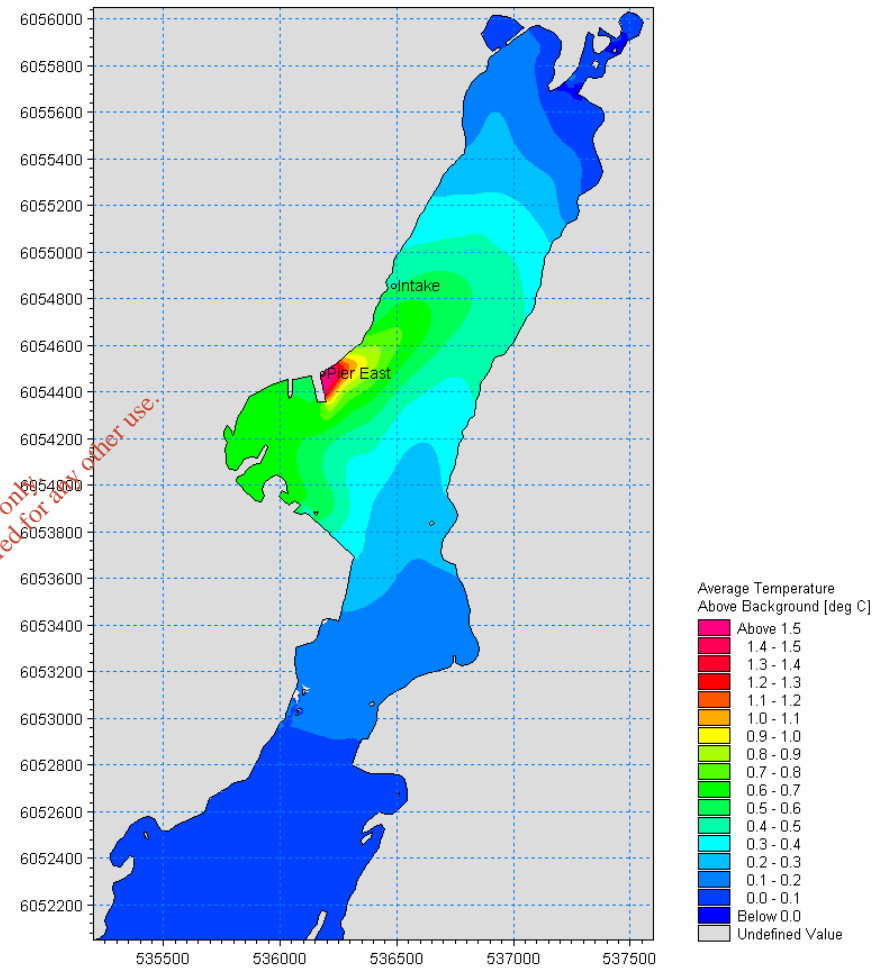


Figure 3.10: Pier East Average Excess Temperature – Neap Tide Surface

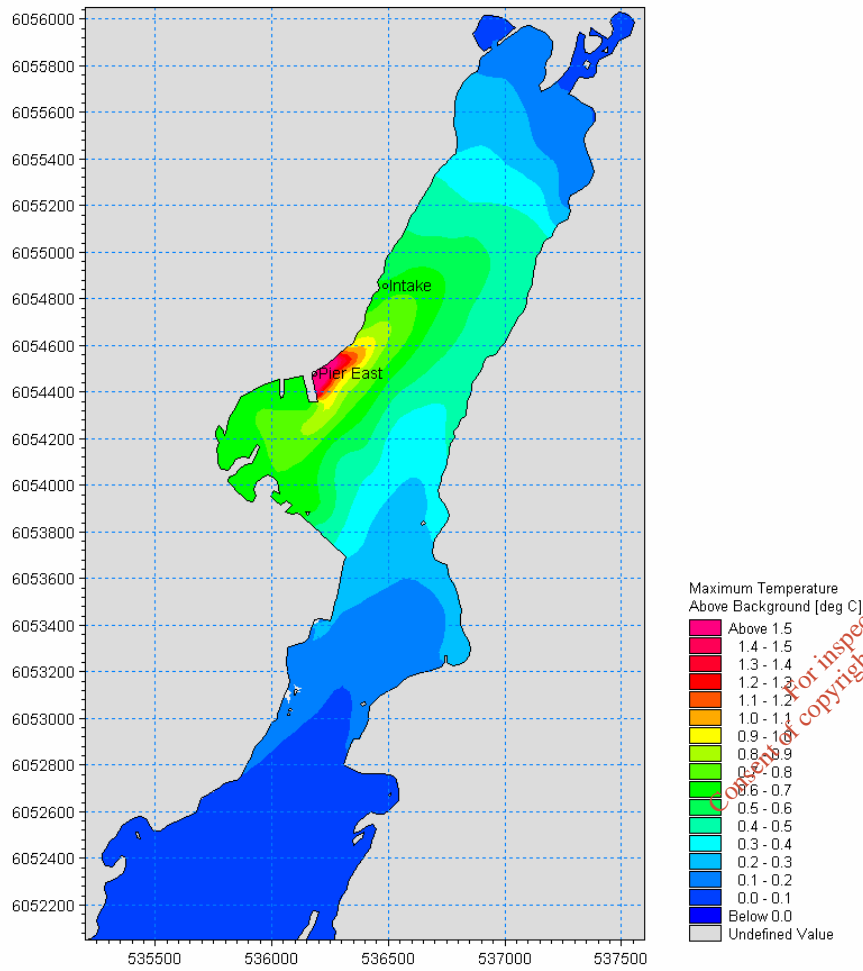


Figure 3.11: Pier East Maximum Excess Temperature – Neap Tide Bed

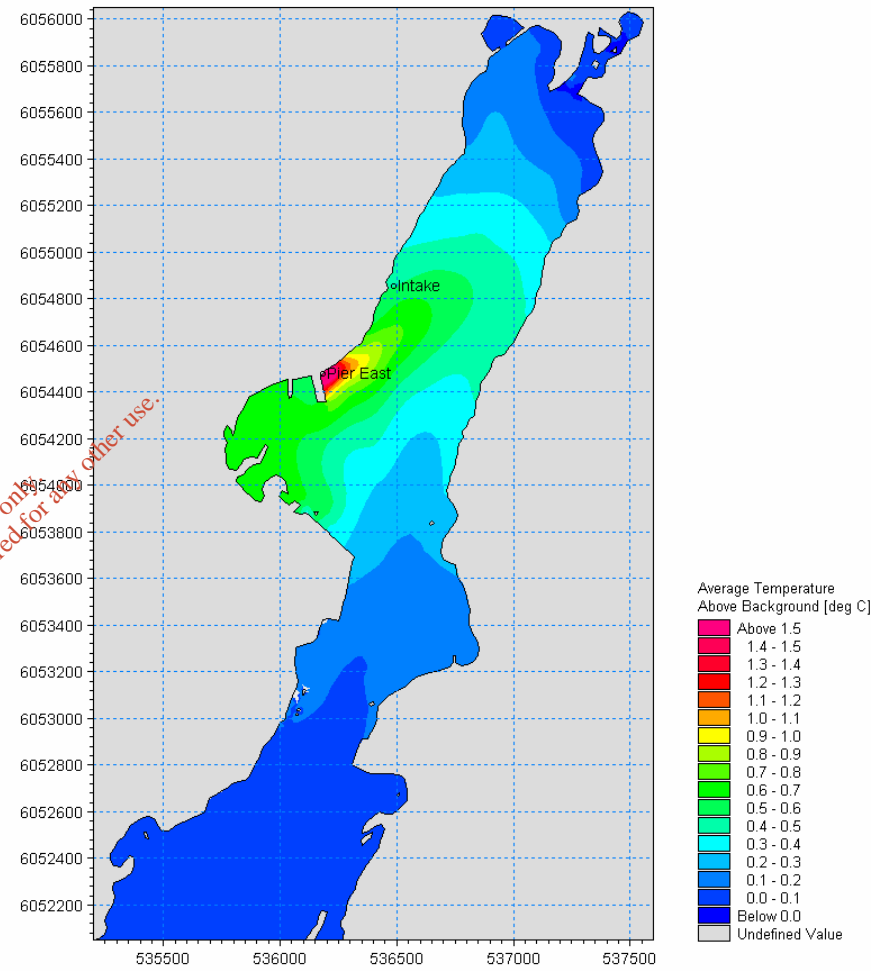


Figure 3.12: Pier East Maximum Excess Temperature – Neap Tide Bed

## 3.2 DISCHARGE WEST OF PIER

The maximum and average spatial distribution of temperature at the outfall located to the west of the landing pier in Killybegs Harbour is illustrated in Figure 3.13 to Figure 3.18 for the spring tide. Similarly the series of figures showing neap temperature values are presented in Figure 3.19 to Figure 3.24.

*For inspection purposes only.  
Consent of copyright owner required for any other use.*

