Engineering a Sustainable Future

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Ref: 111_001_17b_141124_bca *by post*

Caroline Murphy
Environmental Protection Agency,
Headquarters,
Po Box 3000,
Johnstown Castle Estate
Co. Wexford.

24th November 2014

Re: Notice in accordance with Article 14(2)(b)(ii) of the Waste Management (Licensing) Regulations 2004
Reg No: W0285-01

Dear Caroline,

Please find enclosed documentations and drawings for the application in relation to the above.

The documentation consists of the following:

- Original Air Dispersion Model Report
- ANAU Monashell Air & Odour Abatement System Specifications

The drawings consists of the following:

Drawing Title	Drawing No.	Revision Status
Noise Monitoring Locations and Surface Water Locations	111_001_812	D2
Proposed Rain Water Collection System Services Layout	111_001_810	D3
Proposed Watermain Services Layout	111_001_809	D3
Proposed Foul Sewer Services Layout	111_001_808	D3
Proposed Surface Water Services Layout	111_001_807	D3
Proposed General Services Layout	111_001_806	D3
Road Makeup	111_001_802	D2
Site Layout	111_001_801	D3
Surface Water Discharge Route to Riverstown River	111_001_822	D1
Air/ Emission & Dust Monitoring Locations & Ground Water Location	111_001_821	D2

All of the above documents and drawings have been included with this application in the form of:

- 1 x original
- 1 x copy
- 16 x soft copy

With Reference to your correspondence dated the 6th of August 2014 regarding an application for a waste licence relating to a facility at Bio Agrigas Limited, Newdown, The Downs, Mullingar, Co. Westmeath, we would like to respond as follows:

ARTICLE 12 COMPLANCE REQUIRMENTS

1. In the Agency's notice of the 21st June 2013 you were requested to provide evidence to allow the Agency to form an opinion that the applicant, in accordance with the requirements of section 40(7)(c) of the waste management Acts 1996 to 2013, is likely to be in a positon to meet any financial commitments or liabilities that will be entered into or incurred by him or her in carrying on the activity to which the waste licence would relate or in consequence of ceasing to carry on that activity.

   In response to this item, you provided the Directors' Report and Consolidated Financial Statements for the Year Ended 30 June 2012 for Thomas Flynn & Sons Limited (CRO Register No 75620). The information is not apparently applicable to the assessment of Bio Agrigas Limited (CRO Register No.496273)

Response:

Bio Agrigas Limited is a trading name of Thomas Flynn and Sons Limited. Bio Agrigas Limited has not yet started to trade and as such the Directors' Report and Consolidated Financial Statements for the Year Ended 30 June 2012 for Thomas Flynn & Sons Limited should be taken into account.

2. The following information has been provided in the application

Storage Unit	Capacity Per Storage Unit (m^3)	Total Capacity (m^3)	Cost Of Removal of Content
Silage Beet Storage Pits (x3)	2485	7455	**Stable Product €0/tonne**
Slurry Tank			**Land Spread €0/tonne**
Leachate Tank			**€70/tonne**
Waste Reception Bin	165	165	**€150/tonne**
Mixing Tank			**€150/tonne**
Hydrolysis Tanks (x2)			**€150/tonne**
Pre-storage Tanks (x5)	246	1,230	**€150/tonne**
Anaerobic Digestor (x2)	15.323	30,646	**€150/tonne**
Hygienisation Tanks (x2)			**€150/tonne**
Post Digestation Storage Tanks (x2)	6,797.5	13,595	**€150/tonne**
Gas Cleaning Vessel			**€150/tonne**

Using the above table, state the capacity of each of the storage unites to be installed. In addition, state the estimated cost (Euro per tonne or litre) for disposal of all material (waste, feedstock and digestate) at the facility in the event that it falls to the state to dispose of the stored material. State the basis of the estimated cost. Do not take into account any market value as may be attached to the material.

Response:

2. **In relation to the above please find the table which has been completed.**

   The following table represents the revised feedstock types and quantitates proposed for the facility.

Substrates	MT Average Liquid Pig Manure	MT Average Liquid Cattle Manure	Sugar Beet Fresh	Grass Silage Prewilted	Vegetable Waste	Category 2 ABP Belly Grass	Domestic Source Separated Brown Bin	Commercial Wastes (Creamery wastes etc.)
Annual Quantity t/a	3,000	2,000	6,000	5,000	10,000	5,000	10,000	5,000

ARTICLE 13 COMPLANCE REQUIREMENTS

Site boundary:

1. The site boundaries shown on drawing numbers 111_001_812 and 111_001_808 don't correlate. Provide a drawing which indicates the correct site boundary for the facility and update the application as appropriate.

Response:

Please find attached updated drawings associated with this application which indicates the correct site boundary for the facility.

Surface water:

1. Drawing number 111_001_808 indicates two emissions to surface water; however, Table E.2 (i) of the application form states that SW1 is the only storm water emission point and that this discharges to the Riverstown River.
   a. Confirm the number of storm water emissions from the facility and provide the required data for each in Table E.2 (i).
   b. Confirm whether storm water discharges from the facility are to a land or drain.
   c. Provide a labelled drawing which shows:

      - The storm water emission(s) form the facility
      - The upstream and downstream monitoring locations from these emission points:

- The route storm water discharges take via land drain to the Riverstown River
- The location on the Riverstown River of the final discharge.

Note: ensure this drawing includes this drawing includes the correct site boundary and all other proposed monitoring and emission points relating to noise, dust, air and ground.

Response:

a. **As per table E.2 (i) there is only one emission point from the facility which is SW1.**
b. **Please find attached drawing number 111_001_822 which shows the storm water discharging to a drain north east of the facility.**
c. **Please find attached drawing number 111_001_812 which indicates the storm water discharges from the facility and the upstream and downstream monitoring locations. The route the storm water discharges via land drain and the location on the Riverstown River of the final discharge is shown in drawing number 111_001_822.**

Air Dispersion Model:

1. In the Agency's notice of the 21st June 2013 you were requested to provide information on the potential ground level concentrates from hydrogen sulphide, at all sensitive receptors, as a result of emissions from the proposed facility. You confirmed in your correspondence of the 12th August 2014 that there are no potential ground level concentrations for hydrogen sulphide associated with the proposed anaerobic digestion process.

   Provide evidence that there will be no emissions of hydrogen sulphide from the CHP engines.

2. The Air dispersion Model report references an *odour control unit 1 to 3 (AEP3).*

   a. Clarify what compromises the odour control unit.
   b. Confirm whether the biofilter (AEP3) is the only emission from this unit.

3. The Air Dispersion Model report references tables 3.5 and 3.6 on page 18; however, these tables have not been included in the report. Submit all data used to model odour from the odour control units biofilter.

4. Confirm whether Table 4.3 refers the correct units of measurement for scenario 12.

Response:

1. **Hydrogen sulphide will be removed from the gas streams before it reaches the CHP engines by means of chemical oxidative scrubbing. As a result of this there will be no emissions of hydrogen sulphide from the CHP engines.**

2. **Please find document attached of the ANUA Monashell Air and Odour Abatement System proposed for this facility which comprises the odour control unit. We write to confirm that the Biofilter (AEP3) is the only emission from this unit.**

3. **The Tables 3.5 and 3.6 on page 18 that were referenced in the Air Dispersion Model Report was erroneous. The tables that should have been referenced was 4.1 and 4.2. Please find attached original Air Dispersion Model Report.**

4. **We write to confirm that table 4.3 refers to the correct unit of measurement for scenario 12 which is shown on the Air Dispersion Modelling Report.**

Should you have any queries regarding this matter please do not hesitate to contact the undersigned.

Yours sincerely,

Brian Casey.

Brian Casey
Engineer
For and on behalf of
ORS
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DISPERSION MODELLING ASSESSMENT OF EMISSIONS FROM PROPOSED ANAEROBIC DIGESTION FACILITY TO BE LOCATED IN BIO AGRIGAS LTD, NEWDOWNS, THE DOWNS, MULLINGAR, CO. WESTMEATH.

PERFORMED BY ODOUR MONITORING IRELAND ON THE BEHALF OF ORS CONSULTING LTD.

REPORT PREPARED BY:	Dr. Brian Sheridan
REPORT VERSION:	Document Ver.1
ATTENTION:	Mr Damien Collins
DATE:	11th May 2011
REPORT NUMBER:	2011A148(1)
REVIEWERS:	

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Document Amendment Record

Client: ***ORS Consulting Ltd***

Title: Dispersion modelling assessment of emissions from proposed anaerobic digestion facility, to be located in Bio Agrigas Ltd, Newdowns, The Downs, Mullingar, Co. Westmeath.

Project Number: 2011A148(1)			**DOCUMENT REFERENCE:** Dispersion modelling assessment of emissions from proposed anaerobic digestion facility, to be located in Bio Agrigas Ltd, Newdowns, The Downs, Mullingar, Co. Westmeath.		
2011A148(1)	Document for review	B.A.S.	JMC	B.A.S	11/05/2011
Revision	**Purpose/Description**	**Originated**	**Checked**	**Authorised**	**Date**

EXECUTIVE SUMMARY

Odour Monitoring Ireland was commissioned by ORS Consulting Ltd to perform a dispersion modelling assessment of exhaust gas emissions from the proposed operation of an anaerobic digestion facility to be located in Bio Agrigas Ltd, Newdowns, The Downs, Mullingar, co. Westmeath. Emission limit values of specific compounds namely Carbon monoxide, Oxides of nitrogen, Sulphur dioxide, Total particulates, Total non methane Volatile organic compounds, odour and source characteristics (of emission points) were inputted into the dispersion modelling to allow for the assessment of air quality in the vicinity of the proposed emissions points when in operation.

Dispersion modelling assessment was performed utilising AERMOD Prime (09292) dispersion model. Five years of hourly sequential meteorological data from Clones (2002 to 2006 inclusive) was used within the dispersion model. The dispersion modelling assessment was performed in accordance with requirements contained in AG4 – Irish EPA Guidance for dispersion modelling. The total proposed mass limit emission rate of each pollutant was inputted with the source characteristics into the dispersion model in order to assess the maximum predicted ground level concentrations of each pollutant in the vicinity of the facility. This was then compared with statutory and guideline ground level concentration limit values for such pollutants.

The following conclusions are drawn from the study:

1. The assessment was carried out to provide information in line with standard information to be provided to the EPA and regulatory bodies for such projects.

2. Specific dispersion modelling was performed for Carbon monoxide, Oxides of nitrogen, Sulphur dioxide, Particulate matter, TNMVOC as Benzene and Odour.

3. With regards to Carbon monoxide, the maximum GLC+Baseline for CO from the operation of the facility is 1,441 $\mu g\ m^{-3}$ for the maximum 8-hour mean concentration at the 100th percentile. When combined predicted and baseline conditions are compared to the Irish guideline/limit values and EU Limit values set out in SI 271 of 2002 and Directive 2008/50/EC, this is 14.41% of the impact criterion. In addition, the predicted ground level concentration of Carbon monoxide at each of the 42 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

4. With regards to Oxides of nitrogen, the maximum GLC+Baseline for NO_2 from the operation of the facility is 98.20 $\mu g\ m^{-3}$ for the maximum 1-hour mean concentration at the 99.79th percentile. When combined predicted and baseline conditions are compared to SI 271 of 2002 and Directive 2008/50/EC, this is 49.10% of the impact criterion. An annual average was also generated to allow comparison with values contained in SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 35.10 $\mu g/m^3$. When compared the annual average NO_2 air quality impact criterion is 87.75% of the impact criterion. In addition, the predicted ground level concentration of Oxides of nitrogen at each of the 42 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

5. With regards to Sulphur dioxide, the maximum GLC+Baseline for SO_2 from the operation of the facility is 62.60 and 43.10 $\mu g\ m^{-3}$ for the maximum 1-hour and 24 hr mean concentration at the 99.73th and 99.18th percentile respectively. When combined predicted and baseline conditions are compared to SI 271 of 2002 and Directive 2008/50/EC, this is 17.87 and 34.50% of the set target limits established for the 1 hour and 24 hour assessment criteria. An annual average was also generated to allow comparison with SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 11.80

μg/m^3. When compared the annual average SO_2 air quality impact criterion is 59.51% of the impact criterion. In addition, the predicted ground level concentration of Sulphur dioxide at each of the 42 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

6. With regards to Particulate matter, the maximum GLC+Baseline for Particulate matter 10μm from the operation of the facility is 46.90 and 41.90 μg m^{-3} for the maximum 24-hour mean concentration at the 98.08th and 90.40th percentile, respectively. When combined predicted and baseline conditions are compared to Directive 2008/50/EC, this is 93.76 and 83.74% of the impact criterion. An annual average was also generated to allow comparison with the SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 29.80 μg/m^3. When compared, the annual average Particulate matter air quality impact is 74.75 % of the impact criterion. An annual average was also generated for $PM_{2.5}$ to allow comparison with Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 16.80 μg/m^3. When compared, the annual average $PM_{2.5}$ air quality impact is 67.12% of the impact criterion. In addition, the predicted ground level concentration of Particulate matter at each of the 42 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

7. With regards to the results from the assessment of TNMVOC as Benzene ground level concentrations, the results indicate that the ambient ground level maximum annual average concentrations anywhere in the vicinity of the facility could be up to 80.20% of the impact criterion (assuming all TNMVOC is Benzene which will not be the case). In addition, the predicted ground level concentration of TNMVOC as Benzene at each of the 41 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

8. With regards to odour, it is predicted that odour plume spread is in a north westerly south easterly direction of approximately 30 to 50 metres from the emission points with no sensitive receptors impacted by the plume. All resident locations in the vicinity of the proposed facility operations will perceive an odour concentration less than 1.50 Ou_E/m^3 at the 98th percentile of hourly averages for worst case meteorological year Clones 2004. In accordance with odour impact criterion presented in *Table 2.1*, and in keeping with currently recommended odour impact criterion in this country, no long-term odour impacts will be generated by receptors in the vicinity of the proposed facility operations. In addition, the predicted ground level concentration of Odour at each of the 42 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1.* A number of key mitigation measures as outlined in Section 4.1.6 will need to be implemented into the design of the odour containment, capture and treatment system to ensure compliance.

9. The overall modelling indicates that the facility will not result in any significant impact on air quality in the surrounding area with all ground level concentrations of pollutants well within their respective ground level concentration limit values.

1. Introduction and scope

1.1 Introduction

Odour Monitoring Ireland was commissioned by ORS Consulting Ltd to perform a dispersion modelling assessment of proposed emission limit values for a range of pollutants which could potentially be emitted from the proposed anaerobic digestion facility to be located in Bio Agrigas Ltd, Newdowns, The Downs, Mullingar, Co. Westmeath.

The assessment allowed for the examination of proposed short and long term ground level concentrations (GLC's) of compounds as a result of the operation of proposed emission points – Gas utilisation engine 1 (AEP1), Gas utilisation engine 2 (AEP2), Odour control unit 1 to 3 (AEP3). The main compounds assessed included Carbon monoxide, Oxides of nitrogen, Sulphur dioxide, Total particulates, total non methane volatile organic compounds (as Benzene) and Odour.

Predicted dispersion modelling GLC's were compared to proposed regulatory / guideline ground level limit values for each pollutant.

The materials and methods, results, discussion of results and conclusions are presented within this document.

1.2 Scope of the work

The main aims of the study included:

- Air dispersion modelling assessment in accordance with AG4 guidance of proposed mass emission limits of specified pollutants to atmosphere from the anaerobic digestion facility to be located in Bio Agrigas Ltd, Newdowns, The Downs, Mullingar, Co. Westmeath.
- Assessment whether the predicted ground level concentrations of pollutants are in compliance with ground level concentration limit values as taken from SI 271 of 2002 – Air Quality Regulations, CAFE Directive 2008/50/EC, AG4 guidance document and Environment Agency H4 Guidance documents Parts 1 and 2.

The approach adopted in this assessment is considered a worst-case investigation in respect of emissions to the atmosphere from proposed emission points AEP1 to AEP3. These predictions are therefore most likely to over estimate the GLC's that may actually occur for each modelled scenario. These assumptions are summarised and include:

- Emissions to the atmosphere from the emission points – AEP1 to AEP3 process operations were assumed to occur 24 hours each day / 7 days per week over a standard year at 100% output.
- Five years of hourly sequential meteorological data from Clones 2002 to 2006 inclusive was screened to assess worst case dispersion year which will provide statistical significant results in terms of the short and long term assessment. This is in keeping with current national and international recommendations. The worst case year Clones 2004 was used for data presentation.
- Maximum GLC's + Background were compared with relevant air quality objects and limits;
- All emissions were assumed to occur at maximum potential emission concentration and mass emission rates for each scenario.
- AERMOD Prime (09292) dispersion modelling was utilised throughout the assessment in order to provide the most conservative dispersion estimates.
- Five years of hourly sequential meteorological data from Clones 2002 to 2006 inclusive was used in the modelling screen which will provide statistical significant results in terms of the short and long term assessment. The worst case year for Clones met station was 2004 and was used for contour plot presentation. This is in keeping with current national and international recommendations (EPA Guidance AG4

and EA Guidance H4). In addition, AERMOD incorporates a meteorological pre-processor AERMET PRO. The AERMET PRO meteorological preprocessor requires the input of surface characteristics, including surface roughness (z0), Bowen Ratio and Albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. The values of Albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10km from the meteorological station for Bowen Ratio and Albedo and to a distance of 1km for surface roughness in line with USEPA recommendations.

- All building wake effects on all applicable emission points were assessed within the dispersion model using the building prime algorithm (e.g. all buildings / structures / tanks were included).

2. Materials and methods

This section describes the materials and methods used throughout the dispersion modelling assessment.

2.1 Dispersion modelling assessment

2.1.1 Atmospheric dispersion modelling of air quality: What is dispersion modelling?

Any material discharged into the atmosphere is carried along by the wind and diluted by wind turbulence, which is always present in the atmosphere. This process has the effect of producing a plume of air that is roughly cone shaped with the apex towards the source and can be mathematically described by the Gaussian equation. Atmospheric dispersion modelling has been applied to the assessment and control of emissions for many years, originally using Gaussian form ISCST 3. Once the compound emission rate from the source is known, (g s^{-1}), the impact on the vicinity can be estimated. These models can effectively be used in three different ways:

- Firstly, to assess the dispersion of compounds;
- Secondly, in a "reverse" mode, to estimate the maximum compound emissions which can be permitted from a site in order to prevent air quality impact occurring;
- And thirdly, to determine which process is contributing greatest to the compound impact and estimate the amount of required abatement to reduce this impact within acceptable levels (McIntyre et al. 2000).

In this latter mode, models have been employed for imposing emission limits on industrial processes, control systems and proposed facilities and processes (Sheridan et al., 2002).

Any dispersion modelling approach will exhibit variability between the predicted values and the measured or observed values due to the natural randomness of atmospheric environment. A model prediction can, at best, represent only the most likely outcome given the apparent environmental conditions at the time. Uncertainty depends on the completeness of the information used as input to the model as well as the knowledge of the atmospheric environment and the ability to represent that process mathematically. Good input information (emission rates, source parameters, meteorological data and land use characteristics) entered into a dispersion model that treats the atmospheric environment simplistically will produce equally uncertain results as poor information entered into a dispersion model that seeks to simulate the atmospheric environment in a robust manner. It is assumed in this discussion that pollutant emission rates are representative of maximum emission events, source parameters accurately define the point of release and surrounding structures, meteorological conditions define the local atmospheric environment and land use characteristics describe the surrounding natural environment. These conditions are employed within the dispersion modelling assessment therefore providing good confidence in the generated predicted exposure concentration values.

2.1.2 Atmospheric dispersion modelling of air quality: dispersion model selection

The AERMOD model was developed through a formal collaboration between the American Meteorological Society (AMS) and U.S. Environmental Protection Agency (U.S. EPA). AERMOD is a Gaussian plume model and replaced the ISC3 model in demonstrating compliance with the National Ambient Air Quality Standards (Porter et al., 2003) AERMIC (USEPA and AMS working group) is emphasizing development of a platform that includes air turbulence structure, scaling, and concepts; treatment of both surface and elevated sources; and simple and complex terrain. The modelling platform system has three main components: AERMOD, which is the air dispersion model; AERMET, a meteorological data pre-processor; and AERMAP, a terrain data pre-processor (Cora and Hung, 2003).

AERMOD is a Gaussian steady-state model which was developed with the main intention of superseding ISCST3 (NZME, 2002). The AERMOD modeling system is a significant departure from ISCST3 in that it is based on a theoretical understanding of the atmosphere rather than depend on empirical derived values. The dispersion environment is characterized by turbulence theory that defines convective (daytime) and stable (nocturnal) boundary layers instead of the stability categories in ISCST3. Dispersion coefficients derived from turbulence theories are not based on sampling data or a specific averaging period. AERMOD was especially designed to support the U.S. EPA's regulatory modeling programs (Porter at al., 2003)

Special features of AERMOD include its ability to treat the vertical in-homogeneity of the planetary boundary layer, special treatment of surface releases, irregularly-shaped area sources, a three plume model for the convective boundary layer, limitation of vertical mixing in the stable boundary layer, and fixing the reflecting surface at the stack base (Curran et al., 2006). A treatment of dispersion in the presence of intermediate and complex terrain is used that improves on that currently in use in ISCST3 and other models, yet without the complexity of the Complex Terrain Dispersion Model-Plus (CTDMPLUS) (Diosey et al., 2002).

Input data from stack emissions, and source characteristics will be used to construct the basis of the modelling scenarios.

2.2 Air quality impact assessment criteria

The predicted air quality impact from the operation of proposed emission points AEP1 to AEP3 for each scenario is compared to relevant air quality objectives and limits. Air quality standards and guidelines referenced in this report include:

- SI 271 of 2002 – Air Quality Standards Regulations 2002.
- EU limit values set out in the Directives on Air Quality 2008/50/EC.
- Horizontal guidance Note, IPPC H4; Parts 1 and 2, UK Environment Agency.
- AG4 guidance document on dispersion modelling, Environmental Protection Agency.

Air quality is judged relative to the relevant Air Quality Standards, which are concentrations of pollutants in the atmosphere, which achieve a certain standard of environmental quality. Air quality Standards are formulated on the basis of an assessment of the effects of the pollutant on public health and ecosystems.

In general terms, air quality standards have been framed in two categories, limit values and guideline values. Limit values are concentrations that cannot be exceeded and are based on WHO guidelines for the protection of human health. Guideline values have been established for long-term precautionary measures for the protection of human health and the environment. European legislation has also considered standard for the protection of vegetation and ecosystems.

The relevant air quality standards for proposed emission sources AEP1 to AEP3 are presented in *Table 2.1*.

2.2.1 Air Quality Guidelines value for air pollutants

Table 2.1 illustrates the guideline and limit values for air quality pollutants in Ireland.

Table 2.1. EU and Irish Limit values set out in the SI 271 of 2002, CAFÉ directive 2008/50/EC, H4 Guidance documents Parts 1 and 2 and AG4 guidance document.

POLLUTANT	Objective				TO BE ACHIEVED BY[4]
	Concentration[2]	Maximum No. Of exceedences allowed[3]	Exceedence expressed as percentile[3]	Measured as	
Nitrogen dioxide and oxides of nitrogen	300 µg m^{-3} NO_2 200 µg m^{-3} NO_2 40 µg m^{-3} NO_2	18 times in a year 18 times in a year --	99.79^{th} percentile 99.79^{th} percentile --	1 hour mean 1 hour mean Annual mean	19 Jul 1999[4] 1 Jan 2010 1 Jan 2010
Particulates (PM_{10}) (2008/50/EC)	50 µg m^{-3} 40 µg m^{-3} 20 µg m^{-3}	35 times in a year None None	90.40^{th} percentile -- --	24 hour mean Annual mean Annual mean	1 Jan 2010[6] 1 Jan 2005 1 Jan 2010[6]
Particulates ($PM_{2.5}$) (2008/50/EC)	25 µg m^{-3} – Stage 1 20 µg m^{-3} – Stage 2	None None	-- --	Annual mean Annual mean	1 Jan 2015 1 Jan 2020
Carbon monoxide (CO)	10 mg m^{-3}	None	100^{th} percentile	Running 8 hour mean	31^{st} Dec 2003
Sulphur dioxide (SO_2)	350 µg m^{-3} 125 µg m^{-3} 20 µg m^{-3}	24 times in a year 3 times in a year --	99.73th percentile 99.18^{th} percentile --	1 hour mean 24 hour mean Annual mean and winter mean (1^{st} Oct to 31^{st} March	1^{st} Jan 2005 1^{st} Jan 2005 19^{th} Jul 2001[5]
Total non-methane VOC's as Benzene	5 µg m^{-3}	None	--	Annual mean	---
Odour	<1.50 Ou_E/m^3	175 times in a year	98^{th} percentile	1 hour mean	--

2.3 Existing Baseline Air Quality

The EPA has been monitoring national Air quality from a number of sites around the country. This information is available from the EPA's website. The values presented for PM_{10}, SO_2, NO_2, and CO give an indication of expected rural imissions of the compounds listed in *Table 2.1*. *Table 2.2* illustrates the baseline data expected to be obtained from rural areas for classical air pollutants. Since the proposed facility is located in a rural area, it would be considered located in a Zone D area according to the EPA's classification of zones for air quality. Traffic and industrial related emissions would be medium.

The results of $PM_{2.5}$ monitoring at Station Road in Cork City in 2007 (EPA, 2007) indicated an average $PM_{2.5}/PM_{10}$ ratio of 0.53 while monitoring in Heatherton Park in 2008 (EPA, 2008) indicated an average $PM_{2.5}/PM_{10}$ ratio of 0.60. Based on this information, a conservative ratio of 0.60 was used to generate a background $PM_{2.5}$ concentration in 2008 of 9.0 µg/m^3 with a value of 10 µg/m^3 recorded in 2010 (*see Table 2.2*)

Table 2.2. Baseline air quality data used to assess air quality impact criterion in a number of Zone D region – Navan and Kilkitt.

Reference air quality data – Source identity	Sulphur dioxide-SO_2 ($\mu g\ m^{-3}$)	Nitrogen dioxide-NO_x as NO_2 ($\mu g\ m^{-3}$)	Particulate matter-PM_{10} ($\mu g\ m^{-3}$)	Carbon monoxide – CO ($mg\ m^{-3}$)	Details
Navan – annual mean (Zone D)	4.20	16.90	23	-	Measured 2008
Navan – 98%ile & mean 24 hr value (Zone D)	9.60	-	23	-	Measured 2008
Navan – 8 hr max (Zone D)	-	-	-	1.04	Measured 2008
Zone B - Heatherton Park – Annual mean $PM_{2.5}$	-	-	9.0 ($PM_{2.5}$) (Heatherton Park)	-	Measured 2008
Kilkitt – annual mean (Zone D)	4.0	8.0 (Castlebar)	8.0		Measured 2009
Kilkitt – 8 hr max (Zone D)				0.40 (Newbridge zone C)	Measured 2009
Zone C - Ennis – Annual mean $PM_{2.5}$	-	-	10	-	Measured 2009
Zone C – Newbridge Benzene Annual mean	-	-	1.40 (Benzene)	-	Measured 2009

Notes: [1] denotes taken from Air quality monitoring report 2008 and 2009, www.epa.ie.

2.4 Meteorological data

Five years of hourly sequential meteorological data was chosen for the modelling exercise (i.e. Clones 2002 to 2006 inclusive). A schematic wind rose and tabular cumulative wind speed and directions of all seven years are presented in *Section 7*. All five years of met data was screened to provide more statistical significant result output from the dispersion model. This is in keeping with national and international recommendations on quality assurance in operating dispersion models and will provide a worst case assessment of predicted ground level concentrations based on the input emission rate data. Surface roughness, Albedo and Bowen ratio were assessed and characterised around each met station for AERMET Pro processing.

2.5 Terrain data

Topography effects were accounted for within the dispersion modelling assessment Individual sensitive receptors were inputted into the model at their specific height in order to take account of any effects of elevation on GLC's at there specific locations. Topographical data was inputted into the model utilising the AERMAP algorithm.

2.6 Building wake effects

Building wake effects are accounted for in modelling scenarios through the use of the Prime algorithm (i.e. all building features located within the facility) as this can have a significant effect on the compound plume dispersion at short distances from the source and can significantly increase GLC's in close proximity to the facility.

3. Results

This section describes the results obtained for the dispersion modelling exercise. All input data and source characteristics were developed in conjunction with engineering drawings and documentation supplied to OMI for the development.

3.1. Dispersion model input data – Source characteristics

Table 3.1 illustrates the source characteristics utilised within the dispersion model. Grid reference location, stack height (A.G.L), maximum volume flow and temperature of the emission point are presented within this table for reference purposes.

Table 3.1. Source characteristics for proposed emission points AEP1 to AEP3**.**

Parameter	Emission point AEP1 – Gas Engine 1[1]	Emission point AEP2–Gas engine 2[1]	Emission point AEP3–OCU 1 to 3[2]
X coordinate	251118	251118.9	251093.1
Y coordinate	250579.1	250580.4	250590.2
Elevation (A.O.D) (m)	96.67	96.67	96.67
Stack height (m)	15	15	15
Orientation	Vertical	Vertical	Vertical
Temperature (K)	453	453	303
Efflux velocity (m/s)	15.2216	15.2216	15.12226
Max volume flow (Nm^3/hr)	3,000	3,000	41,064 Am^3/hr
Stack tip diameter (m)	0.34	0.34	0.98
Max building height (m)	12.50	12.50	12.50
Building ground level (m)	96.67	96.67	96.67

Notes: [1] denotes referencing conditions for emission point AEP1 to AEP2 are 273.15K, 101.3KPa, dry gas, 5% O_2.
[2]denotes referencing conditions for emission point AEP3 is 303K, 101.3KPa, wet gas, 20.9% O_2.

3.2 Process emissions - Volume flow rate and flue gas concentration guarantees

The input mass emission rate data used in the dispersion model for each emission point is presented in *Tables 3.2, 3.3 and 3.4* for each scenario. All source characteristics and location are reported in *Table 3.1*. These will be utilised as process guarantees for the operating process emission point so as to ensure compliance with the stated guideline limits

Table 3.2. Emission values from exhaust stack of the emission source AEP1.

Parameters – Exhaust stack AEP 1	Conc. Limit Values	Units	Volume flow (Nm^3/hr ref 5% O_2)	Mass emission rate (g/s)
Carbon monoxide (CO)	1,400	mg/Nm^3 5% O_2	3,000	1.1667
Oxides of nitrogen (NOx as NO_2)	500	mg/Nm^3 5% O_2	3,000	0.4167
Sulphur dioxide (SO_2)	150	mg/Nm^3 5% O_2	3,000	0.1250
Total particulates	130	mg/Nm^3 5% O_2	3,000	0.1083
Total non methane Volatile organic compounds	50	mg/Nm^3 5% O_2	3,000	0.0417

Table 3.3. Emission values from exhaust stack of the emission source AEP2.

Parameters – Exhaust stack AEP 2	Conc. Limit Values	Units	Volume flow (Nm^3/hr ref 5% O_2)	Mass emission rate (g/s)
Carbon monoxide (CO)	1,400	mg/Nm^3 5% O_2	3,000	1.1667
Oxides of nitrogen (NOx as NO_2)	500	mg/Nm^3 5% O_2	3,000	0.4167
Sulphur dioxide (SO_2)	150	mg/Nm^3 5% O_2	3,000	0.1250
Total particulates	130	mg/Nm^3 5% O_2	3,000	0.1083
Total non methane Volatile organic compounds	50	mg/Nm^3 5% O_2	3,000	0.0417

Table 3.4. Emission values from exhaust stack of the emission source AEP3.

Parameters – Exhaust stack AEP3	Conc. Limit Values	Units	Volume flow (Am^3/hr)	Mass emission rate (Ou_E/s)
Odour control units 1 to 3	1,000	Ou_E/m^3	41,064	11,407

3.3 Dispersion modelling assessment

AERMOD Prime (09292) was used to determine the overall ground level impact of proposed emission points AEP1 to AEP3 to be located in the anaerobic digestion facility Bio Agrigas Ltd, Newdowns, The Downs, Mullingar, Co. Westmeath. These computations give the relevant GLC's at each 50-meter X Y Cartesian grid receptor location that is predicted to be exceeded for the specific air quality impact criteria. Individual receptor elevations were established at their specific height above ground and also included a 1.80 m normal breathing zone. A total Cartesian + individual receptors of 1,722 points was established giving a total grid coverage area of 4.0 square kilometres around the emission point.

Five years of hourly sequential meteorological data from Clones (Clones 2002 to 2006 inclusive) and source characteristics (*see Table 3.1*), including emission date contained in *Tables 3.2 to 3.4* were inputted into the dispersion model.

In order to obtain the predicted environmental concentration (PEC), background data was added to the process emissions. In relation to the annual averages, the ambient background concentration was added directly to the process concentration. However, in relation to the short-term peak concentrations, concentrations due to emissions from elevated sources cannot be combined in the same way. Guidance from the UK Environment Agency advises that an estimate of the maximum combined pollutant concentration can be obtained by adding the maximum short-term concentration due to emissions from the source to twice the annual mean background concentration.

3.4 Dispersion model Scenarios

AERMOD Prime (USEPA ver. 09292) was used to determine the overall air quality impact of the five combined emission points while in operation at 100% capacity for named air pollutants.

Impacts from the five stack emission points were assessed in accordance with the impact criterion contained in Directive 2008/50/EC, SI 271 of 2002, H4 guidance and AG4 guidance documents.

Twelve scenarios were assessed within the dispersion model examination for each of the classical air pollutants.

The dispersion modelling is carried out in line with the requirements of guidance document AG4- Dispersion modelling.

The output data was analysed to calculate the following:

Ref Scenario 1: Predicted cumulative ground level concentration of Carbon monoxide emission contribution of cumulative emissions for the 100th percentile of 8 hour averages for Clones meteorological station year 2004 for a Carbon monoxide concentration of less than or equal to 100 µg/m^3 assuming 24 hr operation (*see Figure 6.2*).

Ref Scenario 2: Predicted cumulative ground level concentration of Oxides of nitrogen emission contribution of cumulative emissions for the 99.79th percentile of 1 hour averages for Clones meteorological station year 2004 for an Oxides of nitrogen concentration of less than or equal to 58 µg/m^3 assuming 24 hr operation (*see Figure 6.3*).

Ref Scenario 3: Predicted cumulative ground level concentration of Oxides of nitrogen emission contribution of cumulative emissions for the Annual average for Clones meteorological station year 2004 for an Oxides of nitrogen concentration of less than or equal to 11 µg/m^3 assuming 24 hr operation (*see Figure 6.4*).

Ref Scenario 4: Predicted cumulative ground level concentration of Sulphur dioxide emission contribution of cumulative emissions for the 99.73th percentile of 1 hour averages for Clones meteorological station year 2004 for an Sulphur dioxide concentration of less than or equal to 35 µg/m^3 assuming 24 hr operation (*see Figure 6.5*).

Ref Scenario 5: Predicted cumulative ground level concentration of Sulphur dioxide emission contribution of cumulative emissions for the 99.18th percentile of 24 hour averages for Clones meteorological station year 2004 for an Sulphur dioxide concentration of less than or equal to 10 µg/m^3 assuming 24 hr operation (*see Figure 6.6*).

Ref Scenario 6: Predicted cumulative ground level concentration of Sulphur dioxide emission contribution of cumulative emissions for the Annual average for Clones meteorological station year 2004 for an Sulphur dioxide concentration of less than or equal to 2 µg/m^3 assuming 24 hr operation (*see Figure 6.7*).

Ref Scenario 7: Predicted cumulative ground level concentration of Total particulates as PM_{10} emission contribution of cumulative emissions for the 98.08th percentile of 24 hour averages for Clones meteorological station year 2004 for an Total particulates as PM_{10} concentration of less than or equal to 10 µg/m^3 assuming 24 hr operation (*see Figure 6.8*).

Ref Scenario 8: Predicted cumulative ground level concentration of Total particulates as PM_{10} emission contribution of cumulative emissions for the 90.40th percentile of 24 hour averages for Clones meteorological station year 2004 for an Total particulates as PM_{10} concentration of less than or equal to 10 µg/m^3 assuming 24 hr operation (*see Figure 6.9*).

Ref Scenario 9: Predicted cumulative ground level concentration of Total particulates as PM_{10} emission contribution of cumulative emissions for the Annual average for Clones meteorological station year 2004 for an Total particulates as PM_{10} concentration of less than or equal to 4.0 µg/m^3 assuming 24 hr operation (*see Figure 6.10*).

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Ref Scenario 10: Predicted cumulative ground level concentration of Total particulates as $PM_{2.5}$ emission contribution of cumulative emissions for the Annual average for Clones meteorological station year 2004 for an Total particulates as $PM_{2.5}$ concentration of less than or equal to 4.0 µg/m^3 assuming 24 hr operation (*see Figure 6.11*).

Ref Scenario 11: Predicted cumulative ground level concentration of TNMVOC as Benzene emission contribution of cumulative emissions for the Annual average for Clones meteorological station year 2004 for an TNMVOC as Benzene concentration of less than or equal to 1.0 µg/m^3 assuming 24 hr operation (*see Figure 6.12*).

Ref Scenario 12: Predicted cumulative ground level concentration of Odour emission contribution of cumulative emissions for the 98th percentile of hourly averages for Clones meteorological station year 2004 for an Odour concentration of less than or equal to 1.0 Ou_E/m^3 assuming 24 hr operation (*see Figure 6.13*).

4. Discussion of results

This section will present the results of the dispersion modelling.

AERMOD GIS Pro Prime (Ver. 09292) was used to determine the overall named air pollutant air quality impact of the proposed emission points AEP1 to AEP3 during operation.

Various averaging intervals were chosen to allow direct comparison of predicted GLC's with the relevant the relevant air quality assessment criteria as outline in *Section 2.2.1*. In particular, 1-hour, 24 hour, percentile and annual average GLC's of the specified pollutants were calculated at 50 metres distances from the site over a fine and coarse grid extent of 9.0 kilometres squared. Relevant percentiles of these GLC's were also computed for comparison with the relevant pollutant Air Quality Standards to include SI 271 of 2002, Directive 2008/50/EC and AG4 guidance document.

In modelling air dispersion of NOx from combustion sources, the source term should be expressed as NO_2, e.g., NOx mass (expressed as NO_2). Some of the exhaust air is made up of NO while some is made up of NO_2. NO will be converted in the atmosphere to NO_2 but this will depend on a number of factors to include Ozone and VOC concentrations. In order to take account of this conversion the following screening can be performed.

Use the following phased approach for assessment:

Worse case scenario treatment

35% for short-term and 70% for long-term average concentration should be considered to assess compliance with the relevant air quality objective.

This is in accordance with recommendations from the Environmental Agency UK for the dispersion modelling of NO_2 emissions from combustion processes, www.environmentagency.gov.uk

Table 4.1 illustrates the tabular results obtained from the assessment for Clones meteorological station for:

- Worse case scenario treatment as detailed above (for NO_x only).

Maximum predicted GLC's are presented within this table to allow for comparison with Directive 2008/50/EC and SI 271 of 2002. In addition, the predicted ground level concentrations at the selected residential receptors are presented in the Discussion of Results section of the document for all pollutants. A total of 41 individual sensitive receptors were included within the dispersion model and the location of same is presented in *Figure 6.1*. Illustrative contour plots for information purposes only are presented in *Section 6* of this report for each modelled scenario.

Table 4.1. Predicted ground level concentrations for various averaging periods for proposed emission points AEP1 to AEP3 for each pollutant at or beyond the boundary of the facility.

Averaging period	Maximum ground level conc (GLC)
Carbon monoxide - 8 hr maximum GLC (µg/m^3)	401
Oxides of nitrogen - 1 hr max 99.79th percentile (µg/m^3)	64.40
Oxides of nitrogen - Max Annual average (µg/m^3)	18.20
Sulphur dioxide - 1 hr Max 99.73th percentile (µg/m^3)	54.60
Sulphur dioxide - 24 hr Max 99.18th percentile (µg/m^3)	35.13
Sulphur dioxide – Max annual average (µg/m^3)	7.83
Total particulates - 24 hr Max 98.08th percentile (µg/m^3)	23.88
Total particulates - 24 hr Max 90.40th percentile (µg/m^3)	18.87
Total Particulates as PM_{10} - Max annual average (µg/m^3)	6.78
Total Particulates as $PM_{2.5}$ - Max annual average (µg/m^3)	6.78
TNMVOC as benzene – Max Annual average	2.61

Table 4.2 presents the comparison between model predictions for air quality impacts, baseline air quality concentrations for the compounds and the percentage impact of the air quality impact criterion anywhere in the vicinity of the facility.

4.1 Assessment of air quality impacts for pollutants from proposed emission points AEP1 to AEP3

Predictive air dispersion modelling was used to ascertain the maximum ground level concentrations at or beyond the boundary of the facility of selected worst case pollutant concentration to allow for comparison with the ground level limit values contained in *Table 2.1*. *Table 4.2* illustrates the results of the dispersion modelling assessment for each pollutant and comparison with the air quality guideline and limit values contained in *Table 2.1*.

Table 4.2. Comparison between predicted GLC's + baseline national air quality data and limit values contained in *Table 2.1*.

Identity	Predicted %ile GLC - (μg m^{-3})	Baseline concentration value (μg m^{-3})[1]	Baseline + Maximum predicted GLC (μg m^{-3})	Impact criterion (μg m^{-3})[2]	% of Criterion
Carbon monoxide - 8 hr maximum GLC (μg/m^3)	401	1,040	1,441.0	10,000	14.41
Oxides of nitrogen - 1 hr max 99.79th percentile (μg/m^3)	64.40	33.80 (Twice annual mean as per EA)	98.2	200	49.10
Oxides of nitrogen - Max Annual average (μg/m^3)	18.20	16.90	35.1	40	87.75
Sulphur dioxide - 1 hr Max 99.73th percentile (μg/m^3)	54.60	8.0 (Twice annual mean as per EA)	62.6	350	17.89
Sulphur dioxide - 24 hr Max 99.18th percentile (μg/m^3)	35.13	8.0	43.1	125	34.50
Sulphur dioxide – Max annual average (μg/m^3)	7.83	4.0	11.8	20	59.15
Total particulates - 24 hr Max 98.08th percentile (μg/m^3)	23.88	23	46.9	50	93.76
Total particulates - 24 hr Max 90.40th percentile (μg/m^3)	18.87	23	41.9	50	83.74
Total Particulates as PM_{10} - Max annual average (μg/m^3)	6.78	23	29.8	40	74.45
Total Particulates as $PM_{2.5}$ - Max annual average (μg/m^3)	6.78	10.0	16.8	25	67.12
TNMVOC as benzene	2.61	1.40	4.0	5.0	80.20

<u>**Notes**</u>: [1] denotes based on data presented in *Tables 3.1, 3.2, 3.3, 3.4 and 4.1,*
[2] denotes for impact criterion *see Table 2.1.*

As can be observed in *Table 4.2*, the predicted maximum averaging ground level concentration and baseline concentration are presented as a % of the impact criterion contained in *Tables 2.1*.

4.1.1 Carbon monoxide – Ref Scenario 1

The results for the potential air quality impact for dispersion modelling of CO based on process guaranteed emission rates in *Tables 3.2 to 3.4* are presented in *Tables 4.1 and 4.2.* Results are presented for the maximum predicted percentile emission regime. As can be observed in *Tables 4.1 and 4.2,* the maximum GLC+Baseline for CO from the operation of the facility is 1,441 $\mu g\ m^{-3}$ for the maximum 8-hour mean concentration at the 100^{th} percentile. When combined predicted and baseline conditions are compared to the Irish guideline/limit values and EU Limit values set out in SI 271 of 2002 and Directive 2008/50/EC, this is 14.41% of the impact criterion.

In addition, the predicted ground level concentration of Carbon monoxide at each of the 41 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

4.1.2 Oxides of nitrogen – Ref Scenario 2 and 3

The results for the potential air quality impact for dispersion modelling of NO_X as NO_2 based on process guaranteed emission rates in *Tables 3.2 to 3.4* are presented in *Tables 4.1 and 4.2.* Results are presented for the maximum predicted percentile emission regime. As can be observed in *Tables 4.1 and 4.2,* the maximum GLC+Baseline for NO_2 from the operation of the facility is 98.20 $\mu g\ m^{-3}$ for the maximum 1-hour mean concentration at the 99.79^{th} percentile. When combined predicted and baseline conditions are compared to SI 271 of 2002 and Directive 2008/50/EC, this is 49.10% of the impact criterion.

An annual average was also generated to allow comparison with values contained in SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 35.10 $\mu g/m^3$. When compared the annual average NO_2 air quality impact criterion is 87.75% of the impact criterion.

In addition, the predicted ground level concentration of Oxides of nitrogen at each of the 41 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

4.1.3 Sulphur dioxide – Ref Scenario 4, 5 and 6

The results for the potential air quality impact for dispersion modelling of SO_2 based on process guaranteed emission rates in *Tables 3.2 to 3.4* are presented in *Tables 4.1 and 4.2.* Results are presented for the maximum predicted percentile emission regime. As can be observed in *Tables 4.1 and 4.2,* the maximum GLC+Baseline for SO_2 from the operation of the facility is 62.60 and 43.10 $\mu g\ m^{-3}$ for the maximum 1-hour and 24 hr mean concentration at the 99.73^{th} and 99.18^{th} percentile respectively. When combined predicted and baseline conditions are compared to SI 271 of 2002 and Directive 2008/50/EC, this is 17.87 and 34.50% of the set target limits established for the 1 hour and 24 hour assessment criteria.

An annual average was also generated to allow comparison with SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 11.80 $\mu g/m^3$. When compared the annual average SO_2 air quality impact criterion is 59.51% of the impact criterion.

In addition, the predicted ground level concentration of Sulphur dioxide at each of the 41 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

4.1.4 Particulate matter – Ref Scenario 7, 8, 9 and 10

The results for the potential air quality impact for dispersion modelling of Particulate matter based on process guaranteed emission rates in *Tables 3.2 to 3.4* are presented in *Tables 4.1 and 4.2.* Results are presented for the maximum predicted percentile emission regime. As can be observed in *Tables 4.1 and 4.2,* the maximum GLC+Baseline for Particulate matter 10μm from the operation of the facility is 46.90 and 41.90 $\mu g\ m^{-3}$ for the maximum 24-hour mean concentration at the 98.08th and 90.40th percentile, respectively. When combined predicted and baseline conditions are compared to Directive 2008/50/EC, this is 93.76 and 83.74% of the impact criterion.

An annual average was also generated to allow comparison with the SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 29.80 $\mu g/m^3$. When compared, the annual average Particulate matter air quality impact is 74.45 % of the impact criterion.

An annual average was also generated for $PM_{2.5}$ to allow comparison with Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 16.80 $\mu g/m^3$. When compared, the annual average $PM_{2.5}$ air quality impact is 67.12% of the impact criterion.

In addition, the predicted ground level concentration of Particulate matter at each of the 41 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

4.1.5 TNMVOC as Benzene – Ref Scenario 11

The results for the potential air quality impact for dispersion modelling of TNMVOC as Benzene based on process guaranteed emission rates in *Tables 3.2 to 3.4* are presented in *Tables 4.1 and 4.2*. TNMVOC as Benzene modelling results indicate that the ambient ground level annual average concentrations could be up to 80.20% of the impact criterion (assuming all TNMVOC is Benzene which will not be the case).

In addition, the predicted ground level concentration of TNMVOC as Benzene at each of the 41 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

4.1.6 Odour – Ref Scenario 12

The results for the potential air quality impact for dispersion modelling of Odour based on the process guaranteed emission rates in *Tables 3.5 to 3.6* are presented in *Table 4.3 and Figure 6.13*. Odour modelling results indicate that the ambient ground level concentrations are below the relevant guideline odour air quality guideline value.