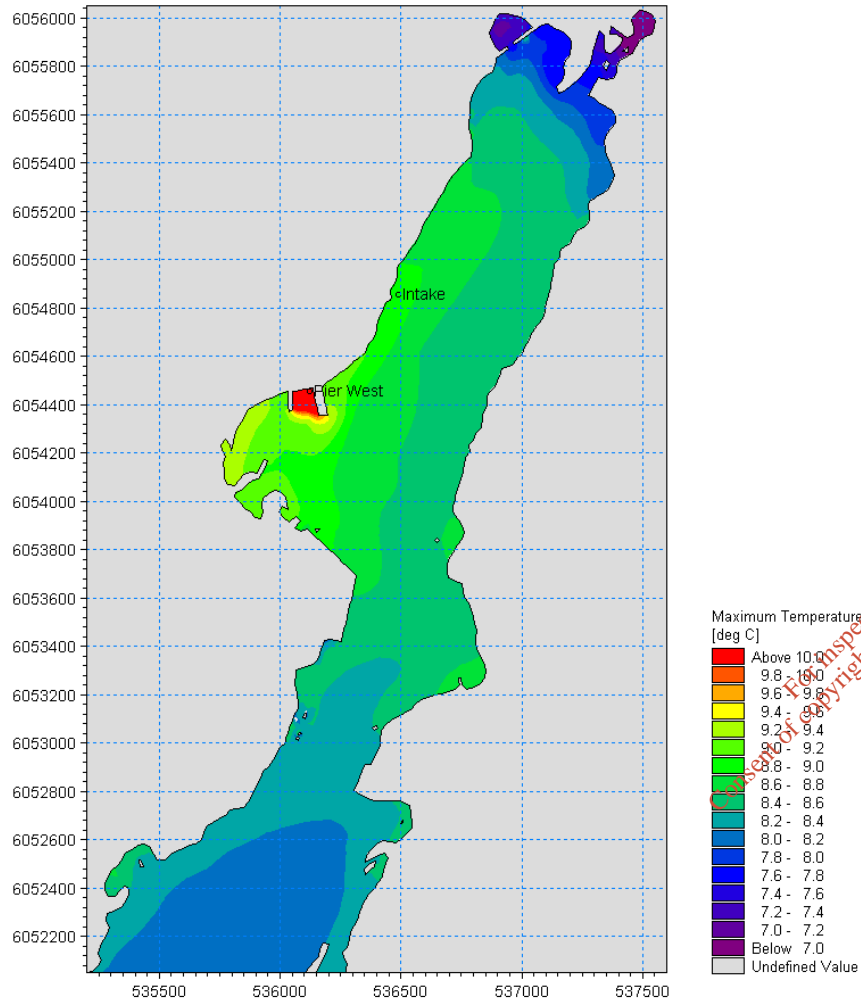


Figure 3.13: Pier West Maximum Temperature – Spring Tide Mid-depth

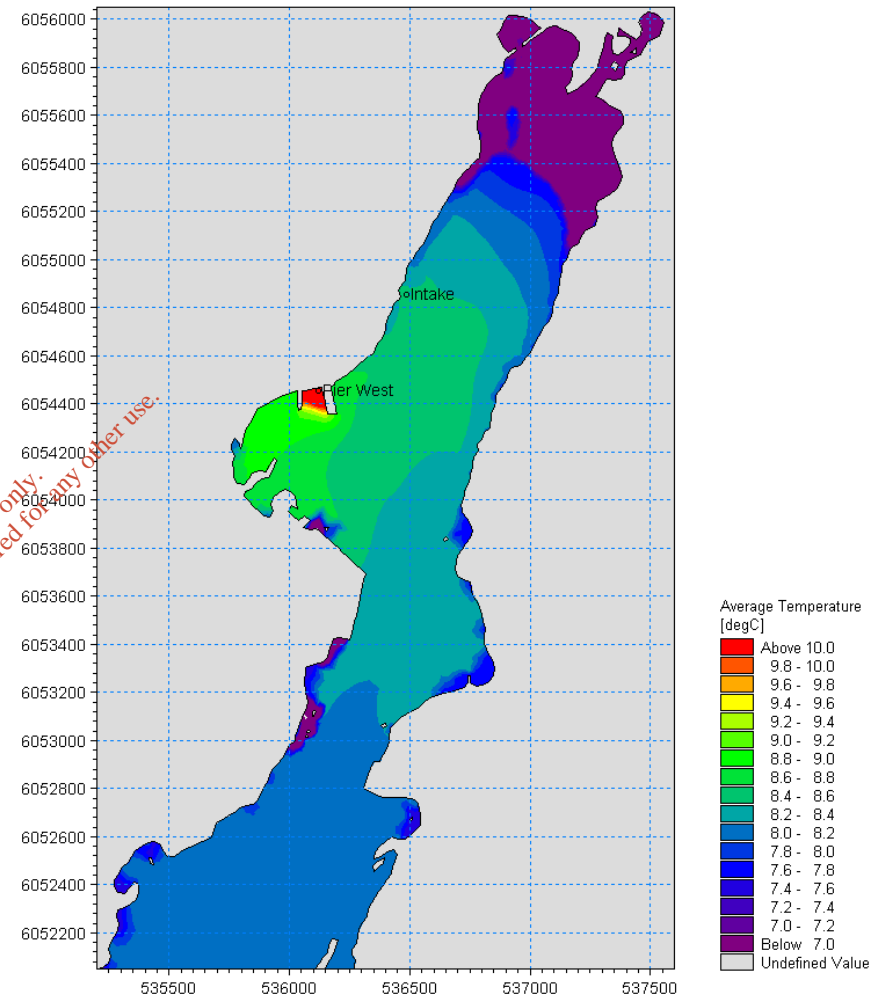


Figure 3.14: Pier West Average Temperature – Spring Tide Mid-depth

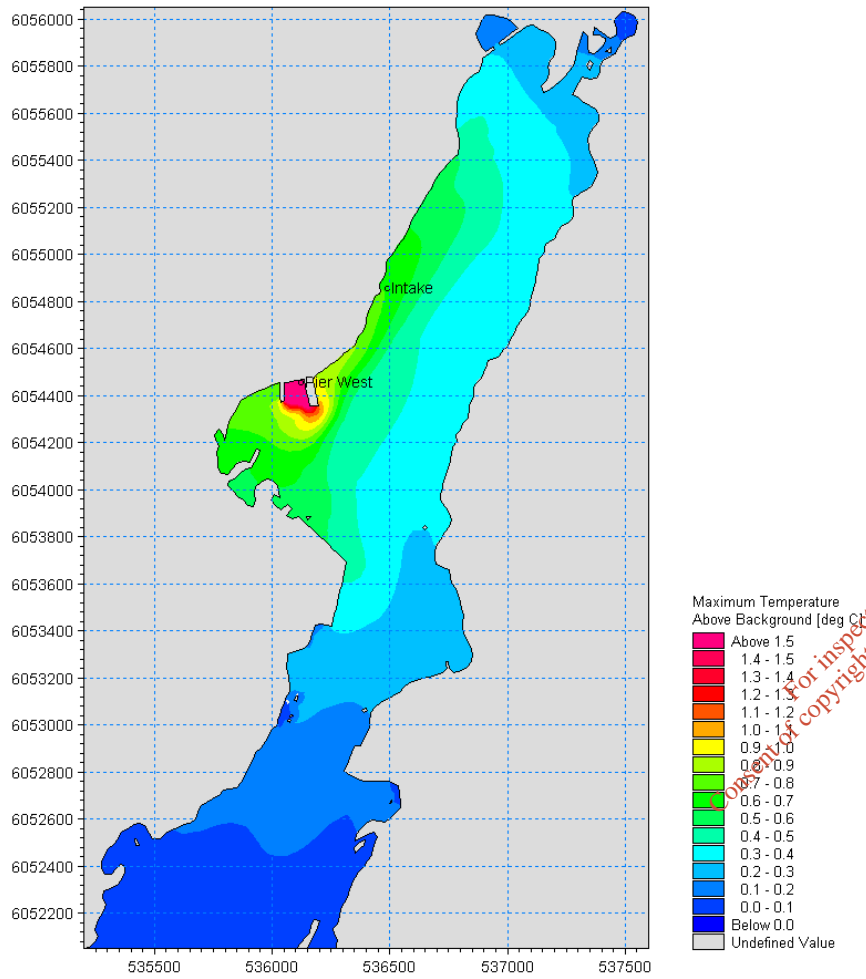


Figure 3.15: Pier West Maximum Excess Temperature – Spring Tide Surface