As can be observed in *Figure 6.13*, it is predicted that odour plume spread is in a north westerly south easterly direction of approximately 30 to 50 metres from the emission point with no sensitive receptors impacted by the plume. All resident locations in the vicinity of the proposed facility operations will perceive an odour concentration less than 1.50 Ou_E/m^3 at the 98th percentile of hourly averages for worst case meteorological year Clones 2004. In accordance with odour impact criterion presented in *Table 2.1*, and in keeping with currently recommended odour impact criterion in this country, no long-term odour impacts will be generated by receptors in the vicinity of the proposed facility operations.

In addition, the predicted ground level concentration of Odour at each of the 42 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

A number of key mitigation measures will need to be implemented into the design of the odour containment, capture and treatment system to include:

1. All buildings should be fitted with a high integrity building fabric with a leakage rate of no greater than 3 $m^3/m^2/hr$.
2. The facility buildings should be capable of attaining a negative pressure value of at least 10 Pa when ventilation is applied and the facility is in operation.
3. All sumps, tanks etc. should be sealed with tight fitting high containment efficiency covers so as to prevent the release of odours from such processes.
4. All mechanical processes within the pre-treatment building should be placed under appropriate negative pressure so as to ensure no significant odour release to the headspace of the building.
5. All building should be fitted with appropriate roller doors / access points of sealed nature (max leakage rate of 10 $m^3/m^2/hr$).
6. All buildings / processes holding or processing material with the potential to generate odours shall be placed under negative ventilation with all odourous air ducted to an appropriate odour control system for treatment. The odour control system shall be capable of providing treatment of odourous air to a level of less than or equal to 600 Ou_E/m^3 in the treated exhaust air stream.
7. All process specifications shall be independently processed proved including odour control system performance, building integrity testing (leakage rate, smoke integrity testing and applied absolute pressure testing) so as to ensure the containment, capture and treatment systems installed at the facility are functioning adequately. This shall be only carried out by personnel experienced in this method of testing.
8. An odour management plan shall be developed for the operating facility so as to ensure adequate operation of all odour management systems on a day to day basis.

Table 4.3. Predicted ground level concentration (excluding baseline) of each pollutant at each identified sensitive receptor locations Rec 1 to Rec 24 for Scenarios 1 to 8 (*see Section 4 and Figure 6.1*).

Receptor identity	X coord (m)	Y coord (m)	Scen 1 - (μg/m³)	Scen 2 - (μg/m³)	Scen 3 - (μg/m³)	Scen 4 - (μg/m³)	Scen 5 - (μg/m³)	Scen 6 - (μg/m³)	Scen 7 - (μg/m³)	Scen 8 -(μg/m³)
R1	251652	249621.8	40.5	16.2	0.3	4.6	1.1	0.1	0.7	0.31
R2	251731.6	249753.7	28.8	16.2	0.4	4.6	1.1	0.1	0.8	0.36
R3	251716.7	249855.6	30.8	17.7	0.4	5.1	1.2	0.1	0.9	0.40
R4	251662	249890.4	35.2	20.8	0.5	5.9	1.3	0.1	1.0	0.46
R5	251617.2	249920.3	39.8	23.7	0.5	6.3	1.4	0.2	1.2	0.50
R6	251430.7	249984.9	79.7	35.7	0.7	8.9	2.1	0.2	1.5	0.68
R7	251373.5	249997.4	58.6	48.4	0.7	11.6	2.1	0.2	1.4	0.78
R8	251316.3	250029.7	58.2	53.0	0.7	13.3	2.2	0.2	1.8	0.75
R9	251164.6	250042.1	87.3	56.6	0.7	15.4	2.5	0.2	1.8	0.69
R10	251055.1	250119.2	75.5	74.1	0.7	21.5	2.7	0.2	1.8	0.79
R11	251010.4	250141.6	95.1	71.5	0.7	18.5	2.7	0.2	1.9	0.62
R12	251002.9	250164	109.9	69.7	0.7	19.8	2.8	0.2	2.0	0.70
R13	250629.9	250400.3	96.4	87.5	1.0	25.2	3.2	0.3	2.0	1.09
R14	250570.2	250395.3	88.3	78.2	0.9	23.1	3.1	0.3	1.7	0.95
R15	250535.3	250492.3	156.3	78.2	0.7	20.8	2.1	0.2	1.4	0.77
R16	250254.3	250815.6	33.4	22.8	0.3	5.4	1.2	0.1	0.8	0.24
R17	250271.7	250922.6	39.0	17.8	0.3	5.0	1.2	0.1	0.7	0.28
R18	250279.2	250994.7	19.5	16.5	0.2	4.6	0.9	0.1	0.6	0.23
R19	250284.2	251069.3	21.2	14.2	0.2	4.1	0.8	0.1	0.5	0.23
R20	250411	251004.6	23.9	18.9	0.3	5.1	0.9	0.1	0.7	0.34
R21	250331.4	251138.9	21.1	15.3	0.2	4.3	0.8	0.1	0.6	0.22
R22	250445.8	251134	26.7	19.1	0.3	5.1	1.0	0.1	0.7	0.27
R23	250490.6	251129	29.3	20.9	0.3	5.6	1.0	0.1	0.7	0.30
R24	250522.9	251124	28.4	24.3	0.3	6.3	1.0	0.1	0.7	0.31

Table 4.3 continued. Predicted ground level concentration (excluding baseline) of each pollutant at each identified sensitive receptor locations Rec 1 to Rec 24 for Scenarios 9 to 12 (*see Section 4 and Figure 6.1*).

Receptor identity	X coord (m)	Y coord (m)	Scen 9 - (μg/m³)	Scen 10 - (μg/m³)	Scen 11 - (μg/m³)	Scen 12 - (μg/m³)
R1	251652	249621.8	0.08	0.08	0.03	0.046
R2	251731.6	249753.7	0.10	0.10	0.04	0.052
R3	251716.7	249855.6	0.11	0.11	0.04	0.064
R4	251662	249890.4	0.12	0.12	0.05	0.069
R5	251617.2	249920.3	0.13	0.13	0.05	0.071
R6	251430.7	249984.9	0.17	0.17	0.07	0.104
R7	251373.5	249997.4	0.18	0.18	0.07	0.108
R8	251316.3	250029.7	0.19	0.19	0.07	0.114
R9	251164.6	250042.1	0.18	0.18	0.07	0.103
R10	251055.1	250119.2	0.19	0.19	0.07	0.095
R11	251010.4	250141.6	0.18	0.18	0.07	0.085
R12	251002.9	250164	0.19	0.19	0.07	0.085
R13	250629.9	250400.3	0.27	0.27	0.10	0.137
R14	250570.2	250395.3	0.23	0.23	0.09	0.101
R15	250535.3	250492.3	0.18	0.18	0.07	0.084
R16	250254.3	250815.6	0.07	0.07	0.03	0.041
R17	250271.7	250922.6	0.08	0.08	0.03	0.042
R18	250279.2	250994.7	0.06	0.06	0.02	0.040
R19	250284.2	251069.3	0.06	0.06	0.02	0.036
R20	250411	251004.6	0.08	0.08	0.03	0.049
R21	250331.4	251138.9	0.06	0.06	0.02	0.036
R22	250445.8	251134	0.07	0.07	0.03	0.042
R23	250490.6	251129	0.08	0.08	0.03	0.044
R24	250522.9	251124	0.08	0.08	0.03	0.044

Table 4.3 continued. Predicted ground level concentration (excluding baseline) of each pollutant at each identified sensitive receptor locations Rec 25 to Rec 42 for Scenarios 1 to 8 (*see Section 4 and Figure 6.1*).

Receptor identity	X coord (m)	Y coord (m)	Scen 1 - (μg/m³)	Scen 2 - (μg/m³)	Scen 3 - (μg/m³)	Scen 4 - (μg/m³)	Scen 5 - (μg/m³)	Scen 6 - (μg/m³)	Scen 7 - (μg/m³)	Scen 8 -(μg/m³)
R25	250545.3	251124	29.7	24.8	0.3	6.5	1.1	0.1	0.7	0.31
R26	250570.2	251124	35.5	25.9	0.3	6.6	1.2	0.1	0.7	0.32
R27	250610	251186.2	48.1	21.8	0.3	6.1	1.0	0.1	0.8	0.27
R28	250644.8	251109.1	45.9	30.8	0.4	7.1	1.5	0.1	0.9	0.36
R29	250669.6	251188.7	44.0	23.7	0.4	6.6	1.4	0.1	0.8	0.34
R30	250716.9	251186.2	55.8	32.5	0.5	8.5	1.4	0.1	1.0	0.42
R31	250769.1	251181.2	62.4	36.5	0.5	10.6	1.6	0.2	1.1	0.54
R32	250813.9	251161.3	53.5	50.5	0.6	13.5	1.7	0.2	1.2	0.60
R33	250838.8	251161.3	70.6	55.8	0.7	14.9	1.9	0.2	1.3	0.73
R34	250910.9	251156.3	68.1	50.9	0.8	13.6	2.5	0.3	1.8	0.77
R35	251174.5	251074.3	76.1	83.2	1.8	22.8	3.9	0.5	2.6	1.39
R36	251229.2	251007.1	80.6	89.0	2.5	24.4	4.0	0.7	3.2	1.82
R37	251448.1	251141.4	77.3	68.9	1.8	19.2	3.2	0.5	2.4	1.40
R38	251542.6	251096.6	59.7	60.9	1.6	15.0	2.6	0.5	2.0	1.15
R39	251895.8	250741	46.2	36.9	0.8	10.6	1.4	0.2	1.1	0.58
R40	251647	250188.9	63.8	42.4	1.0	11.9	2.1	0.3	1.6	0.93
R41	251746.5	250069.5	59.4	31.9	0.7	7.3	1.4	0.2	1.1	0.63
R42	251127.9	250358.2	220.5	116.5	2.3	33.3	7.7	0.7	5.5	1.96

Table 4.3 continued. Predicted ground level concentration (excluding baseline) of each pollutant at each identified sensitive receptor locations Rec 25 to Rec 42 for Scenarios 9 to 12 (*see Section 4 and Figure 6.1*).

Receptor identity	X coord (m)	Y coord (m)	Scen 9 - ($\mu g/m^3$)	Scen 10 - ($\mu g/m^3$)	Scen 11 - ($\mu g/m^3$)	Scen 12 - ($\mu g/m^3$)
R25	250545.3	251124	0.08	0.08	0.03	0.044
R26	250570.2	251124	0.09	0.09	0.03	0.045
R27	250610	251186.2	0.08	0.08	0.03	0.047
R28	250644.8	251109.1	0.10	0.10	0.04	0.054
R29	250669.6	251188.7	0.10	0.10	0.04	0.058
R30	250716.9	251186.2	0.12	0.12	0.05	0.070
R31	250769.1	251181.2	0.14	0.14	0.05	0.089
R32	250813.9	251161.3	0.17	0.17	0.06	0.105
R33	250838.8	251161.3	0.18	0.18	0.07	0.108
R34	250910.9	251156.3	0.22	0.22	0.08	0.149
R35	251174.5	251074.3	0.47	0.47	0.18	0.274
R36	251229.2	251007.1	0.64	0.64	0.25	0.337
R37	251448.1	251141.4	0.48	0.48	0.18	0.198
R38	251542.6	251096.6	0.42	0.42	0.16	0.176
R39	251895.8	250741	0.20	0.20	0.08	0.100
R40	251647	250188.9	0.27	0.27	0.10	0.145
R41	251746.5	250069.5	0.19	0.19	0.07	0.100
R42	251127.9	250358.2	0.59	0.59	0.23	0.529

5. Conclusions

Odour Monitoring Ireland was commissioned by ORS consulting Ltd to perform a dispersion modelling study of a new proposed anaerobic digestion facility to be located in Bio Agrigas Ltd, Newdowns, The Downs, Mullingar, Co. Westmeath. Following a detailed impact and dispersion modelling assessment, it was demonstrated that no significant environmental impact will exist if the source characteristics and emission limit value in the waste gases are achieved.

The following conclusions are drawn from the study:

1. The assessment was carried out to provide information in line with standard information to be provided to the EPA and regulatory bodies for such projects.

2. Specific dispersion modelling was performed for Carbon monoxide, Oxides of nitrogen, Sulphur dioxide, Particulate matter, TNMVOC as Benzene and Odour.

3. With regards to Carbon monoxide, the maximum GLC+Baseline for CO from the operation of the facility is 1,441 $\mu g\ m^{-3}$ for the maximum 8-hour mean concentration at the 100th percentile. When combined predicted and baseline conditions are compared to the Irish guideline/limit values and EU Limit values set out in SI 271 of 2002 and Directive 2008/50/EC, this is 14.41% of the impact criterion. In addition, the predicted ground level concentration of Carbon monoxide at each of the 42 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

4. With regards to Oxides of nitrogen, the maximum GLC+Baseline for NO_2 from the operation of the facility is 98.20 $\mu g\ m^{-3}$ for the maximum 1-hour mean concentration at the 99.79th percentile. When combined predicted and baseline conditions are compared to SI 271 of 2002 and Directive 2008/50/EC, this is 49.10% of the impact criterion. An annual average was also generated to allow comparison with values contained in SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 35.10 $\mu g/m^3$. When compared the annual average NO_2 air quality impact criterion is 87.75% of the impact criterion. In addition, the predicted ground level concentration of Oxides of nitrogen at each of the 42 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

5. With regards to Sulphur dioxide, the maximum GLC+Baseline for SO_2 from the operation of the facility is 62.60 and 43.10 $\mu g\ m^{-3}$ for the maximum 1-hour and 24 hr mean concentration at the 99.73th and 99.18th percentile respectively. When combined predicted and baseline conditions are compared to SI 271 of 2002 and Directive 2008/50/EC, this is 17.87 and 34.50% of the set target limits established for the 1 hour and 24 hour assessment criteria. An annual average was also generated to allow comparison with SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 11.80 $\mu g/m^3$. When compared the annual average SO_2 air quality impact criterion is 59.51% of the impact criterion. In addition, the predicted ground level concentration of Sulphur dioxide at each of the 42 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

6. With regards to Particulate matter, the maximum GLC+Baseline for Particulate matter 10μm from the operation of the facility is 46.90 and 41.90 $\mu g\ m^{-3}$ for the maximum 24-hour mean concentration at the 98.08th and 90.40th percentile, respectively. When combined predicted and baseline conditions are compared to Directive 2008/50/EC, this is 93.76 and 83.74% of the impact criterion. An annual average was also generated to allow comparison with the SI 271 of 2002 and Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 29.80 $\mu g/m^3$. When compared, the annual average Particulate matter air

quality impact is 74.75 % of the impact criterion. An annual average was also generated for $PM_{2.5}$ to allow comparison with Directive 2008/50/EC. The maximum predicted annual average ground level concentration in the vicinity of the facility was 16.80 $\mu g/m^3$. When compared, the annual average $PM_{2.5}$ air quality impact is 67.12% of the impact criterion. In addition, the predicted ground level concentration of Particulate matter at each of the 42 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

7. With regards to the results from the assessment of TNMVOC as Benzene ground level concentrations, the results indicate that the ambient ground level maximum annual average concentrations anywhere in the vicinity of the facility could be up to 80.20% of the impact criterion (assuming all TNMVOC is Benzene which will not be the case). In addition, the predicted ground level concentration of TNMVOC as Benzene at each of the 41 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1*.

8. With regards to odour, it is predicted that odour plume spread is in a north westerly south easterly direction of approximately 30 to 50 metres from the emission points with no sensitive receptors impacted by the plume. All resident locations in the vicinity of the proposed facility operations will perceive an odour concentration less than 1.50 Ou_E/m^3 at the 98^{th} percentile of hourly averages for worst case meteorological year Clones 2004. In accordance with odour impact criterion presented in *Table 2.1*, and in keeping with currently recommended odour impact criterion in this country, no long-term odour impacts will be generated by receptors in the vicinity of the proposed facility operations. In addition, the predicted ground level concentration of Odour at each of the 42 sensitive receptors is presented in *Table 4.3*. As can be observed, all predicted ground level concentrations are well within the ground level concentration limit values contained in *Table 2.1.* A number of key mitigation measures as outlined in Section 4.1.6 will need to be implemented into the design of the odour containment, capture and treatment system to ensure compliance.

9. The overall modelling indicates that the facility will not result in any significant impact on air quality in the surrounding area with all ground level concentrations of pollutants well within their respective ground level concentration limit values.

6. *Appendix I* - Air dispersion modelling contour plots (Process contributions and illustrative purposes only).

These contour maps are for illustrative purposes only.

6.1 Site layout drawing and location of proposed facility and nearby residences

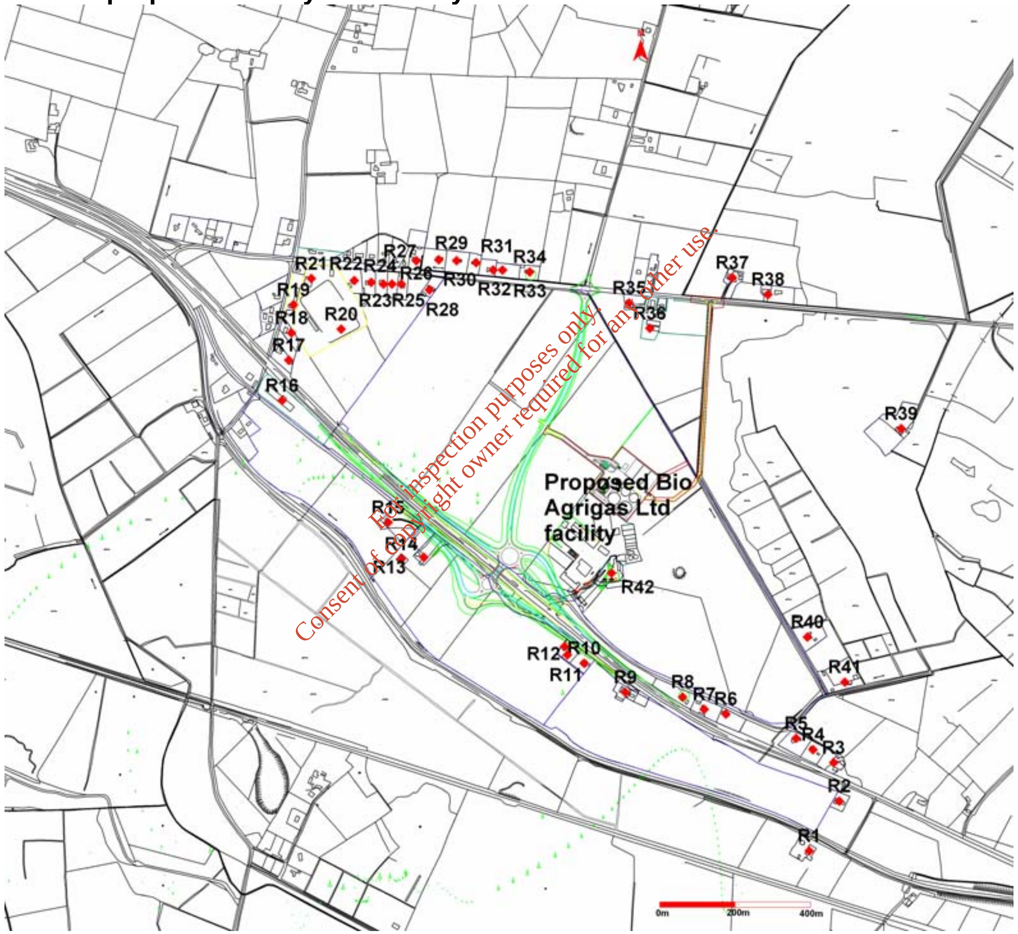

Figure 6.1. Plan view facility layout drawings for Bio Agrigas anaerobic digestion facility including specific location of nearest sensitive receptors Rec 1 to Rec 42.

6.2. Dispersion modelling contour plots for Scenarios 1 to 12 – Worst case meteorological year Clones 2004

6.2.1 Scenario 1 - Carbon monoxide

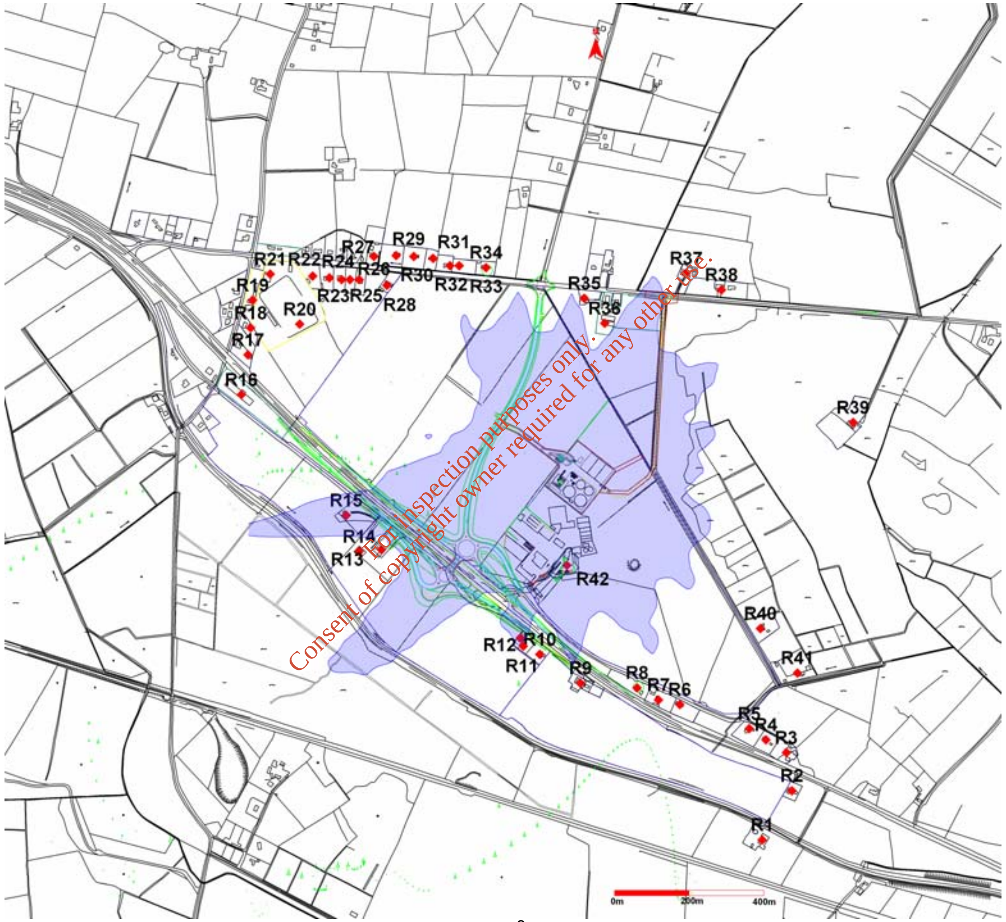

Figure 6.2. Predicted 8 hr average CO ground level concentration of 100 µg/m^3 (▬) for cumulative emissions from emission points AEP1 to AEP3 for Scenario 1 for Clones meteorological station (worst case year 2004) - 24 hr plant operation.

6.2.2 Scenario 2 and 3 - Oxides of nitrogen

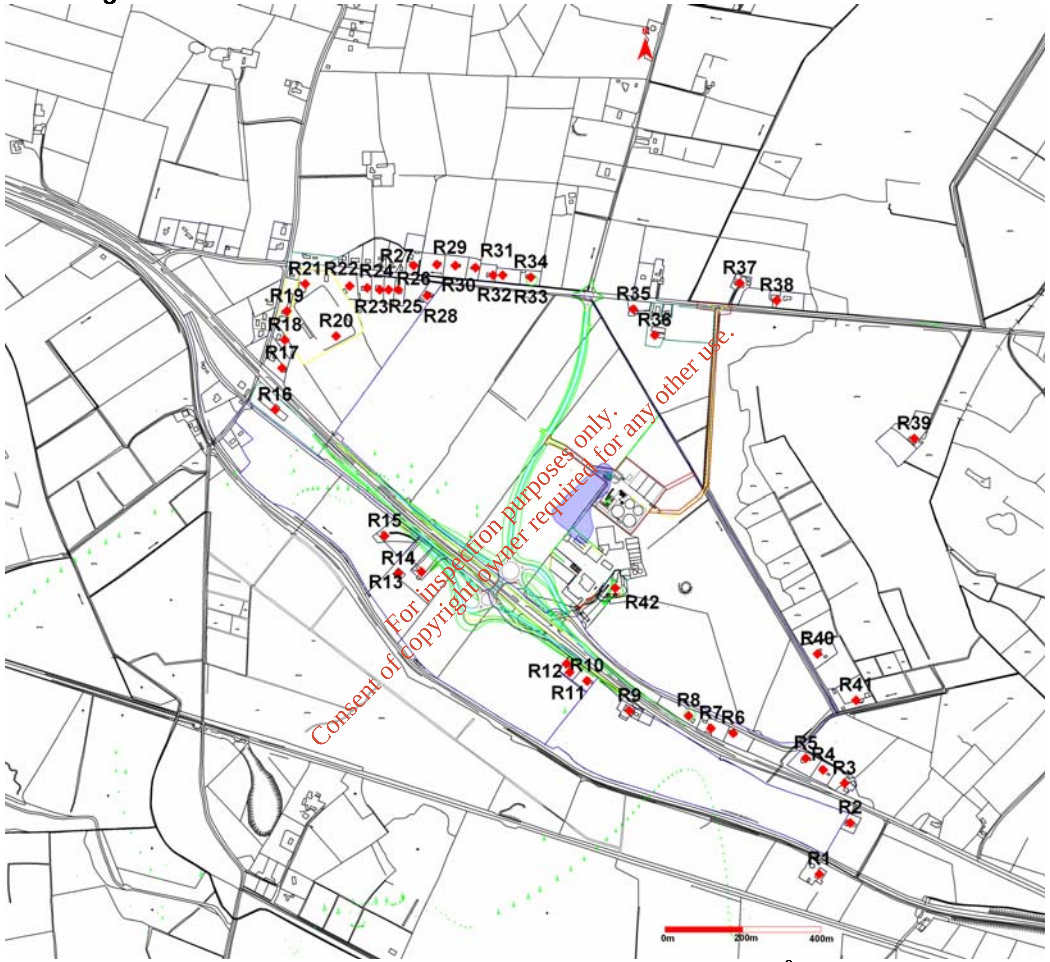

Figure 6.3. Predicted 99.79th percentile of 1 hr averages for NO_2 ground level concentration of 58 $\mu g/m^3$ ( ) for cumulative emission for Scenario 2 for Clones meteorological station (worst case year 2004) - 24 hr plant operation.

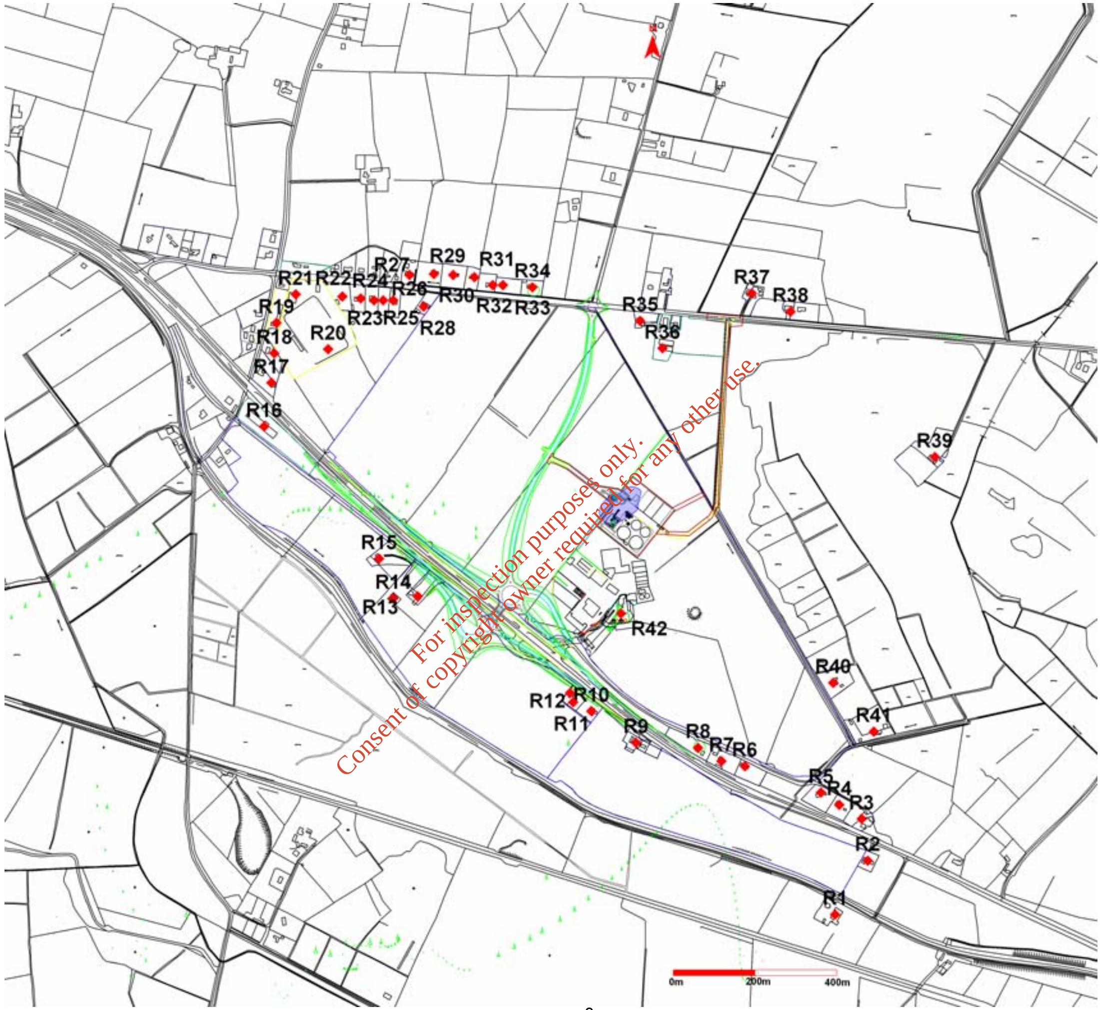

Figure 6.4. Predicted annual average NO_2 ground level concentration of 11 $\mu g/m^3$ ( ) for cumulative emissions for Scenario 3 for Clones meteorological station (worst case year 2004) - 24 hr plant operation.

6.2.3 Scenario 4, 5 and 6 - Sulphur dioxide

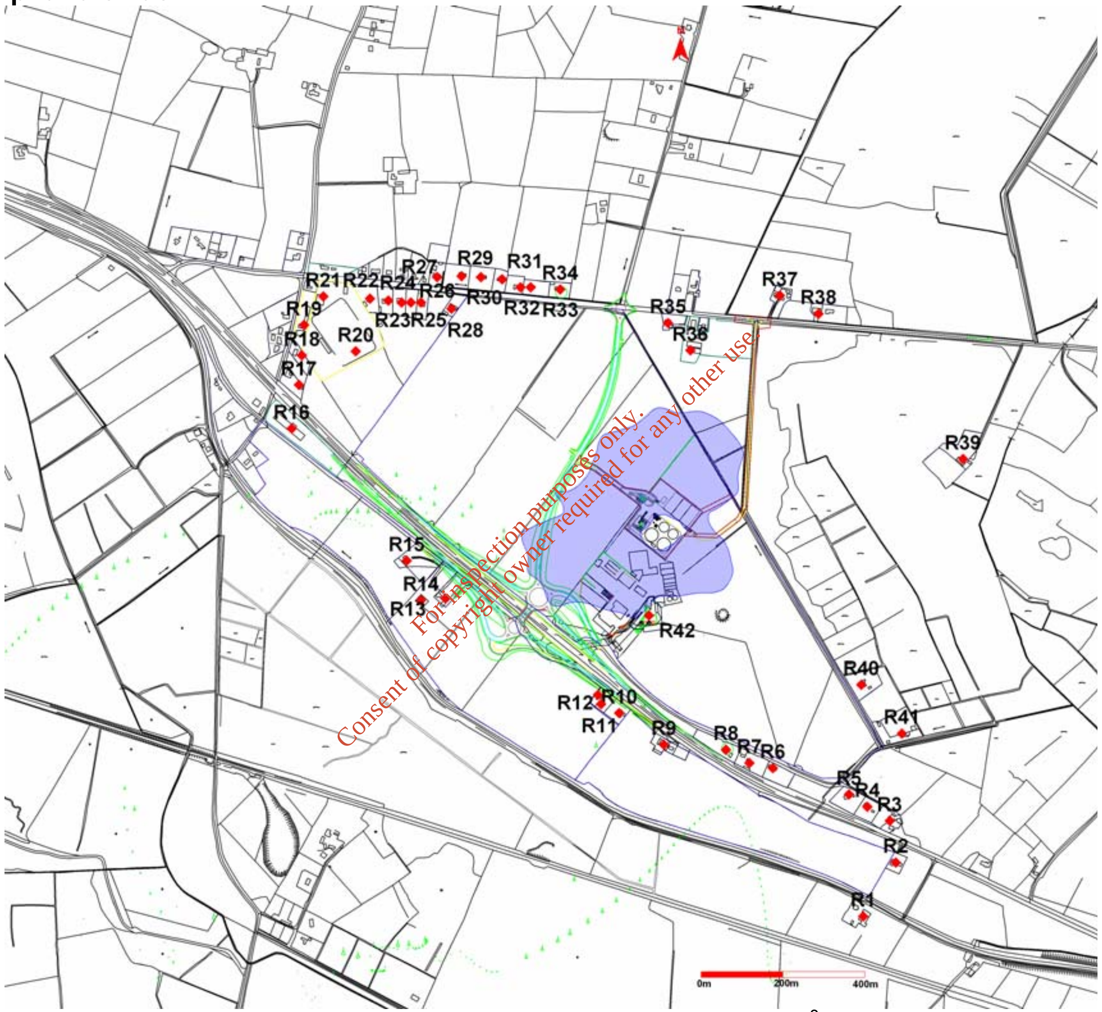

Figure 6.5. Predicted 99.73th percentile of 1 hr averages for SO_2 ground level concentration of 35 $\mu g/m^3$ ( ) for cumulative emission for Scenario 4 for Clones meteorological station (worst case year 2004) - 24 hr plant operation.

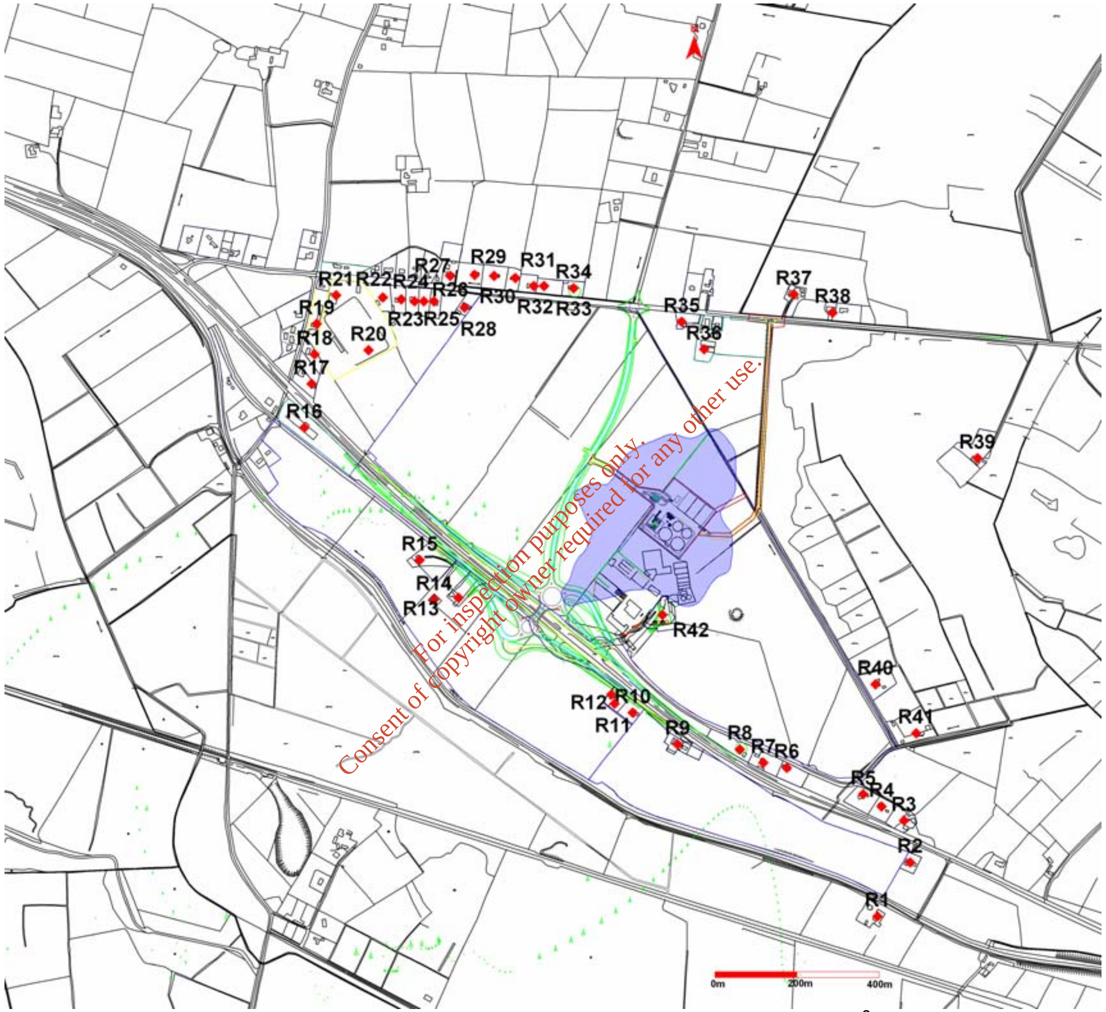

Figure 6.6. Predicted 99.18th percentile of 24 hr averages for SO_2 ground level concentration of 10 $\mu g/m^3$ (▬▬) for cumulative emission for Scenario 5 for Clones meteorological station (worst case year 2004) - 24 hr plant operation.

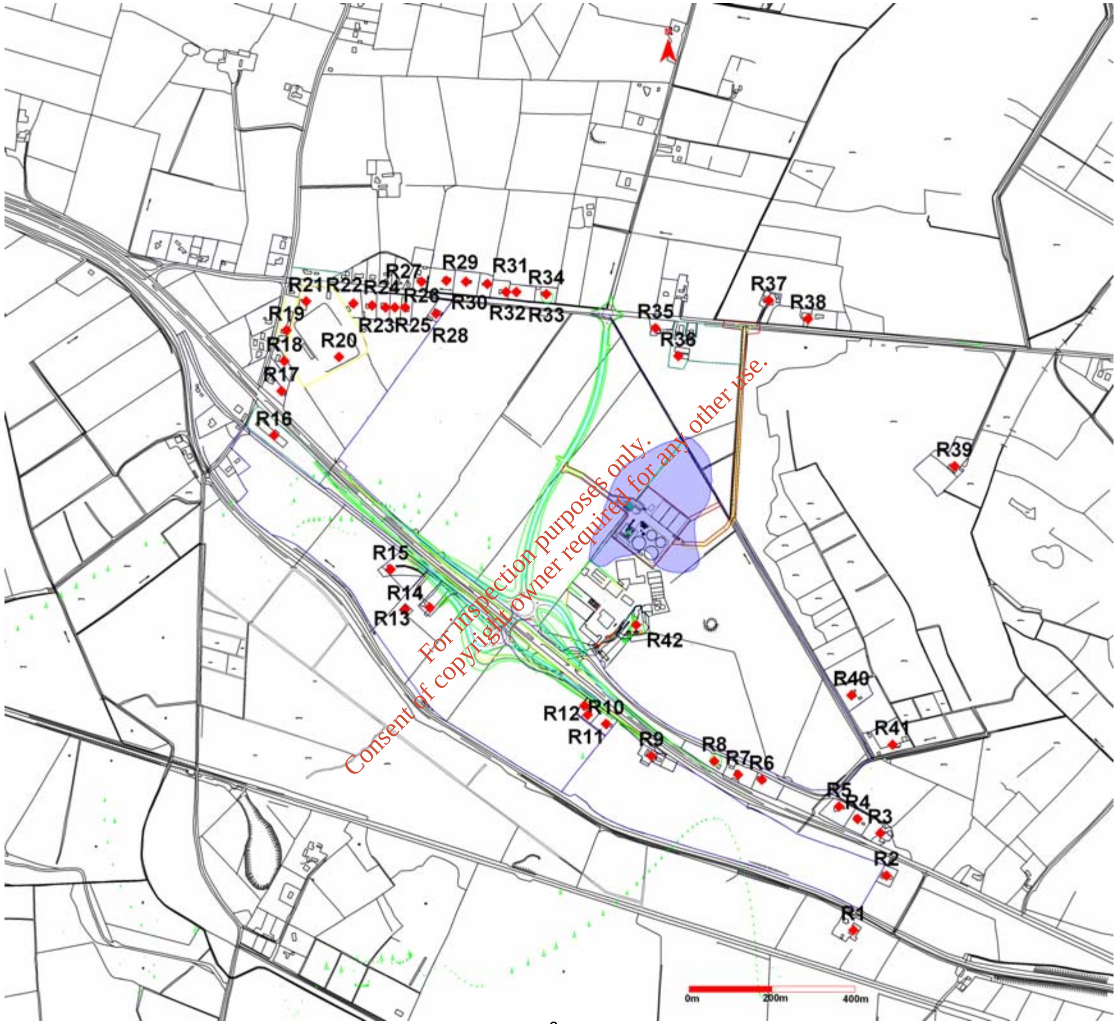

Figure 6.7. Predicted annual average SO_2 ground level concentration of 2 μg/m^3 (▬) for cumulative emissions for Scenario 6 for Clones meteorological station (worst case year 2004) - 24 hr plant operation.

6.2.4 Scenario 7, 8, 9 and 10 - Total particulates

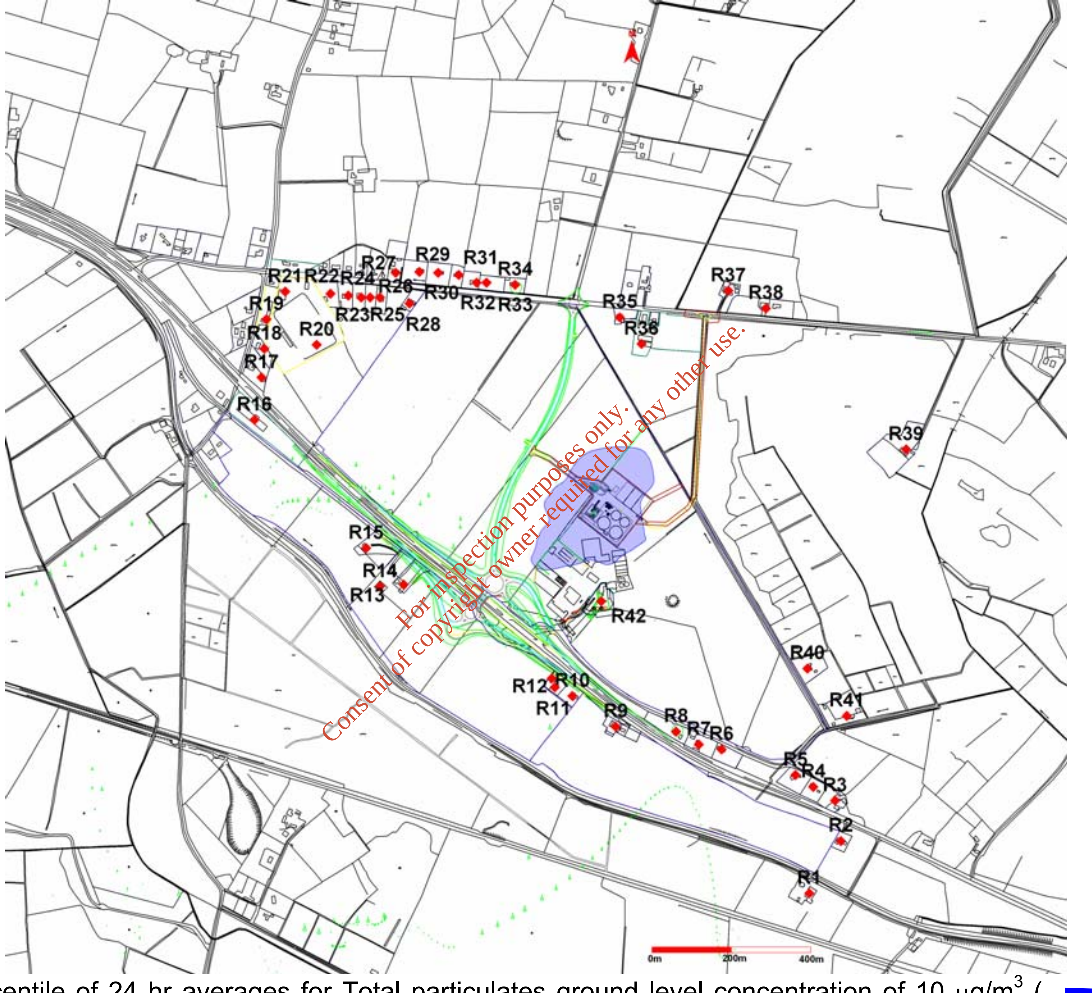

Figure 6.8. Predicted 98.08th percentile of 24 hr averages for Total particulates ground level concentration of 10 μg/m^3 (▬) for cumulative emission for Scenario 7 for Clones meteorological station (worst case year 2004) - 24 hr plant operation.

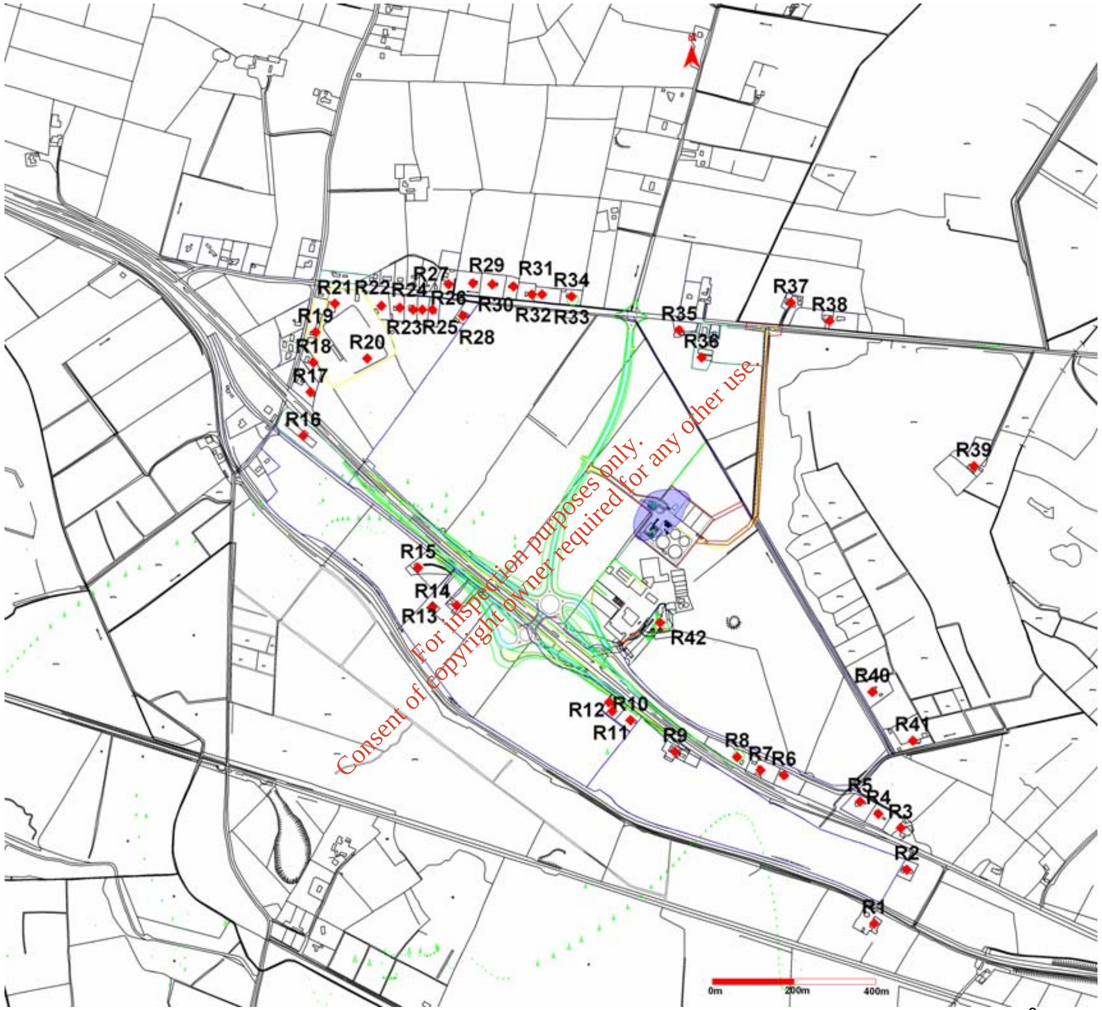

Figure 6.9. Predicted 90.40th percentile of 24 hr averages for Total particulates ground level concentration of 10 $\mu g/m^3$ ( ) for cumulative emission for Scenario 8 for Clones meteorological station (worst case year 2004) - 24 hr plant operation.