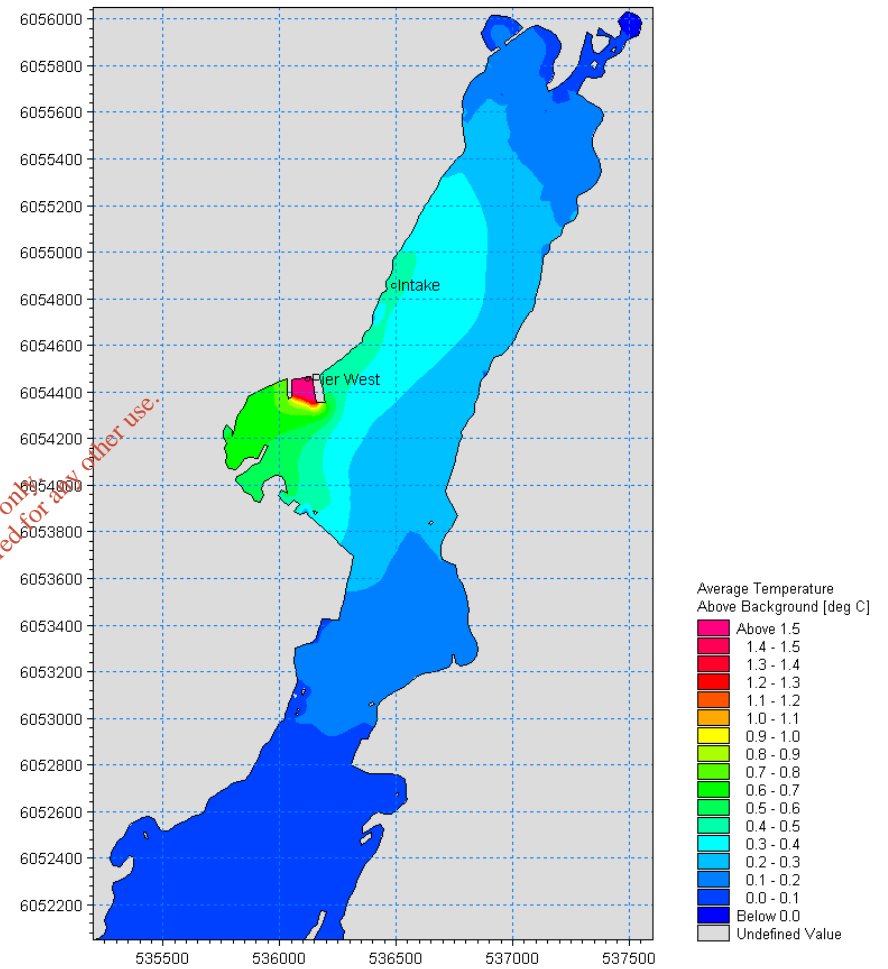


Figure 3.16: Pier West Average Excess Temperature – Spring Tide Surface

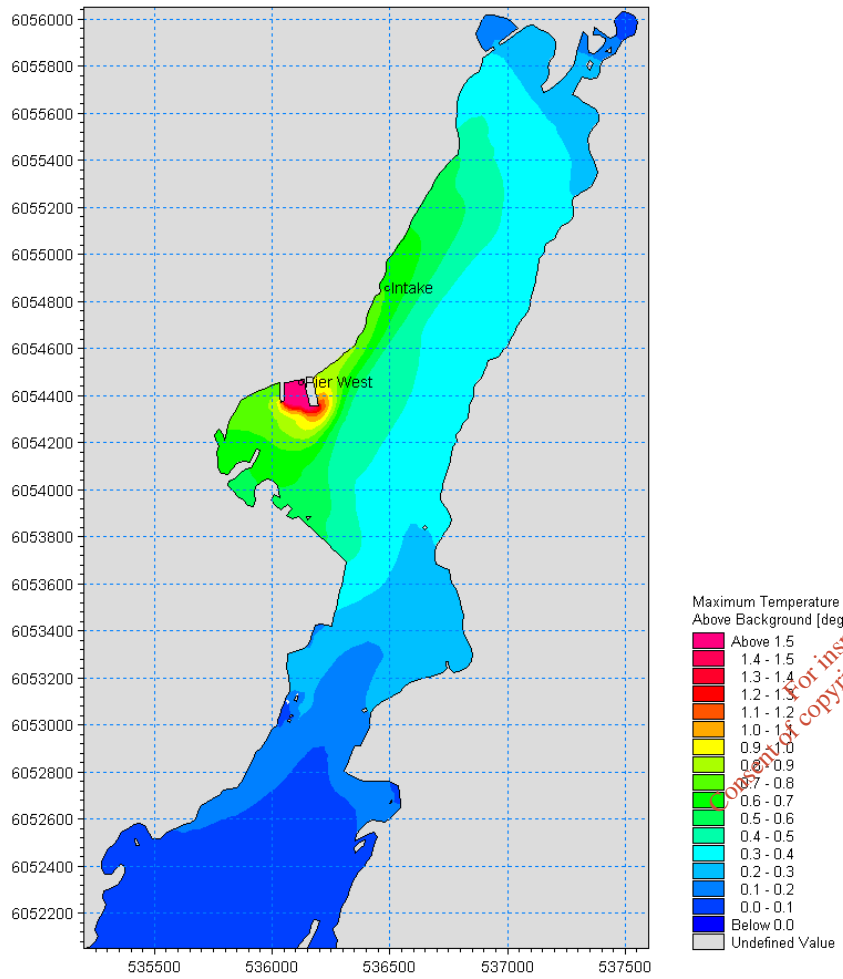


Figure 3.17: Pier West Maximum Excess Temperature – Spring Tide Bed

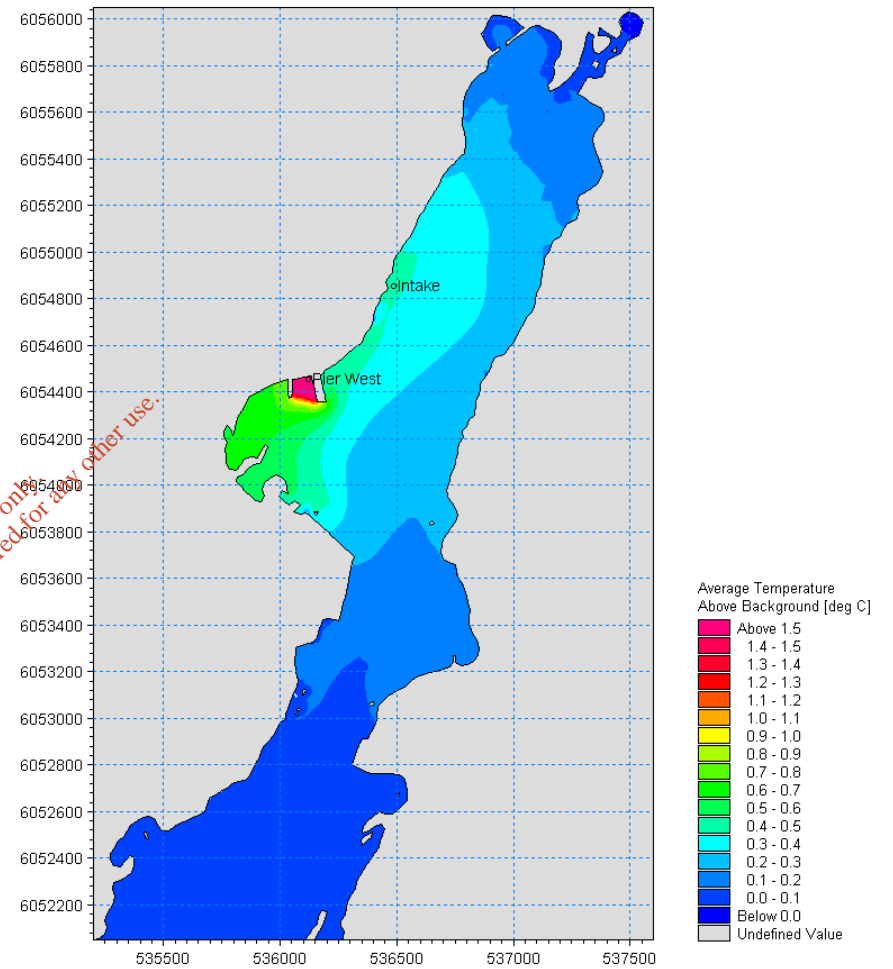


Figure 3.18: Pier West Average Excess Temperature – Spring Tide Bed