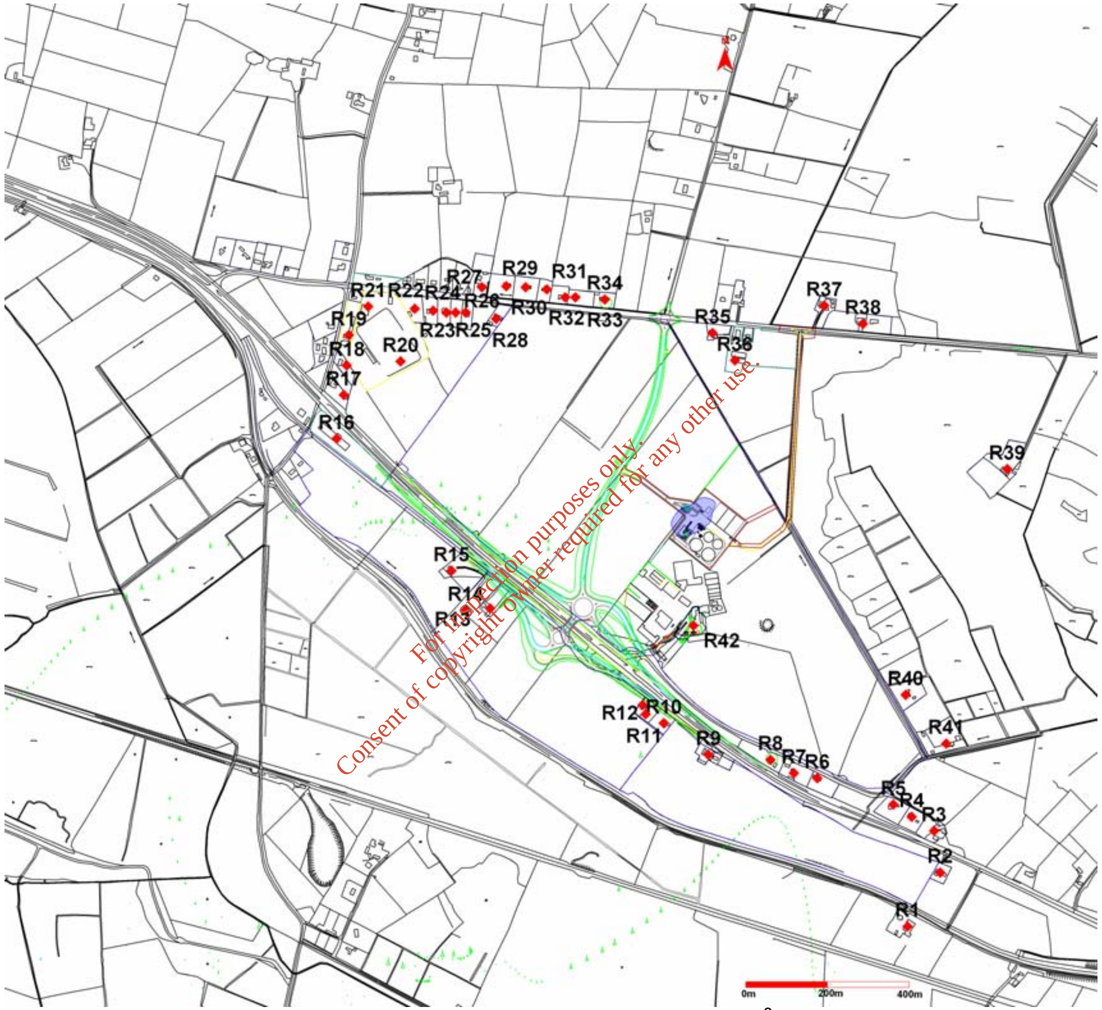

Figure 6.10. Predicted annual average Total particulates ground level concentration of 4.0 μg/m^3 (blue line) for cumulative emissions for Scenario 9 for Clones meteorological station (worst case year 2024) - 24 hr plant operation.

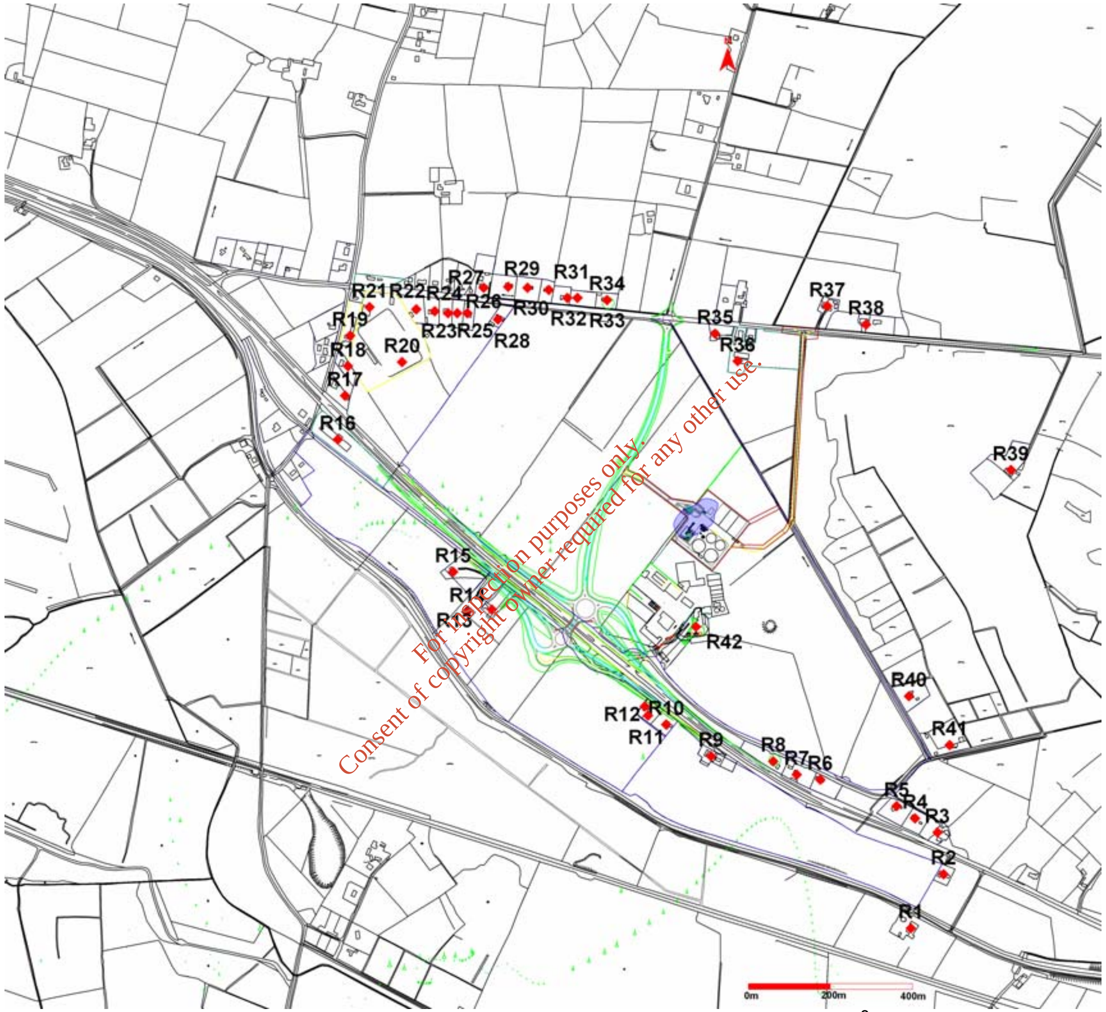

Figure 6.11. Predicted annual average Total particulates as $PM_{2.5}$ ground level concentration of 4.0 $\mu g/m^3$ ( ) for cumulative emissions for Scenario 10 for Clones meteorological station (worst case year 2004) - 24 hr plant operation.

6.2.5 Scenario 11 – TNMVOC as Benzene

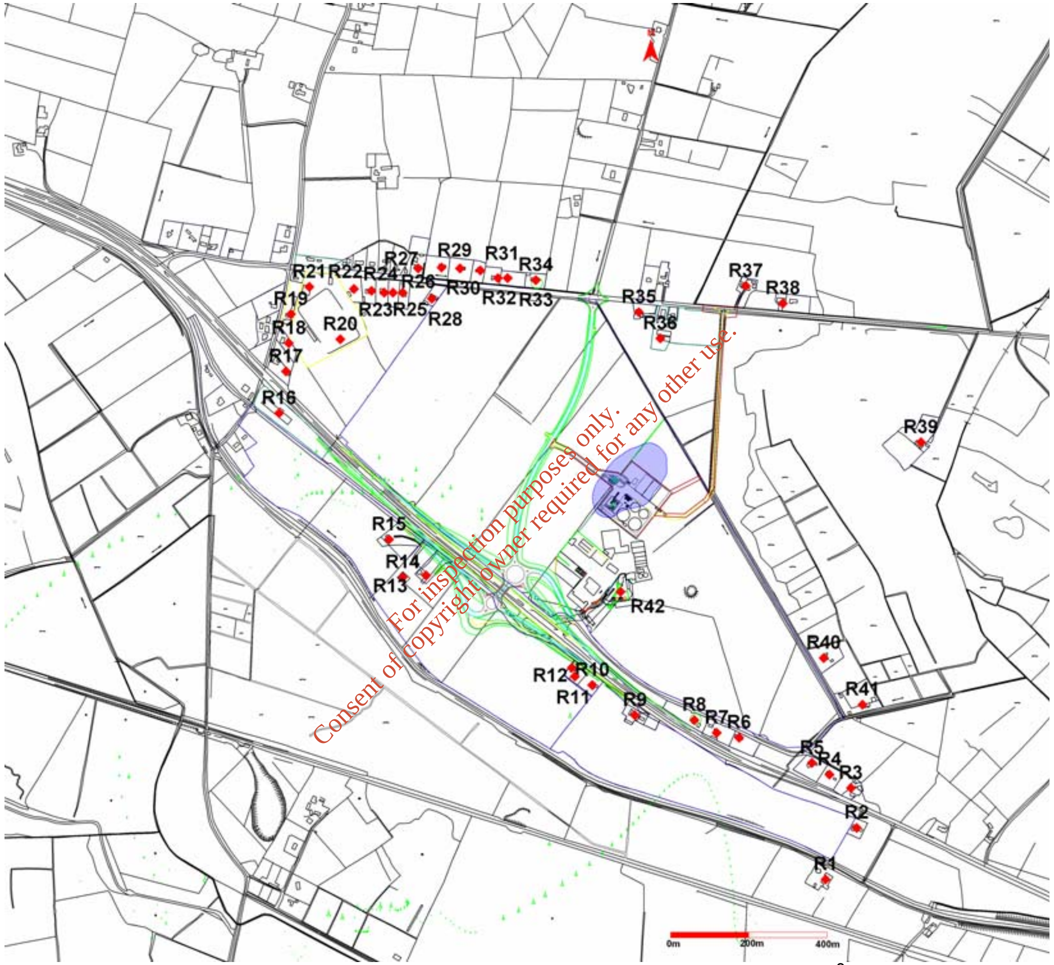

Figure 6.12. Predicted annual averages for TNMVOC as Benzene ground level concentration of 1.0 μg/m^3 (▬) for cumulative emission for Scenario 11 for Clones meteorological station (worst case year 2004) - 24 hr plant operation.

6.2.6 Scenario 12 – Odour

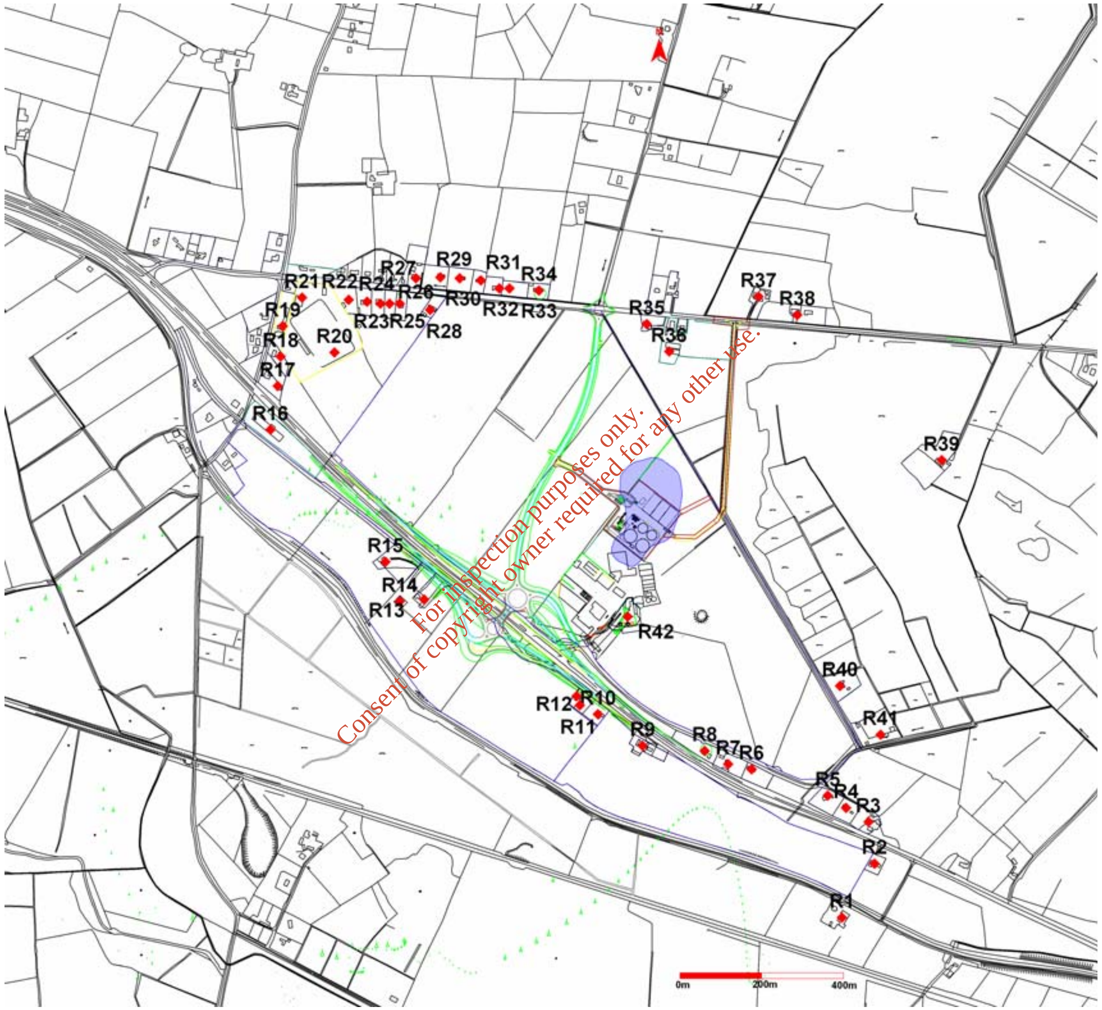

Figure 6.13. Predicted 98th percentile of 1 hr averages for an Odour ground level concentration of less than or equal to 1.0 Ou_E/m^3 (▬▬) for cumulative emission for Scenario 13 for Clones meteorological station (worst case year 2004) - 24 hr plant operation.

7. *Appendix II* - Meteorological data used within the Dispersion modelling study.

Meteorological file Clones 2002 to 2006 inclusive

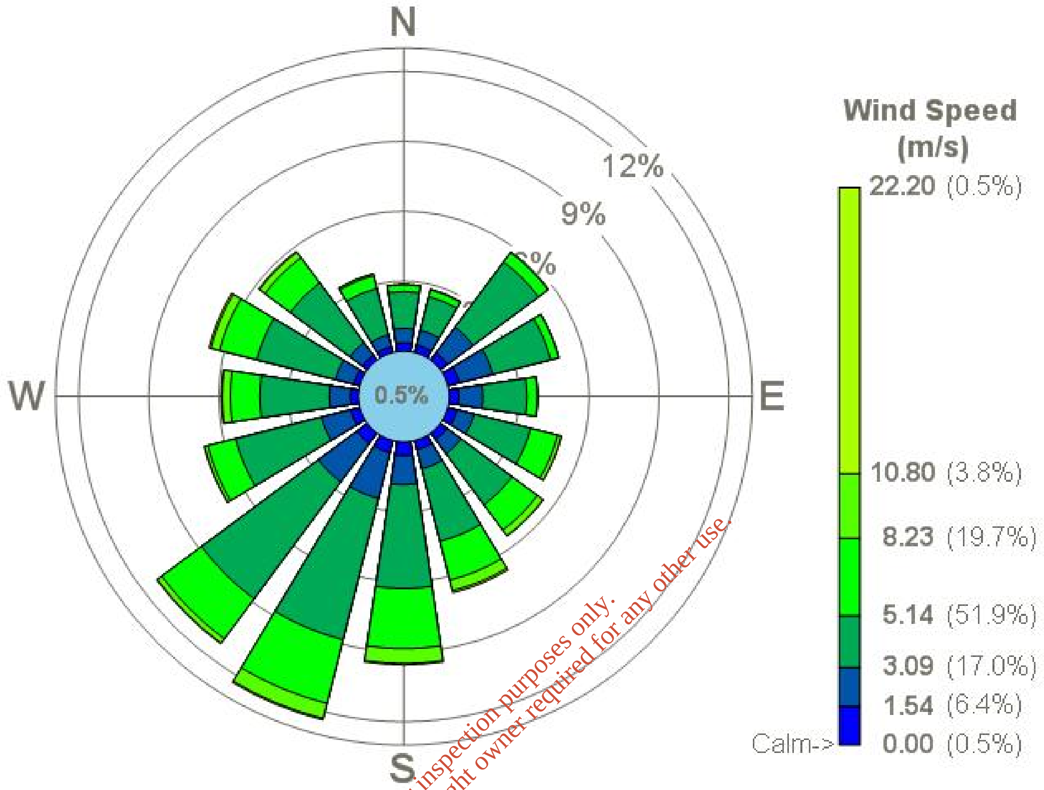

Figure 7.1. Schematic illustrating windrose for meteorological data used for atmospheric dispersion modelling, Clones 2002 to 2006 inclusive.

Table 7.1. Cumulative wind speed and direction for meteorological data used for atmospheric dispersion modelling Clones 2002 to 2006 inclusive.

Cumulative Wind Speed Categories							
Relative Direction	**> 1.54**	**>3.09**	**>5.14**	**>8.23**	**> 10.80**	**< 10.80**	**Total**
0	0.36	0.62	1.57	0.30	0.02	0.00	2.87
22.5	0.34	0.65	1.49	0.31	0.02	0.00	2.79
45	0.39	1.36	3.49	0.50	0.03	0.00	5.77
67.5	0.52	1.47	2.56	0.35	0.01	0.00	4.90
90	0.41	1.04	1.89	0.44	0.02	0.00	3.79
112.5	0.40	0.76	2.51	1.20	0.16	0.00	5.02
135	0.35	0.75	2.74	1.34	0.30	0.02	5.50
157.5	0.40	0.84	3.20	1.72	0.47	0.09	6.73
180	0.59	1.24	4.45	2.58	0.63	0.06	9.56
202.5	0.53	2.03	6.24	2.82	0.67	0.06	12.35
225	0.55	2.06	6.24	2.14	0.24	0.03	11.26
247.5	0.41	1.29	3.80	1.23	0.14	0.01	6.88
270	0.35	0.90	2.98	1.27	0.35	0.05	5.89
292.5	0.26	0.81	3.48	1.65	0.39	0.08	6.67
315	0.27	0.67	3.20	1.34	0.29	0.05	5.81
337.5	0.26	0.51	2.05	0.56	0.08	0.01	3.48
Total	**6.39**	**17.00**	**51.87**	**19.74**	**3.80**	**0.47**	**99.28**
Calms	--	-	-	-	-	-	0.48
Missing	-	-	-	-	-	-	0.24
Total	**-**	**-**	**-**	**-**	**-**	**-**	100.00

8. *Appendix III* - Checklist for EPA requirements for air dispersion modelling reporting

Table 8.1. EPA checklist as taken from their air dispersion modelling requirements report.

Item	Yes/No	Reason for omission/Notes
Location map	Section 6	-
Site plan	Section 6	-
List of pollutants modelled and relevant air quality guidelines	Yes	-
Details of modelled scenarios	Yes	-
Model description and justification	Yes	-
Special model treatments used	Yes	-
Table of emission parameters used	Yes	-
Details of modelled domain and receptors	Yes	-
Details of meteorological data used (including origin) and justification	Yes	-
Details of terrain treatment	Yes	-
Details of building treatment	Yes	-
Details of modelled wet/dry deposition	N/A	-
Sensitivity analysis	Yes	Five years of hourly sequential data screened from nearest valid met station-Clones 2002 to 2006.
Assessment of impacts	Yes	Pollutant emissions assessment from process identified.
Model input files	No	DVD will be sent upon request. Files are a total of 3.1 GB in size.

ISO 9001 REGISTERED FIRM

ISO 14001 REGISTERED FIRM

SAFEcontractor APPROVED

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BRITISH WATER
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Meeting the Highest Standards

Anua is committed to meeting and surpassing the highest quality standards required for each of its products. That's why you will always see national and/or international standards, accreditations for all Anua products.

- Patented
- Mónashell is a world-wide patented media.
- **Free** pre-planning and site reports
- **Free** no obligation quotations
- Nationwide maintenance call-out service.
- Expert customer support

Mónashell Applications

Mónashell (Incl Mónashell Dualpass and EBf) have been deployed globally across a wide variety of applications.

Wastewater Treatment Industry
Wastewater pumping stations
Wastewater inlet works
Solid waste handling, treatment and storage processes

Food/Agri Industry
Animal by-products processes
Industrial effluent treatment

Pharmaceutical/Petro Chemical/ Printing & Coating/Other Industries
Industrial process emissions
Industrial effluent treatment

Municipal Solid Waste
Green waste and MSW composting
Mechanical Biological Treatment facilities
Anaerobic Digestion centres

Mónashell EBf has also been used in the following industries
Semi-conductors
Aircraft maintenance
Metal coating
Geotextiles

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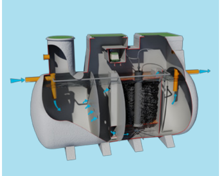
e usainfo@anuainternational.com

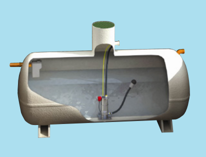
For further information, go to **www.anuainternational.com**

Renew



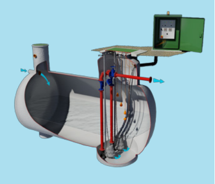
Wastewater Treatment

Recover



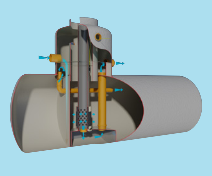
Rainwater Harvesting

Re-direct



Pumps

Recycle

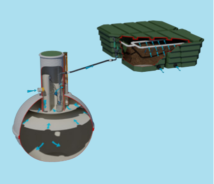


SUDS

Rarefy

Odour Abatement

Retain



Holding Tanks

In keeping with company policy of continuing research and development and in order to offer our clients the most advanced products, Anua reserves the right to alter specifications and drawings without prior notice.