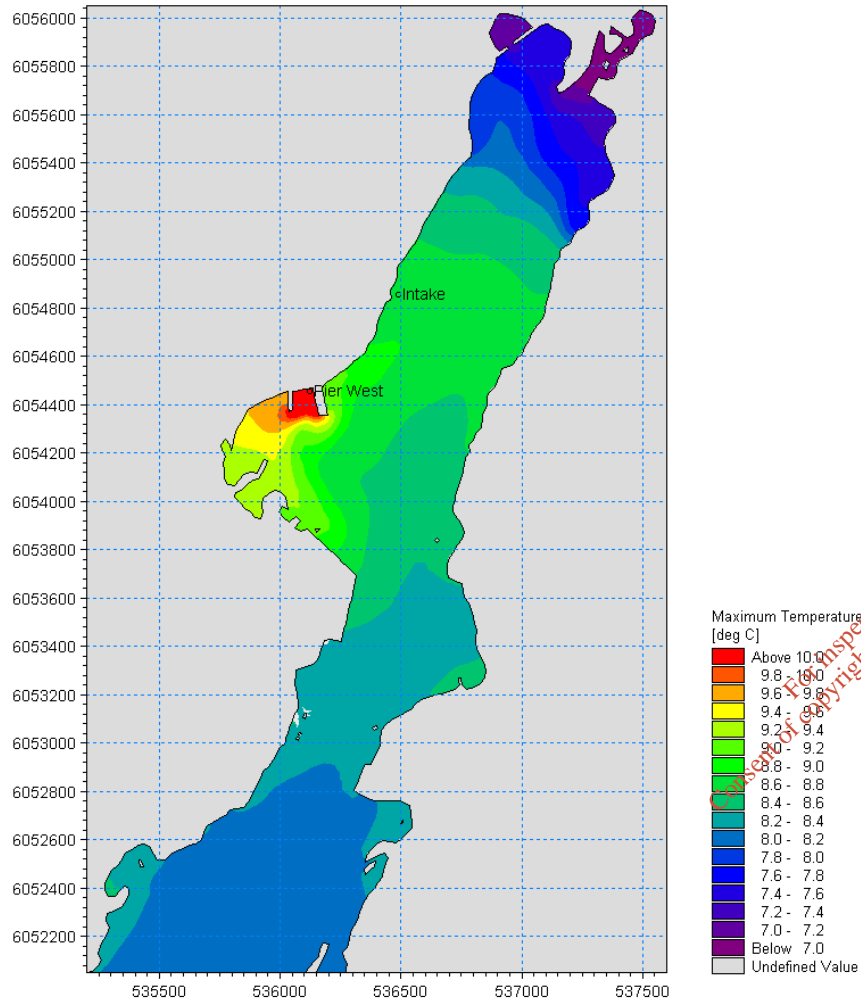


Figure 3.19: Pier West Maximum Temperature – Neap Tide Mid-depth

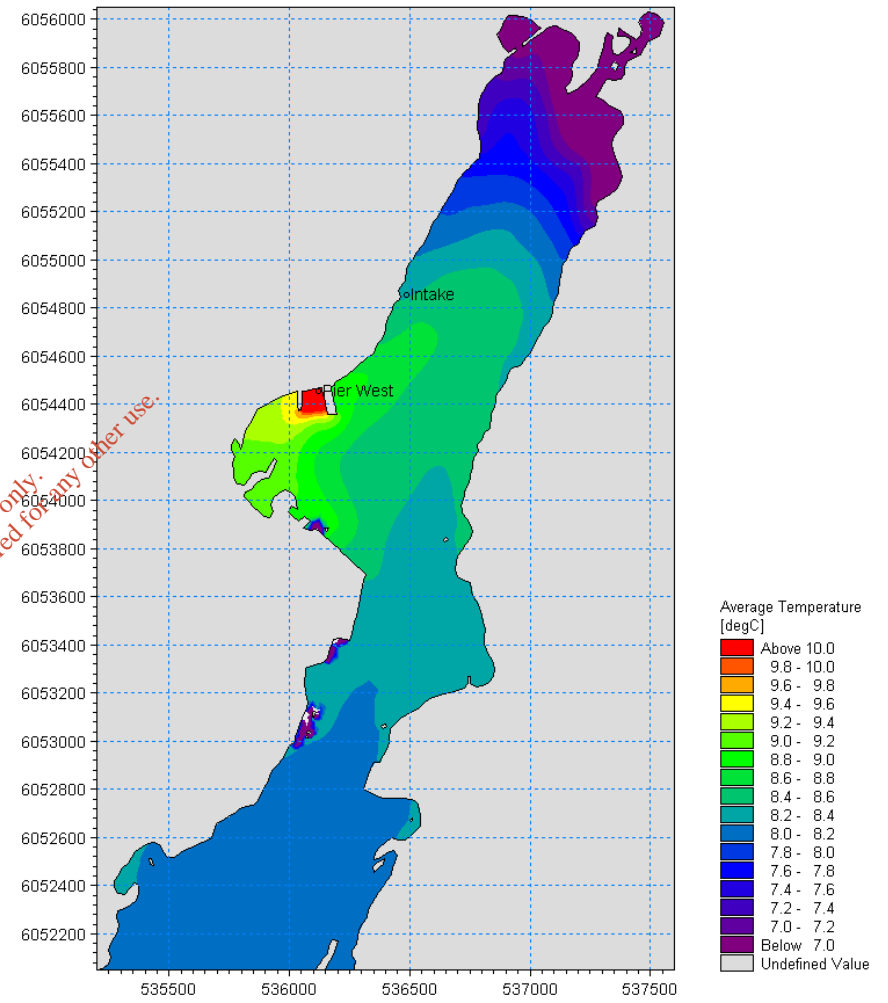


Figure 3.20: Pier West Average Temperature – Neap Tide Mid-depth

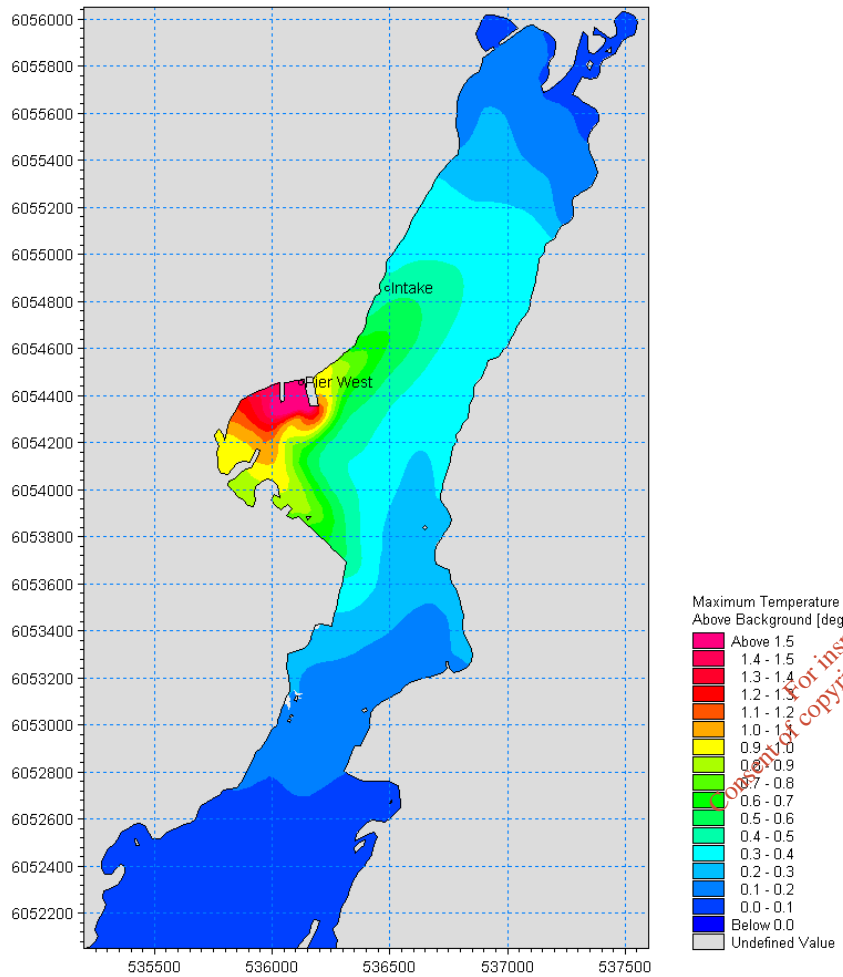


Figure 3.21: Pier West Maximum Excess Temperature – Neap Tide Surface

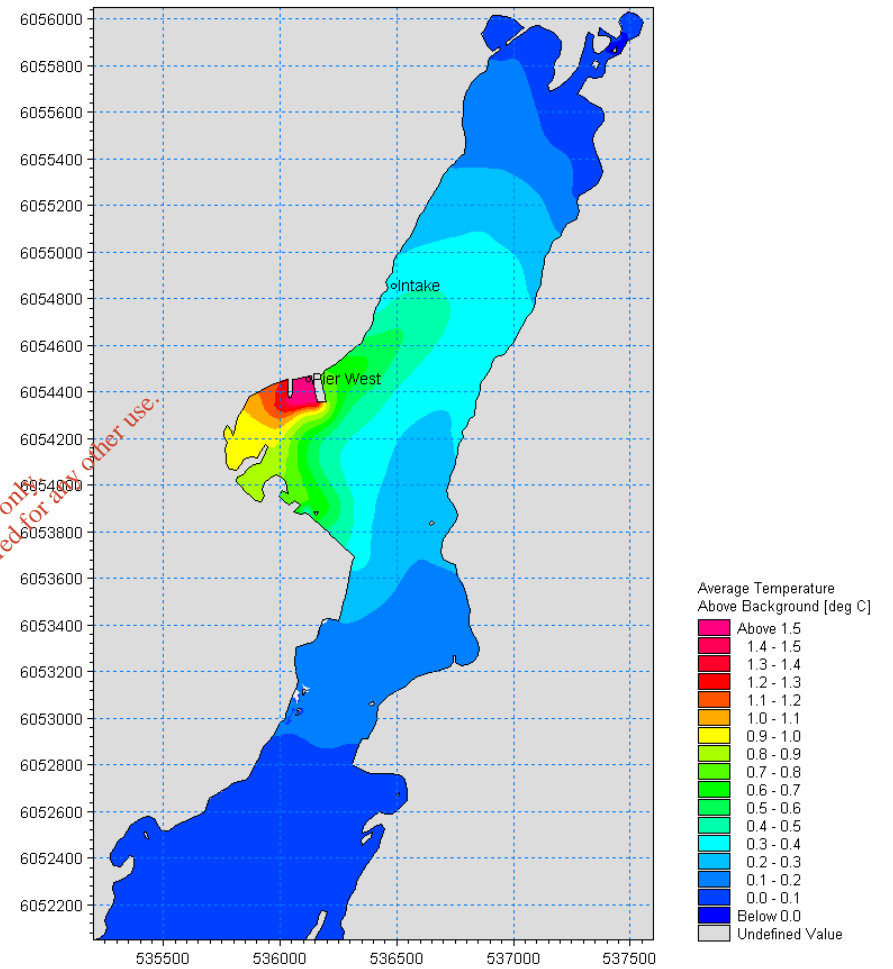


Figure 3.22: Pier West Average Excess Temperature – Neap Tide Surface

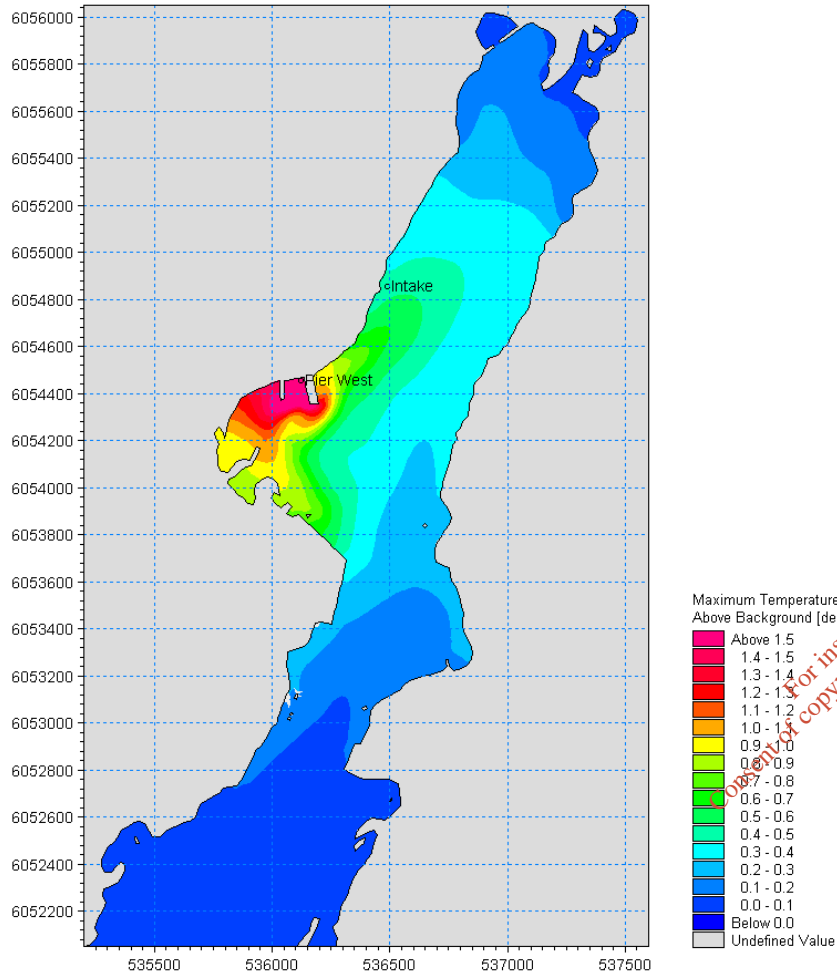


Figure 3.23: Pier West Maximum Excess Temperature – Neap Tide Bed

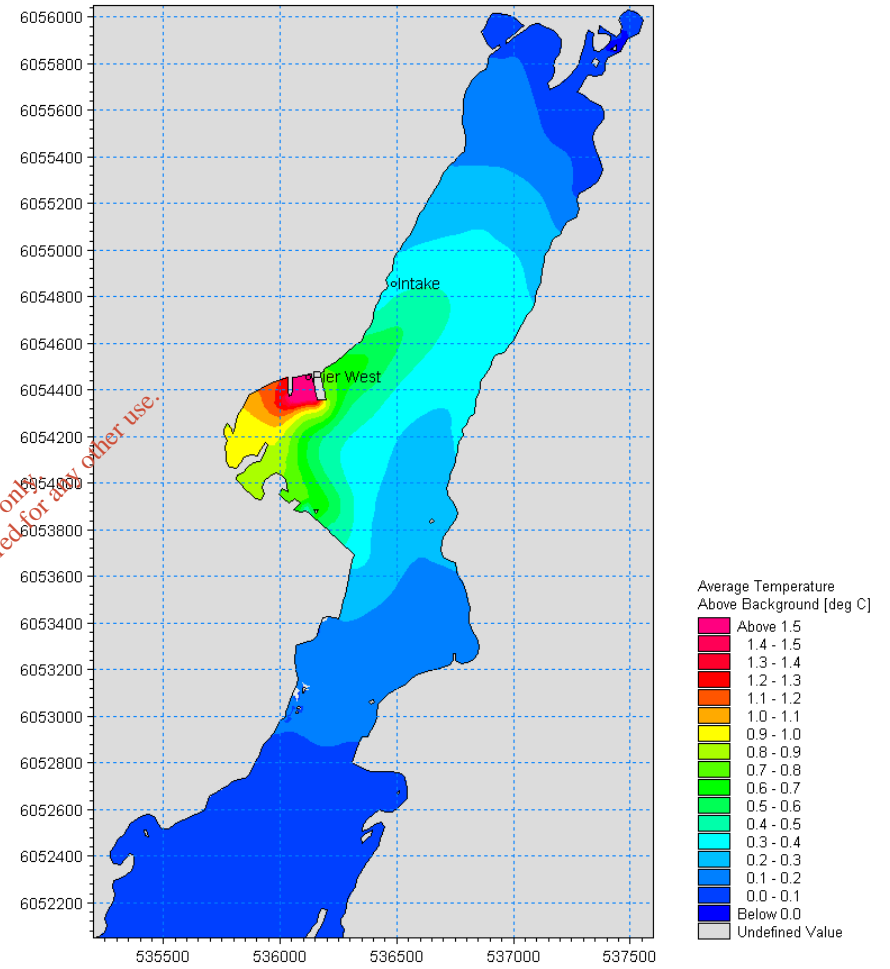


Figure 3.24: Pier West Maximum Excess Temperature – Neap Tide Bed

## 4 THERMAL DISCHARGE STUDY RESULTS

Throughout this study the models have been used to assess temperature across the harbour and at various levels within the water column based on the tidal flows and naturally occurring vertical mixing due to temperature differences. The dispersion modelling has demonstrated that satisfactory mixing of the Killybegs Harbour water and warmed water is achieved close to the outfall at either of the sites presented. Furthermore outside the immediate mixing zone at the outfall, additional dispersion occurs and in both cases the typical increase in temperature in the harbour area is much less than 1°C.