Mónashell

Air & Odour Abatement System for the Municipal, Utility and Industrial Markets

ANUA

Technology that Serves Customers and the Planet

Anua means 'to renew'. It describes our renewed contract with nature and our renewed focus on the development of innovative environmental solutions. We continue to develop and produce the sustainable technologies that our customers demand. Anua is part of Bord na Móna, a highly successful organisation and Ireland's leading resources company for over 75 years, which has a unique heritage and understanding of the natural environment. Bord na Móna has used its expert insights into natural processes, allied to its excellent in-house research facilities, to develop sustainable solutions across a wide range of environmental challenges – odour abatement, wastewater treatment, land reclamation, power generation, resource recovery and renewable energy. This is both Anua's history and our mission for the future.

Anua enjoys the benefit of the support of its highly respected parent company. As part of this wider organisation, we adhere to their world-class standards and values for both the technology we provide and the service we give our customers.

Anua has developed odour treatment systems that are based on environmentally sound principles. We offer proven, patented clean air bio-technologies which are renowned for providing best-in-class system performance, while ensuring low life-cycle costs. Over the last 20 years Anua has been a leading designer, manufacturer and supplier of odour abatement technologies. We have provided solutions for customers around the world with more than 600 odour abatement and VOC treatment systems being installed in Europe, Asia, USA and Australia. But it is not just our technical capability that stands us apart, we offer our customers a comprehensive, flexible bespoke service which is supported by our team of experts with excellent project management and customer service skills.

We have a wealth of expertise and experience across a broad range of sectors such as Industrial, Municipal and Utility. Our customers trust us to deliver the best sustainable solutions. That is why we work with our clients throughout every project to achieve the best possible result, one that will build both our reputations.

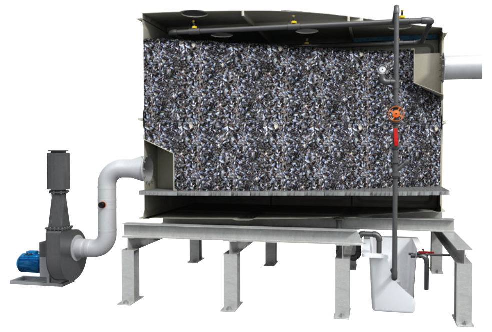
Complete Solutions

We don't just sell technologies. With our extensive laboratories and innovation centres located in Europe and the USA, we understand new challenges, pioneer research and create new processes. We work with you to create the systems you require, ensure correct project implementation and offer the full services from project planning to project completion. Anua stands by its technology and its customers and we are there for the long haul.

Customised for Customers

Customers need a partner – and products – they can trust. Like nature itself, Anua must be adaptable and responsive to change. That means developing the solutions that best suit each individual project.

For Anua staff, understanding their customers' world is their business. That depth of understanding is matched by the depth of our customer support and focus. We work with clients to design technically superior solutions that focus on life cycle costs. We're with you every step of the way



The Mónashell Advantages	
Ability to treat high levels of H_2S and organic sulphides	No nutrient addition
Lower footprint than conventional biofilters	Reduces or may eliminate the need for chemicals
High efficiencies	Sustainable process, utilising naturally-occurring media
Low life cycle costs	High performance on a broad range of compounds
Low maintenance	Effective on variable inlet concentrations
Low water usage	High quality housing with proven long life
Low consumables required	Flexible modular design
	Offsite or onsite modular construction for ease of installation

The Mónashell Process

The Mónashell Biofiltration System from Anua is a unique patented technology, which allows for the biological treatment of airstreams.

Biofiltration is a biological process whereby microorganisms are immobilised on a filtration media, converting captured pollutants from an air stream into harmless, nonodourous by-products.

Mónashell is a natural biological system that utilises shells coated with a blend of specifically selected microorganisms with an ability to control variation in pH by neutralising the acid by-products. This allows for the treatment of high levels of H_2S and reduced sulphur compounds. The process is also assisted by optimum pH ranges on the surface of the packing, which enhances capture and breakdown of low solubility organic sulphide compounds such as Alkyl Sulphides and Mercaptans.

The shells contain a high level of $CaCO_3$, which neutralises acid as it is produced as a result of bacterial oxidation of sulphides. The bacteria are selected for their ability to degrade high levels of H_2S. The process is further enhanced by the physical structure and chemical properties of the media, which allow for smaller filters with high efficiencies and improved elimination capacities. The process has also proved to be effective for the treatment of Volatile Organic Compounds (VOCs) and nitrogen-based compounds.

Mónashell at Work

Contaminated air is captured and ventilated to the inlet of our Mónashell biological filters.

As air passes through the filter the chemical contaminants are captured by a combination of adsorbtion, absorbtion and chemisorption into the water layer on the surface of the filter where an active biofilm oxidises and breaks down the odorous compounds.
Acidic oxidation by-products are neutralised by the calcium carbonate present in the shell media ensuring optimum pH for capture and break down of odorous compounds.

The Mónashell is continuously irrigated and pH is maintained by the media ensuring minimum top up requirements.

Treated air passes through the filter from which it is exhausted to atmosphere.

Anua also have two enhanced Mónashell offerings.

- Mónashell Dual pass for use on persistent low solubility VOCs.
- Mónashell EBF for the biological treatment of difficult industrial emissions containing high levels of VOC, H_2S and organic sulphur groups VOCs.

The Mónashell Dual Pass

Mónashell Dual Pass technology is for use on persistent, low solubility VOCs and for difficult wastewater treatment applications where activated carbon polishing has traditionally been required. By employing enhanced airflow dynamics, Mónashell Dual Pass achieves significant improvement in performance with the same overall contact time. The considerable performance improvement is achieved for minimal additional cost, providing clients with a very attractive alternative to activated carbon polishing, for reduced life cycle costs.

Mónashell EBf (Enhanced Technology for Enhanced Effectiveness)

Mónashell EBf's effectiveness for removing VOCs is achieved by employing two additional dynamics to enhance the existing processes and to create greater capture and catabolic breakdown of VOCs.
Firstly, the technology utilises the recirculation of the air stream and this increases predilution of the inlet contaminants and acceleration of mass transfer. This results in increased efficiency (typically from 50>90%) and increased elimination capacity (typically by a factor of 4). Secondly, further dynamics (electromagnetic stimuli) are used to regulate and control the production of extra cellular polysaccharides by microbes, leading to a higher catabolic of VOCs.

Mónashell Typical System Performance*

Compounds	Concentration Range	Minimum Removal Efficiency
Odour	1,000 – 400,000 OU_E/m^3	85 – 99%
VOC	1 – 200 MgC/m^3	50 – 80%
Hydrogen Sulphides	1 – 200 ppm	95 – 99%
Ammonia**	1 – 30 ppm	95 – 98%
Organic Sulphides	1 – 15 ppm	95 – 98%

*Specific guarantees will be agreed on each individual project depending on agreed criteria.
** High levels of ammonia will require increased supply of irrigation water

Installation

Mónashell can be supplied as a skid-mounted modular system or site-erected filter constructed on a prepared concrete plinth. Each Mónashell system is supplied complete with plenum floor, filter media, irrigation system, removable cover, inlet and outlet connections and access ports. All internal components are constructed from high-grade corrosion-resistant materials.

Mónashell Typical Dual Pass System Performance*

Compounds	Concentration Range	Minimum Removal Efficiency
Odour	1,000 – 400,000 OU_E/m^3	90 – 99.5%
VOC	1 – 200 MgC/m^3	70 – 85%
Hydrogen Sulphides	1 – 200 ppm	99 – 99.5%
Ammonia**	1 – 100 ppm	98 – 99%
Organic Sulphides	1 – 100 ppm	98 – 99%

The Mónashell Dual Pass Additional Advantages

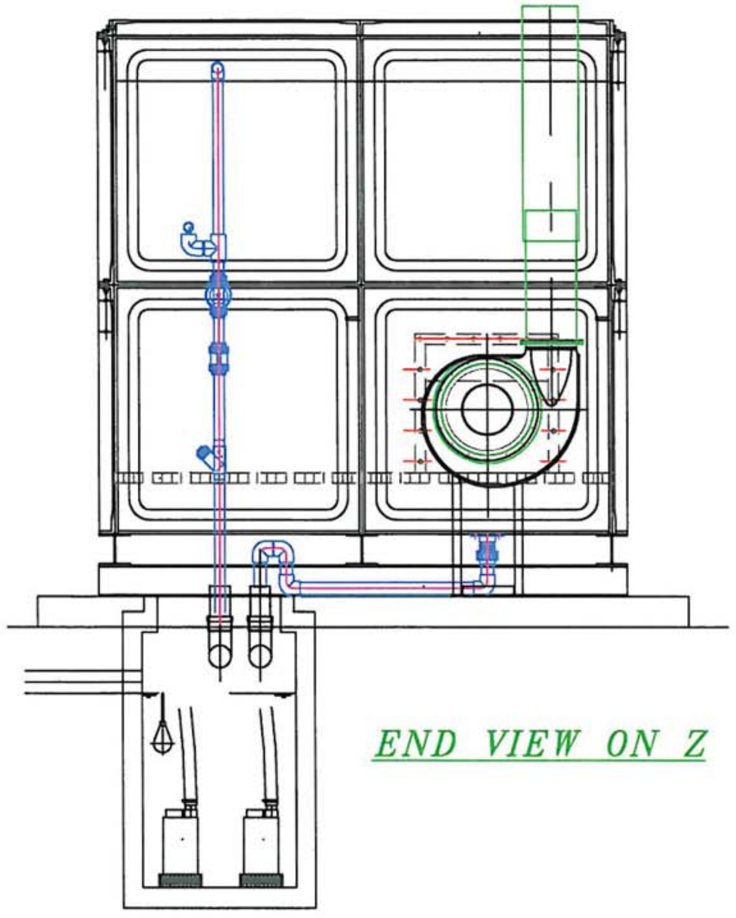
- High odour removal efficiencies
- High elimination capacity on H_2S organic sulphides
- Primary and polishing stages in single unit reduces cost
- Configured as duty/duty or duty standby for maintenance

Mónashell Typical EBf System Performance*

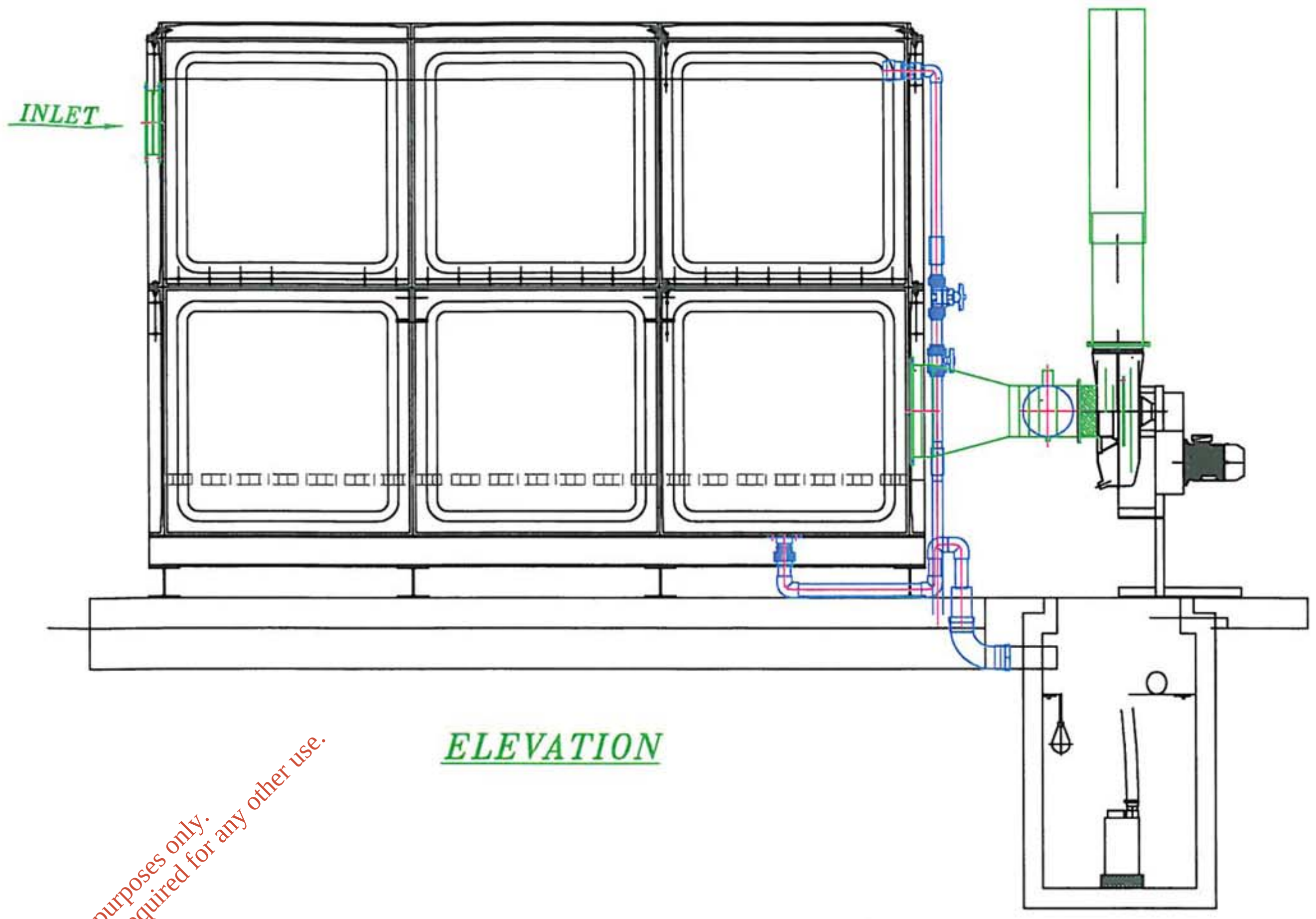
Compounds	Concentration Range	Minimum Removal Efficiency
VOC	100 – 1,200 MgC/m^3	50 – 90%
Hydrogen Sulphides	100 – 2,000 ppm	99 – 99.99%
Organic Sulphides	50 – 200 ppm	98 – 99.9%

The Mónashell EBf Additional Advantages

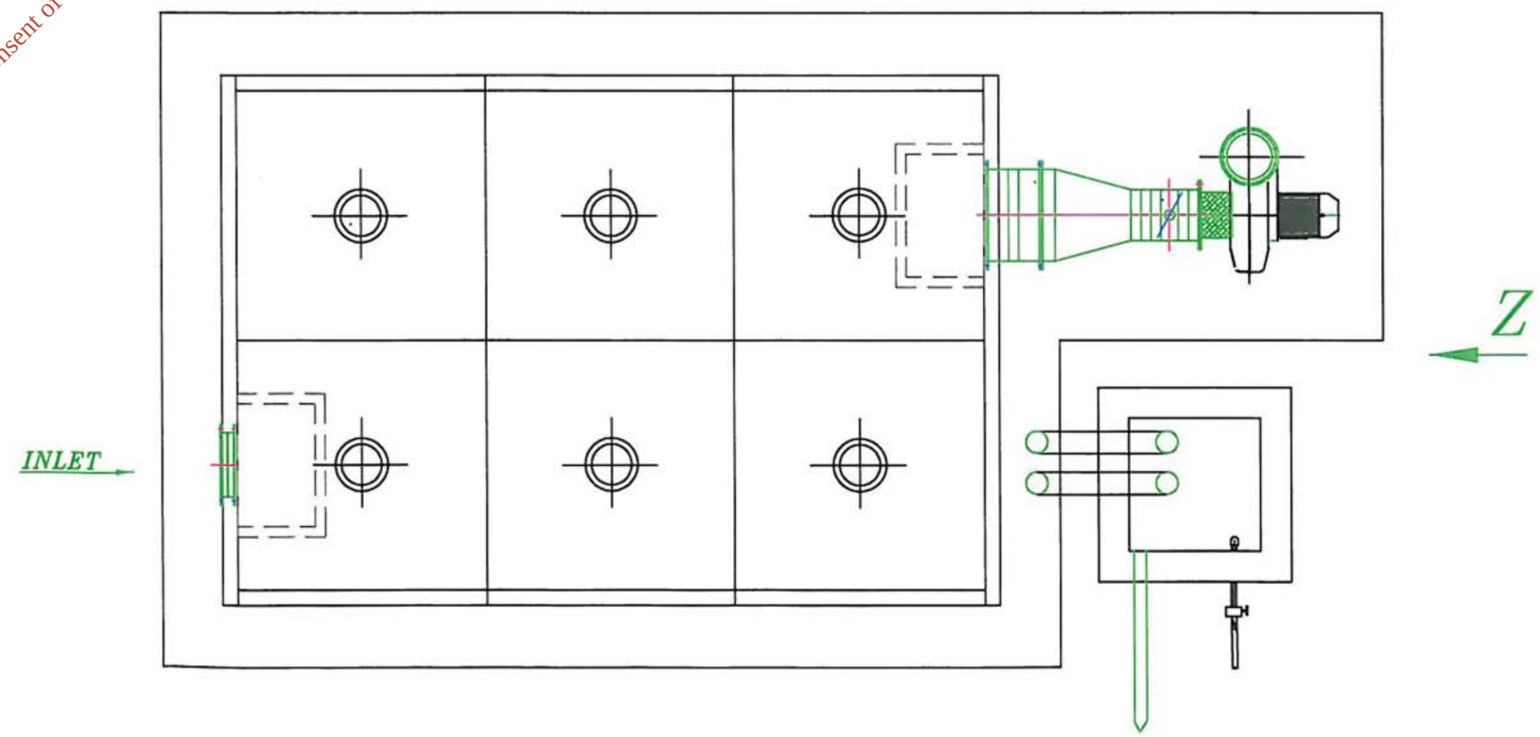
- Ability to treat high levels of VOC, H_2S and organic sulphides
- Environmentally friendly alternative to thermal treatment
- Strong performance on wide range of compounds
- Adaptability and flexibility of operation



END VIEW ON Z



ELEVATION



PLAN

NEWBRIDGE, CO. KILDARE, IRELAND
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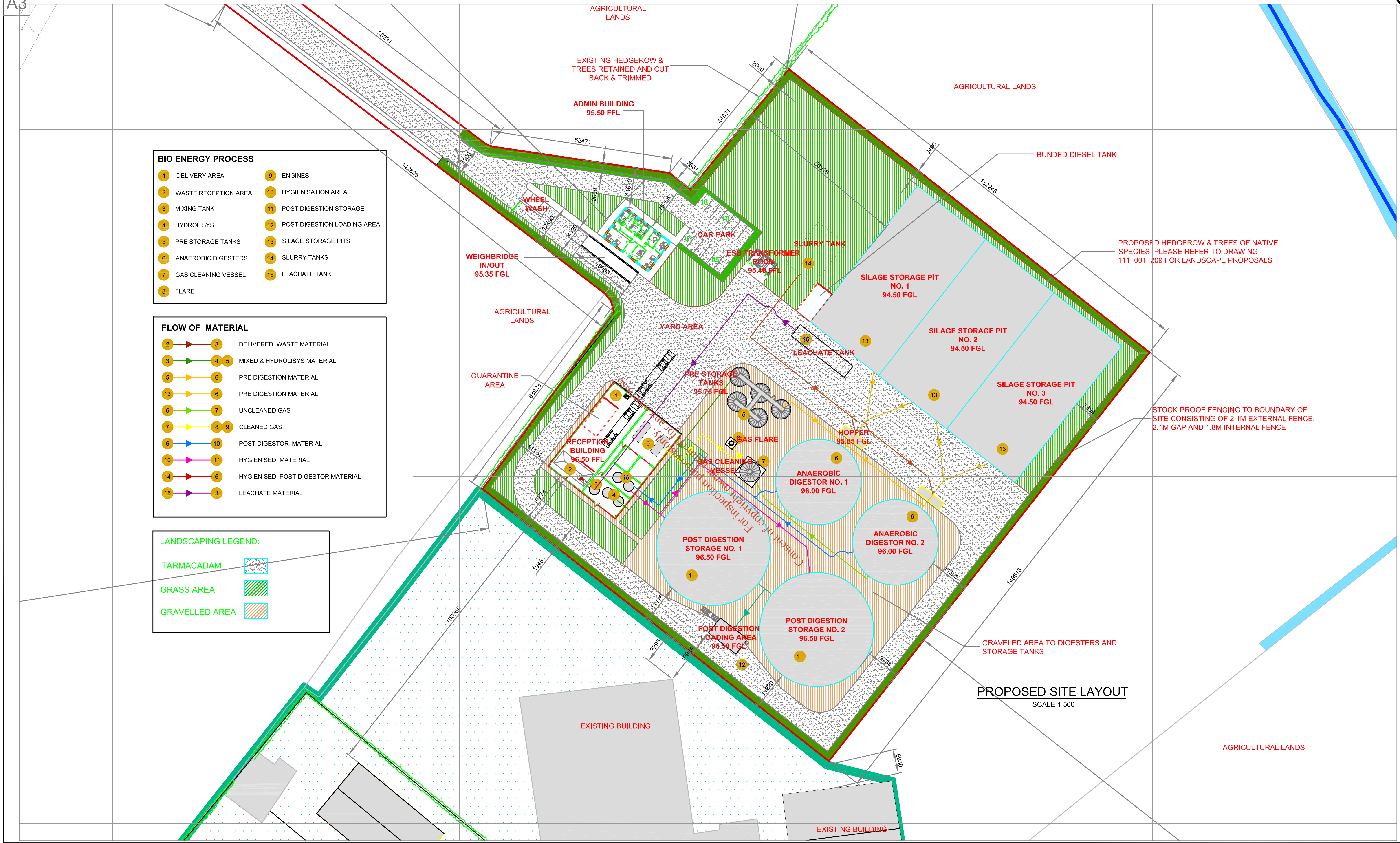
E-MAIL ed.info@bnm.ie



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ON ORIGINAL
0 5 10 15 20 25 30 40 50mm

REV NO:	DATE:	REVISION NOTE:	DWN BY:	CKD BY:
D3	03/11/14	ISSUED TO EPA	BCA	DC

SITE LOCATION

Datum: Malin Head
Grid System: ITM

CLIENT:	BIO AGRIGAS LTD
PROJECT:	PROPOSED BIOENERGY FACILITY AT NEWDOWNS, THE DOWNS, CO.WESTMEATH
TITLE:	SITE LAYOUT

DRAWN:	CHECKED:	APPROVED:	DRAWING NO:	REV:
RN	DC		111_001_801	D3
DATE: JULY 12	SCALE: 1:1000			

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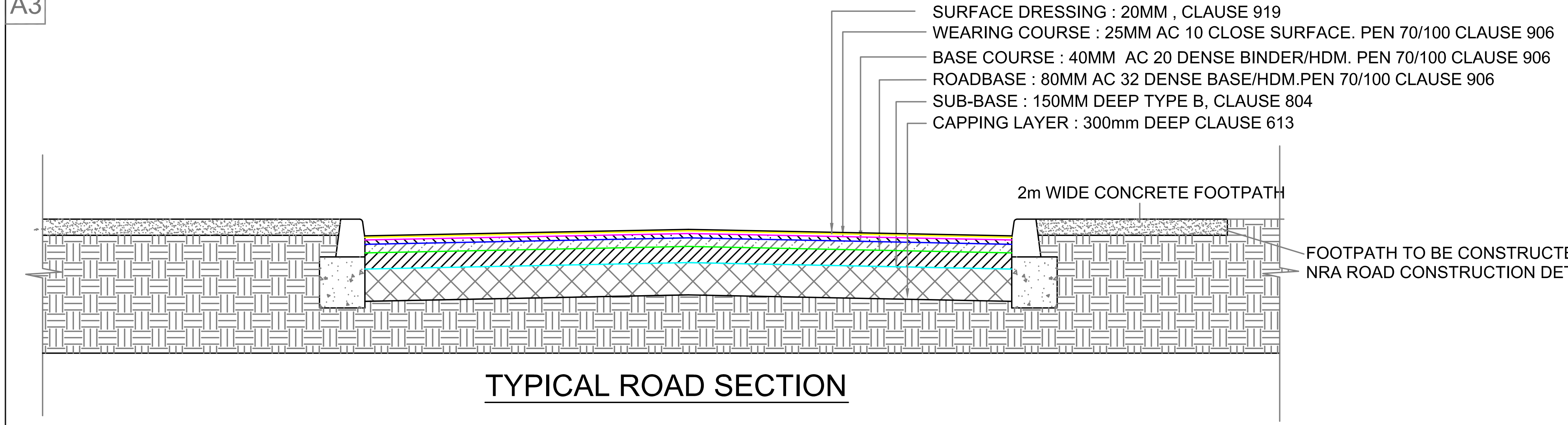
A3

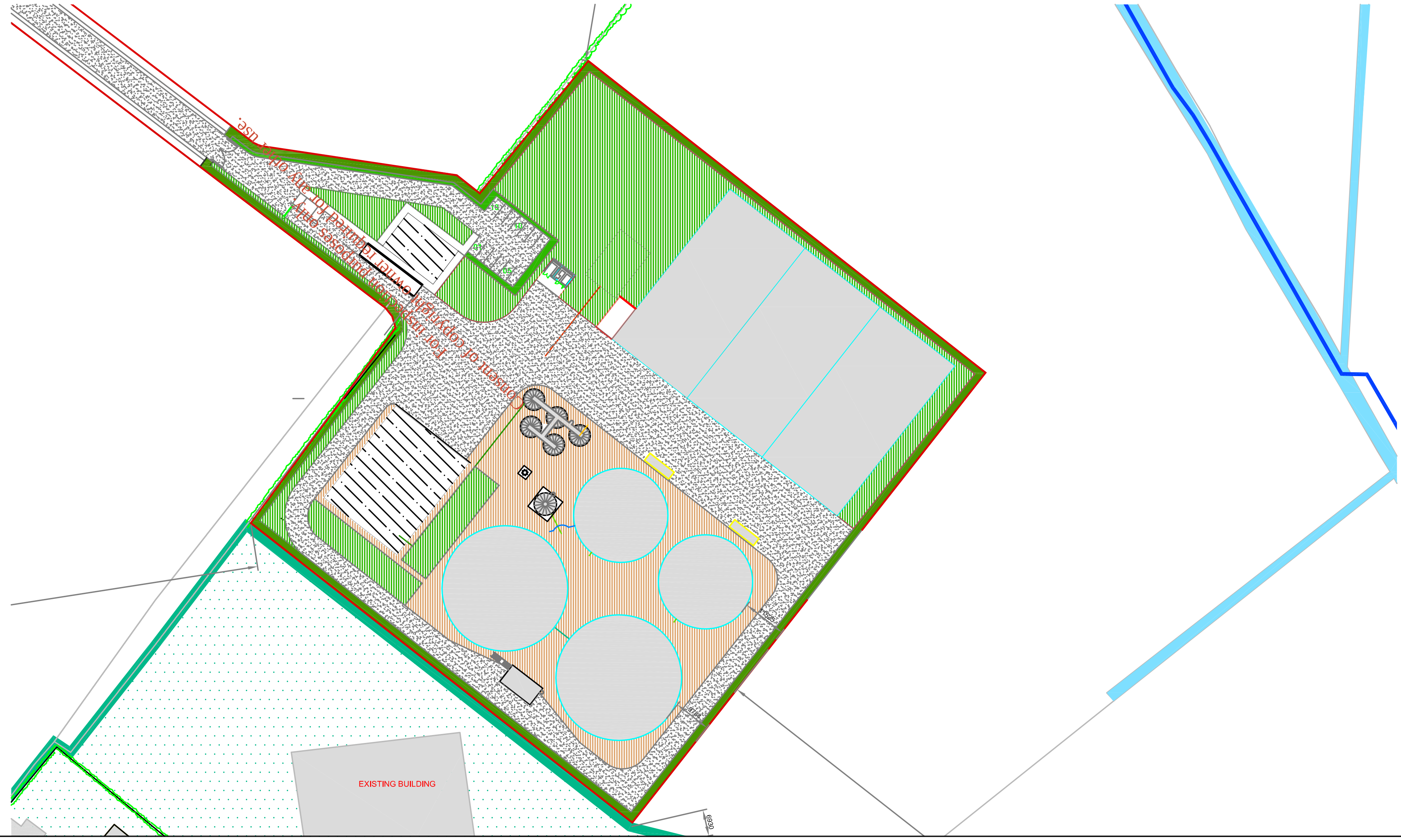


TYPICAL ROAD SECTION

LANDSCAPING LEGEND:

- INTERNAL ROAD
- GRASS AREA
- GRAVELLED AREA
- CONCRETE AREA
- BUILDING

LAYER	DEPTH	MATERIAL TO BS594987:2007	NRA SPECIFICATION
SURFACE DRESSING		DOUBLE SURFACE DRESSING LAYER, 14MM FIRST LAYER 6MM SECOND LAYER STANDARD CATIONIC EMULSION, 1.61/M² AND 0.61/M² FIRST AND SECOND LAYERS RESPECTIVELY. MINIMUM PSV60	CLAUSE 919
WEARING COURSE	25MM	AC 10 CLOSE SURFACE. PEN 70/100	CLAUSE 906
BASE COURSE	40MM	AC 20 DENSE BINDER/HDM. PEN 70/100	CLAUSE 906
ROAD BASE	80MM	AC 32 DENSE BASE/HDM. PEN 70/100	CLAUSE 906
SUB-BASE	150MM	TYPE B	CLAUSE 804
CAPPING	300MM	6F2, CRUSHED ROCK	CLAUSE 613



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REV NO:	DATE:	REVISION NOTE:	DWN BY:	CKD BY:
D2	04/11/12	ISSUED FOR APPROVAL	BCA	DC

SITE LOCATION

Datum: Malin Head
Grid System: ITM

CLIENT:	BIO AGRIGAS LTD
PROJECT:	PROPOSED BIOENERGY FACILITY AT NEWDOWNS, THE DOWNS, CO. WESTMEATH
TITLE:	ROAD MAKE UP
DRAWN:	FMS
CHECKED:	
APPROVED:	
DATE:	JULY 12
SCALE:	
DRAWING NO:	111_001_802
REV:	D2

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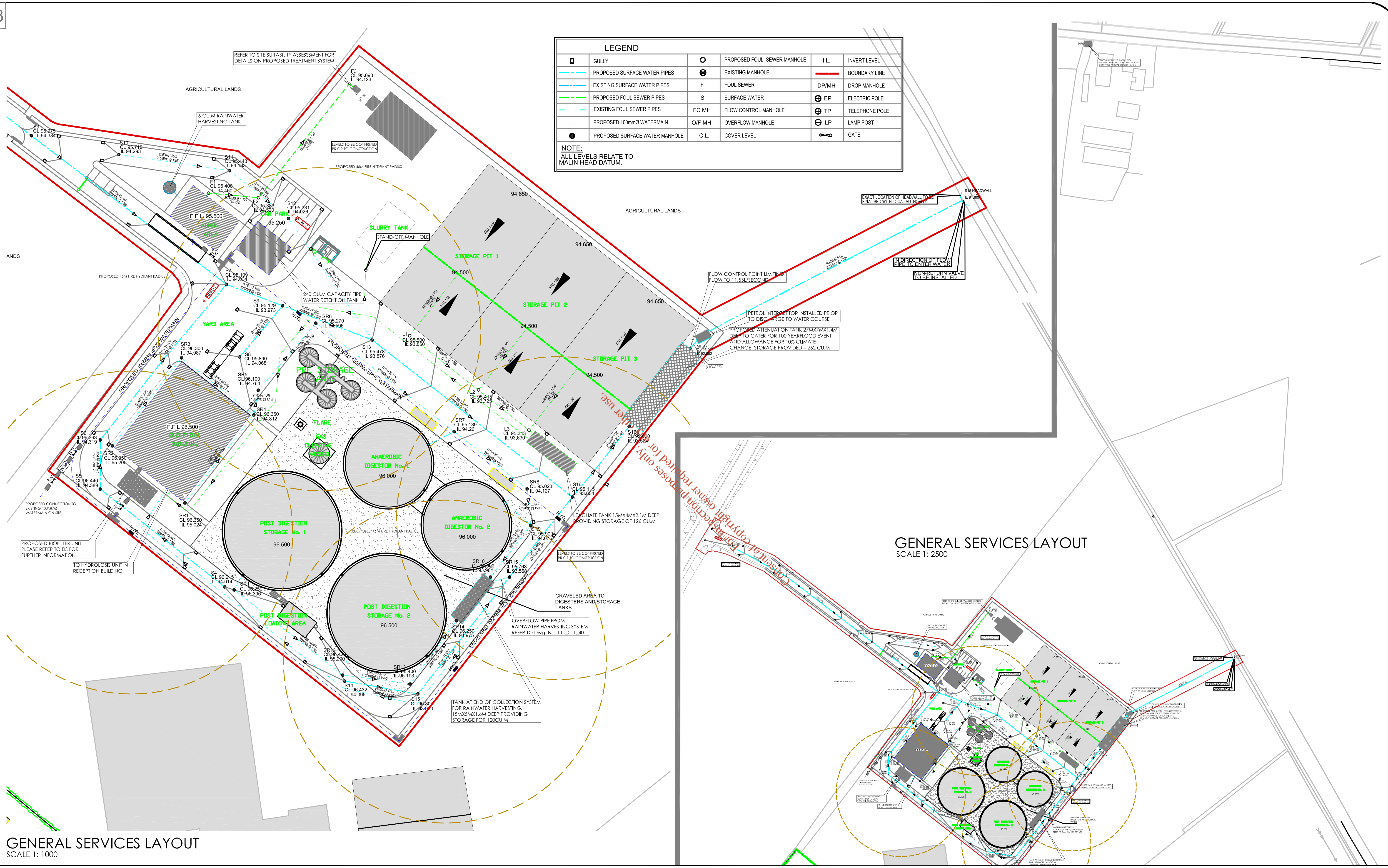
A3



LEGEND

▣	GULLY	○	PROPOSED FOUL SEWER MANHOLE	I.L.	INVERT LEVEL
	PROPOSED SURFACE WATER PIPES	⊖	EXISTING MANHOLE		BOUNDARY LINE
	EXISTING SURFACE WATER PIPES	F	FOUL SEWER	DP/MH	DROP MANHOLE
	PROPOSED FOUL SEWER PIPES	S	SURFACE WATER	⊕ EP	ELECTRIC POLE
	EXISTING FOUL SEWER PIPES	FC MH	FLOW CONTROL MANHOLE	⊕ TP	TELEPHONE POLE
	PROPOSED 100mmØ WATERMAIN	O/F MH	OVERFLOW MANHOLE	⊖ LP	LAMP POST
●	PROPOSED SURFACE WATER MANHOLE	C.L.	COVER LEVEL		GATE

NOTE:
ALL LEVELS RELATE TO MALIN HEAD DATUM.

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ON ORIGINAL
0 5 10 15 20 25 30 40 50mm

REV NO:	DATE:	REVISION NOTE:	DWN BY:	CKD BY:
D3	04/11/14	ISSUED FOR APPROVAL	BCA	DC

SITE LOCATION

Datum: Malin Head
Grid System: ITM

CLIENT:	BIO AGRIGAS LTD
PROJECT:	PROPOSED BIOENERGY FACILITY AT NEWDOWNS, THE DOWNS, CO. WESTMEATH
TITLE:	PROPOSED GENERAL SERVICES LAYOUT
DRAWN: RN	CHECKED: DC
APPROVED:	
DATE: JULY 2012	SCALE: AS SHOWN
DRAWING NO: 111_001_806	REV: D3

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A3

LEGEND

▣	GULLY	○	PROPOSED FOUL SEWER MANHOLE	I.L.	INVERT LEVEL
— - —	PROPOSED SURFACE WATER PIPES	⊖	EXISTING MANHOLE	——	BOUNDARY LINE
— · —	EXISTING SURFACE WATER PIPES	F	FOUL SEWER	DP/MH	DROP MANHOLE
— —	PROPOSED FOUL SEWER PIPES	S	SURFACE WATER	⊕ EP	ELECTRIC POLE
- · -	EXISTING FOUL SEWER PIPES	FC MH	FLOW CONTROL MANHOLE	⊕ TP	TELEPHONE POLE
— —	PROPOSED 100mmØ WATERMAIN	O/F MH	OVERFLOW MANHOLE	⊖ LP	LAMP POST
●	PROPOSED SURFACE WATER MANHOLE	C.L.	COVER LEVEL	⊸	GATE

NOTE:
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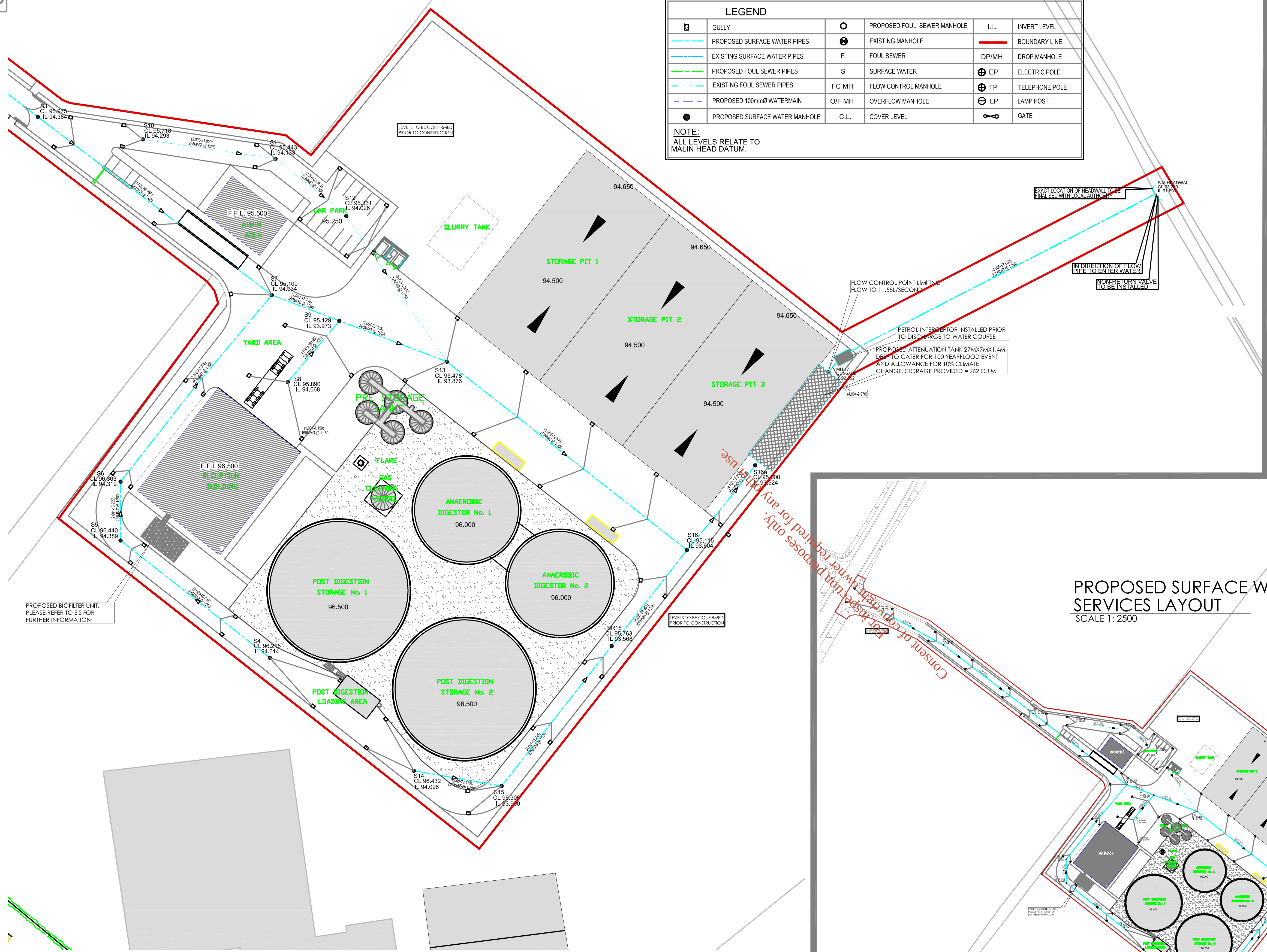
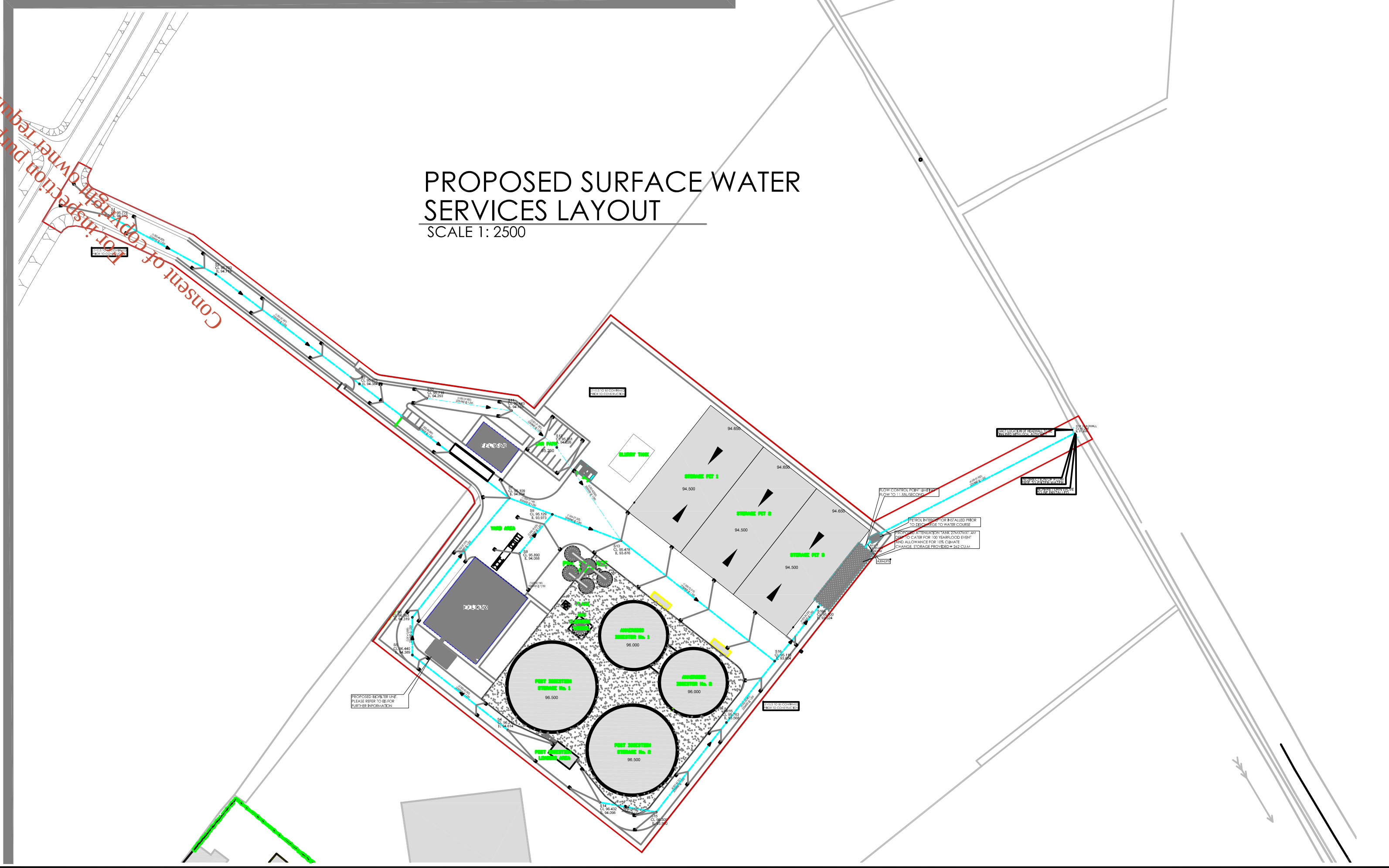


PROPOSED SURFACE WATER SERVICES LAYOUT
SCALE 1: 1000



PROPOSED SURFACE WATER SERVICES LAYOUT
SCALE 1: 2500

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REV NO:	DATE:	REVISION NOTE:	DWN BY:	CKD BY:
D3	04/11/14	ISSUED TO EPA	BCA	DC

SITE LOCATION

Datum: Malin Head
Grid System: ITM

CLIENT:	BIO AGRIGAS LTD
PROJECT:	PROPOSED BIOENERGY FACILITY AT NEWDOWNS, THE DOWNS, CO. WESTMEATH
TITLE:	PROPOSED SURFACE WATER SERVICES LAYOUT
DRAWN: RN	CHECKED: DC
APPROVED:	DRAWING NO: 111_001_807
REV:	D3
DATE: JULY 2012	SCALE: AS SHOWN

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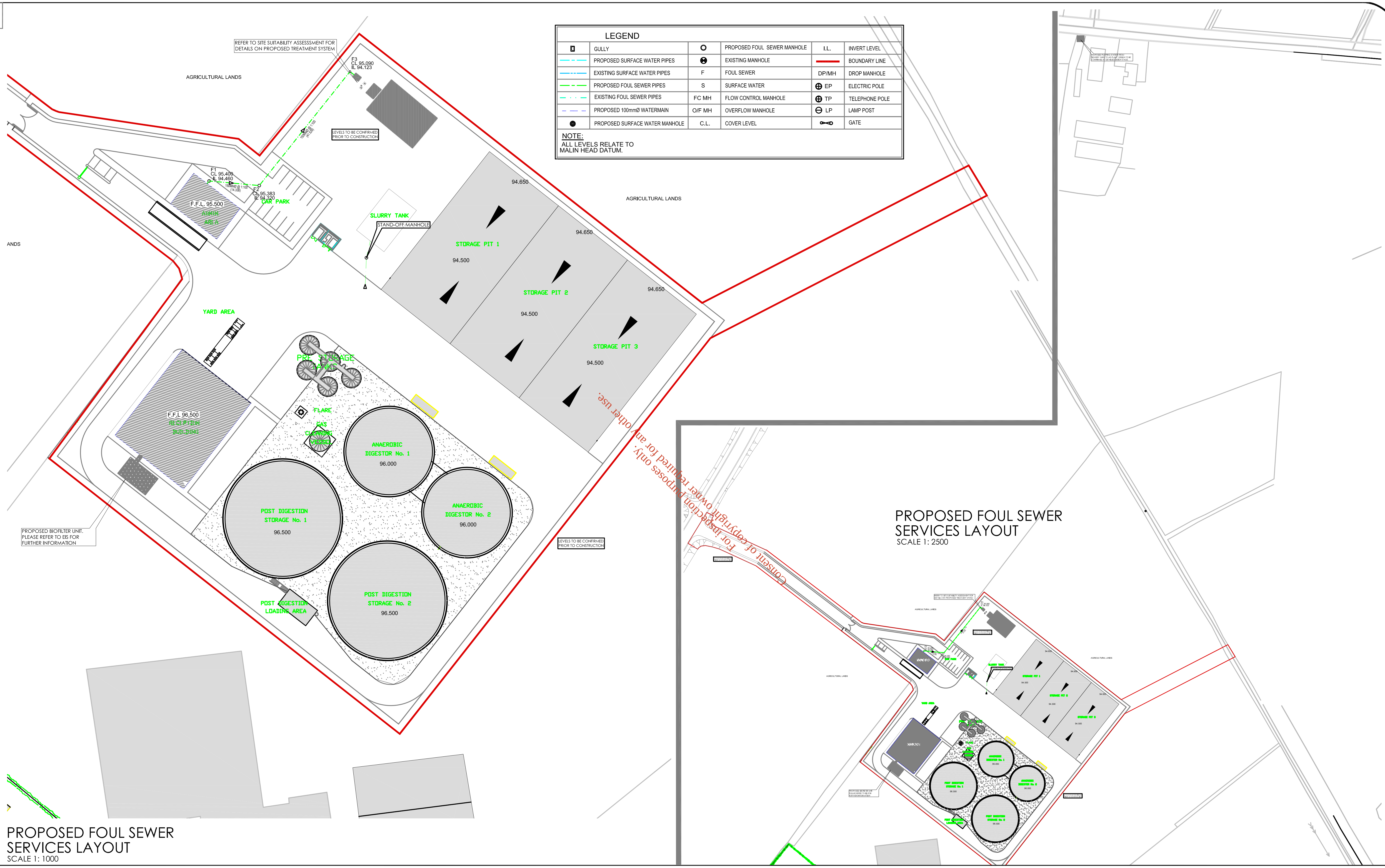

LEGEND

▣	GULLY	○	PROPOSED FOUL SEWER MANHOLE	I.L.	INVERT LEVEL
	PROPOSED SURFACE WATER PIPES	⊗	EXISTING MANHOLE		BOUNDARY LINE
	EXISTING SURFACE WATER PIPES	F	FOUL SEWER	DP/MH	DROP MANHOLE
	PROPOSED FOUL SEWER PIPES	S	SURFACE WATER	⊕ EP	ELECTRIC POLE
	EXISTING FOUL SEWER PIPES	FC MH	FLOW CONTROL MANHOLE	⊕ TP	TELEPHONE POLE
	PROPOSED 100mmØ WATERMAIN	O/F MH	OVERFLOW MANHOLE	⊖ LP	LAMP POST
●	PROPOSED SURFACE WATER MANHOLE	C.L.	COVER LEVEL		GATE

NOTE:
ALL LEVELS RELATE TO MALIN HEAD DATUM.