In all tidal states and water depths for both outfall options the maximum (and hence average) values of temperature increase above background do not exceed the 1.5°C beyond the immediate vicinity of the outfall site. This would be deemed to be within the mixing zone and therefore comply with the stipulations set out within the Freshwater Fish Life Directive.

The model output presented was extracted at the end of the two month period with the highest rate of production and therefore the uppermost discharge rate. The modelling strategy employed a coupled source, where the 20°C temperature increase due to production was applied to the fluid at the temperature from the intake therefore the impact of any feedback loop was incorporated into the model results. In both outfall sites it can be seen that the intake is located within the discharge plume, however significant dispersion has occurred prior to the plume reaching the intake. In the case of the east pier location the average feedback after a prolonged period of the increased discharge is of the order of 0.55°C. The west side location shows a reduction in the value to 0.35°C on average.

Although the feedback is reduced to some extent by positioning the outfall to the west of the pier, the plume is restricted to the area between the piers and the near field dispersion is constrained within the harbour area. The modelling demonstrates that both outfall locations provide sufficient dispersion to the discharge to comply with the Freshwater Fish Life Directive. The feedback is limited to less than one degree even after prolonged rates of production; therefore either site would be suitable for a discharge of this magnitude.

## 5 SUMMARY & CONCLUSIONS

The assessment of the proposed thermal discharge was undertaken using numerical techniques using a 3D flexible mesh model capable of incorporating the thermally driven currents and the effect of feedback. Two potential locations are presented in this document and compared with respect to the background levels. Both scenarios were found to achieve mixing which resulted in excess temperatures of less than 1.5°C in the immediate vicinity of the discharge location and were therefore deemed to comply with the Freshwater Fish Life Directive.

A discharge location sited to the west of the pier showed a slight reduction in the effect of feedback when compared with the eastern site; however in both cases the feedback was found to be limited even after prolonged discharge at the highest production rates. The site to the east was shown to experience the greatest level of dispersion; taking advantage of the increased water depth resulting with the larger plume with the lowest excess temperatures.

*For inspection purposes only.  
Consent of copyright owner required for any other use.*

For inspection purposes only.  
Consent of copyright owner required for any other use.

**Attachment I.3**  
**Assessment of Impact of Sewer Discharge**

For information purposes only.  
Consent of copyright owner required for any other use.

## Attachment I.3 – Assessment of Impact of Sewage Discharge

There is one emission to sewer, SE1 (formerly S1). The current location of this emission is illustrated in Map E.3(i) in Attachment E.3.

### **Information on the receiving sewer**

*Pre 2011*

Historically, the sewerage collection scheme in Killybegs was a combined drainage system and discharged without treatment to the Inner Harbour adjacent to the new harbour at Rough Point.

The sewer network conveyed both untreated domestic waste water and treated industrial effluent from the fish processing factories in Killybegs to the discharge point in the inner harbour. There are two main pump stations and five storm water overflows on the existing network. The former wastewater treatment works is inoperable and was decommissioned in 2002. The continued development of Killybegs, including its emergence as a major pelagic fishing centre in Ireland and the consequent development of the fish processing industry, resulted in the works being incapable of treating the volume of waste water being produced with resultant bypassing of the works.

The wastewater collection and treatment infrastructure in Killybegs was considered to be inadequate. Discharges of untreated domestic sewage and industrial effluent from the fish processing industry is having a negative impact on water quality in the inner harbour which is a designated sensitive area under the Urban Waste Water Treatment Regulations, 2001.

In accordance with the polluter pays principle, an agreement was signed on 23<sup>rd</sup> June 1999 between Donegal County Council and the fish processing industry in and around Killybegs. Under the agreement, each fish industry must treat its own fish processing waste water. The method of treatment agreed was Dissolved Air Flotation (DAF) without the use of chemicals.

In order to improve the situation in Killybegs, the following works under the Killybegs Sewerage Scheme were planned and implemented by Donegal County Council:

- Upgrade the existing sewage collection network;
- Provide a separate industrial network for the fish processing industry;
- Construct a new domestic wastewater treatment works for a population equivalent of 4,200 (Stage 1) and 6,500 (Stage 2) and install secondary treatment;
- Construct a new main pumping station for storm water, foul and industry;
- Construct a new primary discharge point 3.5 kilometres southwest of Killybegs in the outer harbour area which will discharge both the treated domestic effluent and the treated effluent arising from the fishing-based industry in Killybegs.

Donegal County Council commissioned Aqua-Fact International Services Ltd. to undertake a study on the impact of the effluent discharge on the water quality in Killybegs Harbour post-works. The August 2007 report concluded that the loadings outlined above will not affect compliance with the environmental quality standards that were being considered for receiving waters at that time. Environmental Quality Standards for transitional and coastal waters have since been established in Irish law under the EC Environmental Objectives (Surface Waters) Regulations, 2009, S.I. No. 272 of 2009.

The combined effects of the above works would improve the water quality in the inner harbour which is designated as nutrient sensitive.

### Post 2011

Since 2011 Donegal County Council have provided a separate industrial network for the fish processing industry and as such have constructed a long sea outfall to the Outer Harbour approximately 3.5 km southwest of Killybegs, which discharges effluent arising from the fishing-based industry in Killybegs. This discharge point has been operational since the end of 2011 and replaces the previous discharge to the Inner Harbour (designated nutrient sensitive waters).

Due to discharge from the fish meal plant, it is necessary to consider the impact of the nutrient load on the receiving water body in order to assess the assimilative and carrying capacity of the water body. This assessment is essential in determining the potential for eutrophication in the bay.

Water quality modeling has not been undertaken as part of this Industrial Emissions Licence Review application process. However, in 2006, Aqua-Fact International Services Ltd were commissioned to undertake a detailed environmental impact assessment of the likely effects of discharging effluent from the fish processing plant on the local environment on behalf of Donegal County Council. This assessment was to be carried out with particular reference to possible adverse effects produced by the high levels of dissolved inorganic nitrogen in the effluent. This assessment has undergone a number of iterations, most recently in May 2011, and is the basis for the setting of emission limits on operators who discharge to the sewer by Donegal County Council.

*For inspection purposes only.  
Consent of copyright owner required for any other use.*