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ON ORIGINAL
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REV NO:	DATE:	REVISION NOTE:	DWN BY:	CKD BY:
D3	04/11/14	ISSUED TO EPA	BCA	DC

SITE LOCATION

Datum: Malin Head
Grid System: ITM

CLIENT:	BIO AGRIGAS LTD
PROJECT:	PROPOSED BIOENERGY FACILITY AT NEWDOWNS, THE DOWNS, CO. WESTMEATH
TITLE:	PROPOSED FOUL SEWER SERVICES LAYOUT
DRAWN: RN	CHECKED: DC
APPROVED:	
DATE: JULY 2012	SCALE: AS SHOWN
DRAWING NO: 111_001_808	REV: D3

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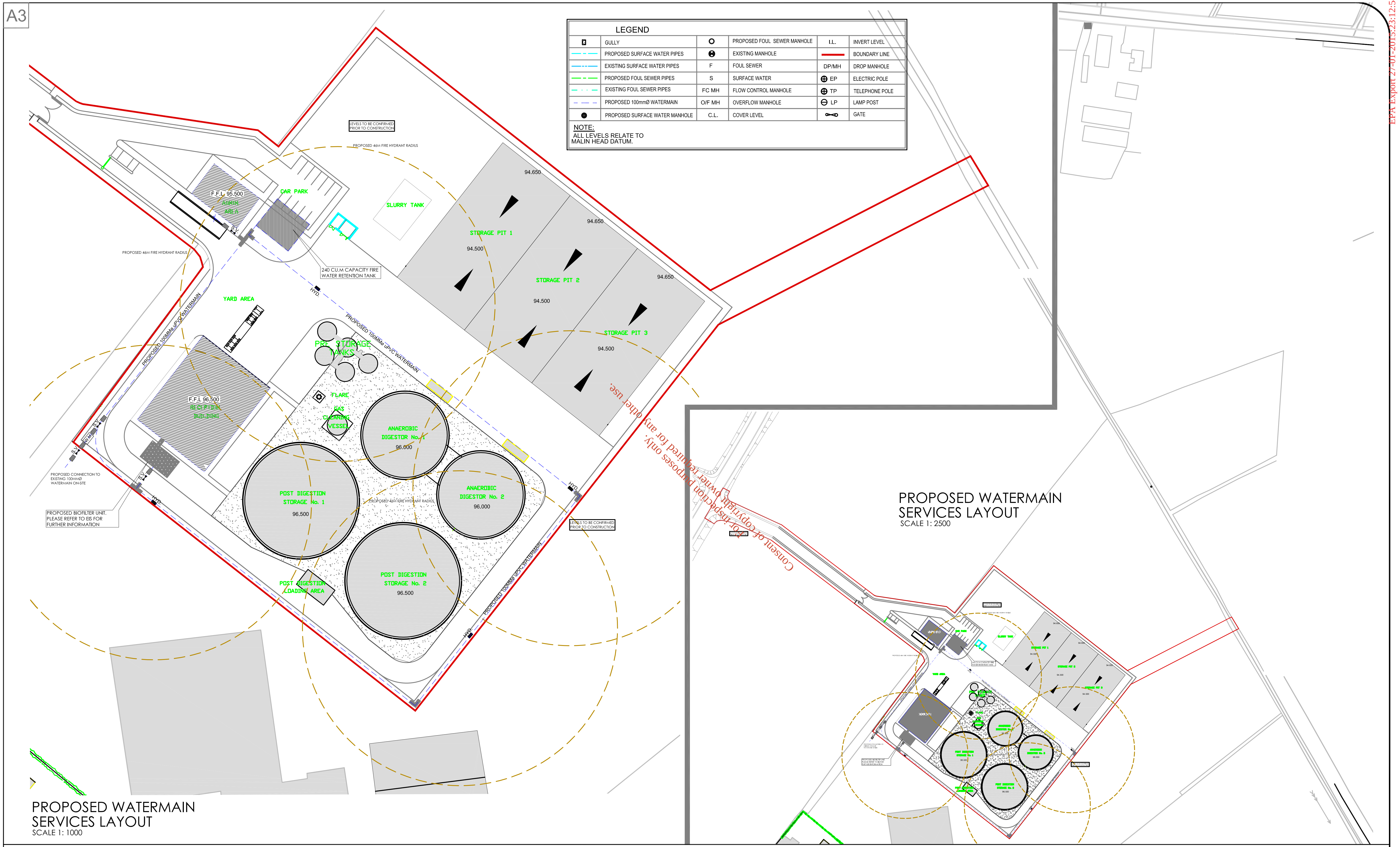

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REV NO:	DATE:	REVISION NOTE:	DWN BY:	CKD BY:
D3	04/11/14	ISSUED TO EPA	BCA	DC

SITE LOCATION

Datum: Malin Head
Grid System: ITM

CLIENT:	BIO AGRIGAS LTD
PROJECT:	PROPOSED BIOENERGY FACILITY AT NEWDOWNS, THE DOWNS, CO. WESTMEATH
TITLE:	PROPOSED WATERMAIN SERVICES LAYOUT

DRAWN:	CHECKED:	APPROVED:	DRAWING NO:	REV:
RN	DC		111_001_809	D3
DATE: JULY 2012	SCALE: AS SHOWN			

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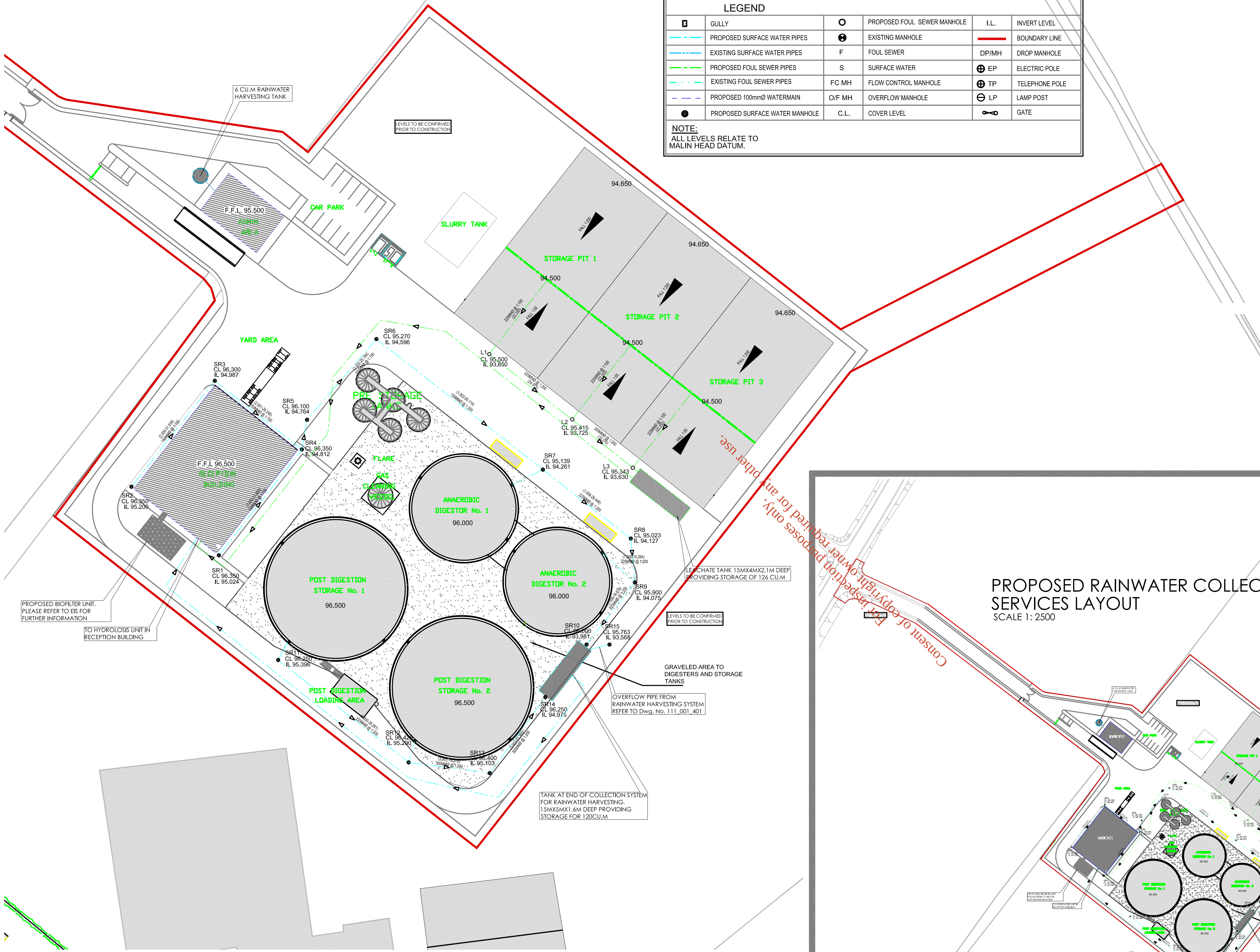
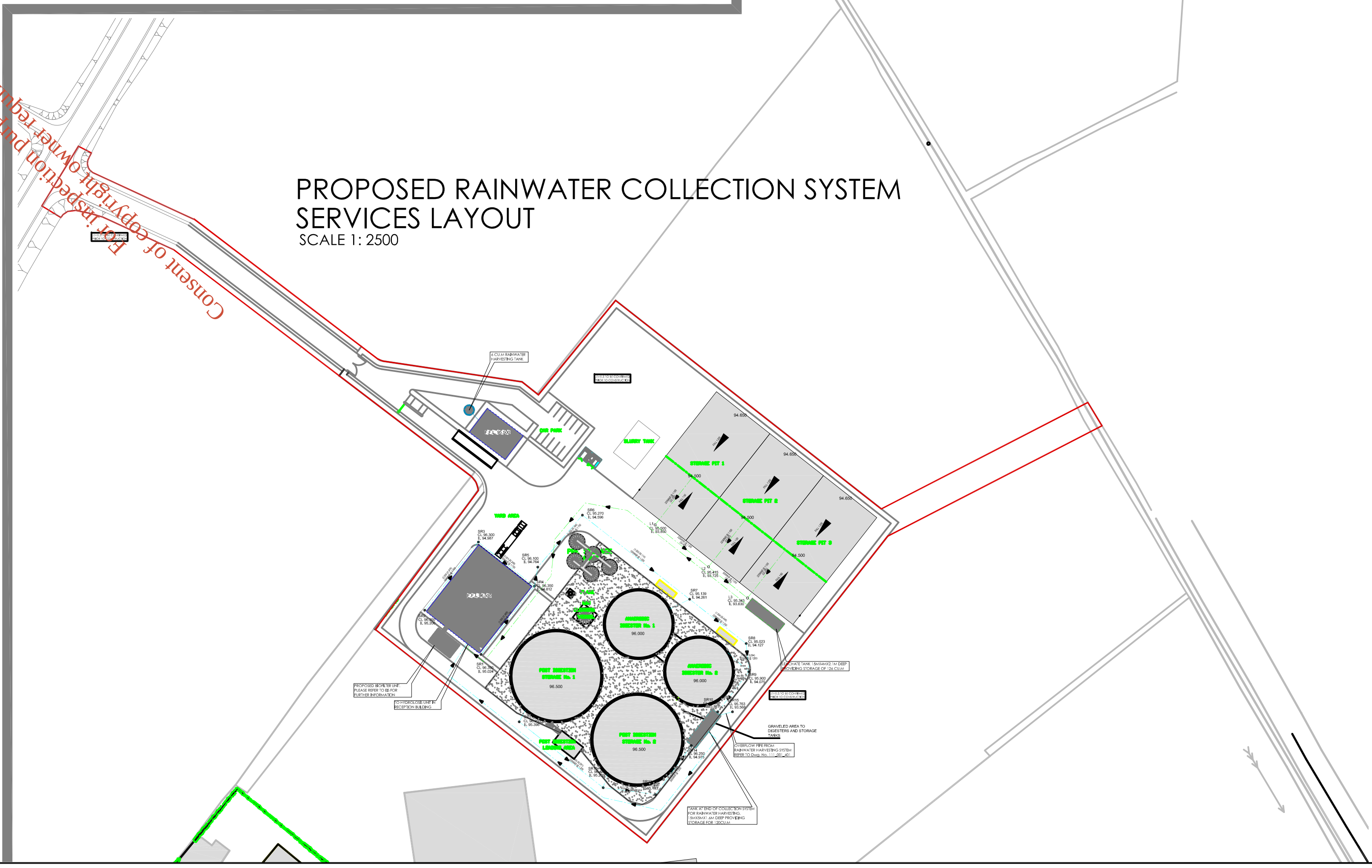


LEGEND

▣	GULLY	○	PROPOSED FOUL SEWER MANHOLE	I.L.	INVERT LEVEL
	PROPOSED SURFACE WATER PIPES		EXISTING MANHOLE		BOUNDARY LINE
	EXISTING SURFACE WATER PIPES	F	FOUL SEWER	DP/MH	DROP MANHOLE
	PROPOSED FOUL SEWER PIPES	S	SURFACE WATER	EP	ELECTRIC POLE
	EXISTING FOUL SEWER PIPES	FC MH	FLOW CONTROL MANHOLE	TP	TELEPHONE POLE
	PROPOSED 100mmØ WATERMAIN	O/F MH	OVERFLOW MANHOLE	LP	LAMP POST
●	PROPOSED SURFACE WATER MANHOLE	C.L.	COVER LEVEL		GATE

NOTE:
ALL LEVELS RELATE TO MALIN HEAD DATUM.

PROPOSED RAINWATER COLLECTION SYSTEM
SERVICES LAYOUT
SCALE 1: 1000



PROPOSED RAINWATER COLLECTION SYSTEM
SERVICES LAYOUT
SCALE 1: 2500

DRAFT

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ON ORIGINAL
0 5 10 15 20 25 30 40 50mm

REV NO:	DATE:	REVISION NOTE:	DWN BY:	CKD BY:
D3	04/11/14	ISSUED TO EPA	BCA	DC

SITE LOCATION

Datum: Malin Head
Grid System: ITM

CLIENT:	BIO AGRIGAS LTD
PROJECT:	PROPOSED BIOENERGY FACILITY AT NEWDOWNS, THE DOWNS, CO. WESTMEATH
TITLE:	PROPOSED RAINWATER COLLECTION SYSYEM SERVICES LAYOUT

DRAWN:	CHECKED:	APPROVED:	DRAWING NO:	REV:
RN	DC		111_001_810	D3
DATE: JULY 2012	SCALE: AS SHOWN			

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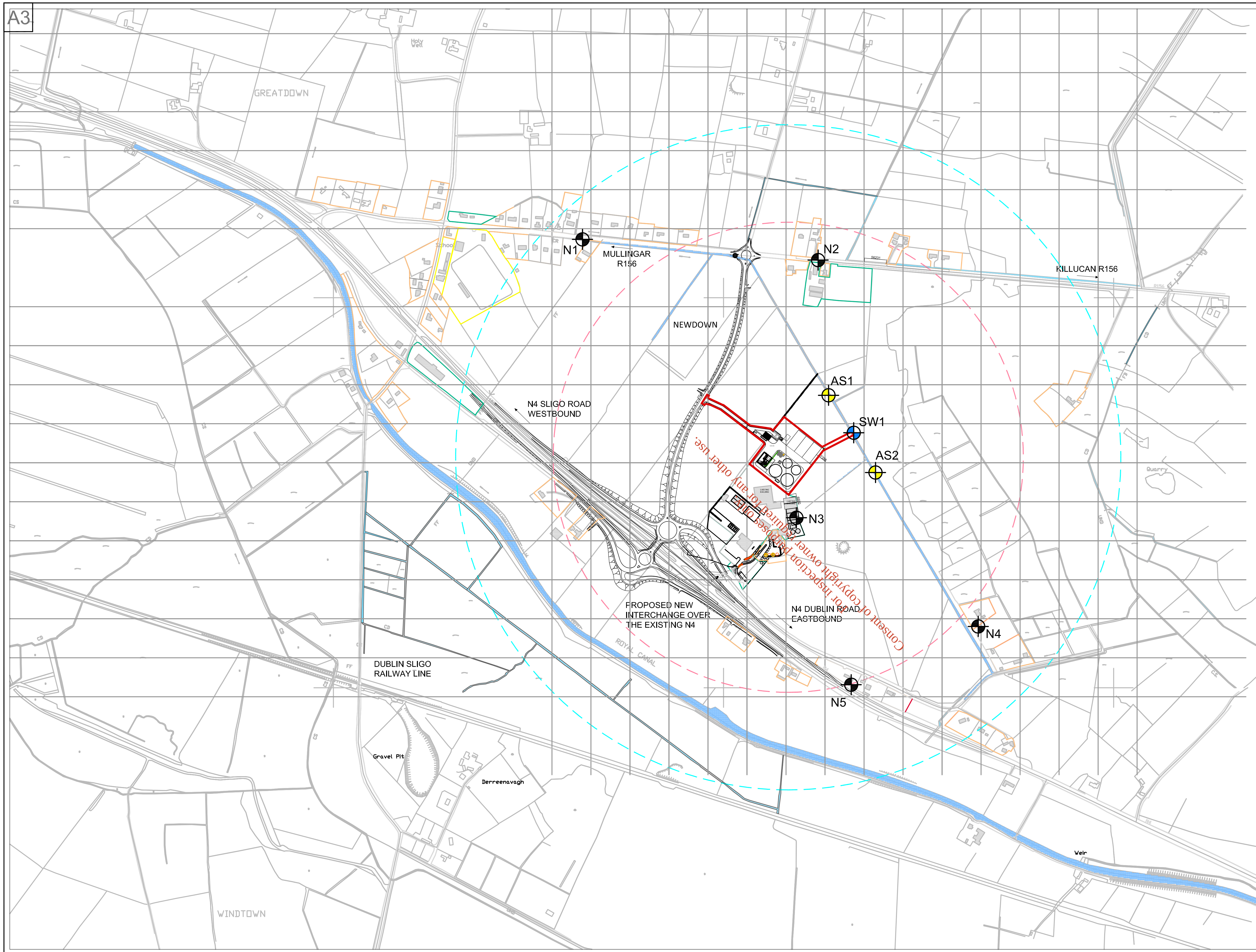
ISO 9001:2000 QUALITY ASSURED COMPANY

A3



NOISE MONITORING LOCATIONS	GRID REFERENCE
N1	X= 250660 , Y= 251154
N2	X= 251260, Y= 251092
N3	X= 251160, Y= 250434
N4	X= 251660, Y= 250177
N5	X= 251360, Y= 249977

SURFACE WATER LOCATIONS	GRID REFERENCE
SW1	X= 251342, Y= 250677

AMBIENT MONITORING LOCATIONS	GRID REFERENCE
AS1	X= 251269, Y= 250758
AS2	X= 251398, Y= 250538

DRAFT

Figured dimension only to be taken from this drawing.
All dimensions to be checked on site.
Consultants to be informed immediately of any discrepancies before work proceeds.

ON ORIGINAL
0 5 10 15 20 25 30 40 50mm

REV NO:	DATE:	REVISION NOTE:	DWN BY:	CKD BY:
D2	04/11/14	ISSUED FOR APPROVAL	BCA	DC

SITE LOCATION

Datum: Malin Head
Grid System: ITM

CLIENT:	BIO AGRIGAS LTD
PROJECT:	PROPOSED BIOENERGY FACILITY AT NEWDOWNS, THE DOWNS, CO. WESTEMATH
TITLE:	NOISE MONITORING LOCATIONS & SURFACE WATER LOCATIONS

DRAWN:	CHECKED:	APPROVED:	DRAWING NO:	REV:
RN	DC		111_001_812	D2
DATE: JULY 2012	SCALE: 1:10000			

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OTHER EMISSIONS LOCATIONS	GRID REFERENCE
A2-1	X= 251122 , Y= 250587
A2-2	X= 251121, Y= 250585
A2-3	X= 251094, Y= 250567

DUST MONITORING LOCATIONS	GRID REFERENCE
D1	X= 251165, Y= 250508
D2	X= 251244, Y= 250614
D3	X= 251160, Y= 250684
D4	X= 251075, Y= 250577

GROUND WATER LOCATIONS	GRID REFERENCE
GW1	X= 251094, Y= 250677

DRAFT

ON ORIGINAL
0 5 10 15 20 25 30 40 50mm

REV NO:	DATE:	REVISION NOTE:	DWN BY:	CKD BY:
D2	10/11/2014	ISSUED TO EPA	BCA	DC

SITE LOCATION

Datum: Malin Head
Grid System: ITM

CLIENT:	BIP AGRIGAS LTD
PROJECT:	PROPOSED BIOENERGY FACILITY AT NEWDOWNS, THE DOWNS, CO. WESTMEATH
TITLE:	AIR/EMISSION & DUST MONITORING LOCATIONS
DRAWN: RN	CHECKED: DC
APPROVED:	
DRAWING NO: 111_001_821	REV: D2
DATE: JULY 2012	SCALE: AS SHOWN

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DRAFT

Figured dimension only to be taken from this drawing.
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ON ORIGINAL

REV NO:	DATE:	REVISION NOTE:	DWN BY:	CKD BY:
D1	10/11/14	ISSUED TO EPA	BCA	DC

SITE LOCATION

Datum: Malin Head
Grid System: ITM

CLIENT:	BIO AGRIGAS LTD
PROJECT:	PROPOSED BIOENERGY FACITITY AT NEWDOWNS, THE DOWNS, CO.WESTEMATH
TITLE:	SURFACE WATER DISCHARGE ROUTE TO RIVERSTOWN RIVER

DRAWN:	CHECKED:	APPROVED:	DRAWING NO:	REV:
BCA	DC		111_001_822	D1
DATE: NOV 2014	SCALE: NTS			

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