Article 16 (1)(a)(i) Further Information

Waste Licence Review No. W0140-04

Prepared For: -

Nurendale Ltd T/a PANDA Waste Services,
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Navan,
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1. INTRODUCTION

This is the response by Nurendale Ltd, trading as PANDA Waste Services (PANDA), Rathdrinagh, Beauparc, Navan, County Meath, to the Notice issued under Article 16(1)(a)(1) of the Waste Management Licensing Regulations, dated 27th October 2011, in relation to Application Register No. W0140-04 for the Materials Recovery Facility at Rathdrinagh, Beauparc, Navan, County Meath.

Section 2 contains the responses to the Agency's requests. For ease of interpretation each of the requests are presented in italics followed by PANDA's response.

2. ARTICLE 16 COMPLIANCE REQUIREMENTS

1. *Section 1.2, Appendix 2 of the application states that an emergency flare bums the surplus biogas from the biological treatment facility. Additional information supplied to the Agency on 8 September 2011 states that biogas will be fed into three gas powered electricity generators and the associated air emission points A2-3, A2-4 arid A2-5 have been identified on drawing number 3 revision C at the CHP unit. The dispersion modeling assessment supplied to the Agency on 21 April 2011 also states that A3, A4 and A5 are the emission points from the CHP gas engines.*

   - *Confirm whether air emissions will be generated from three gas engines and a gas flare as part of the overall operation of the CHP plant.*

     The reference to three gas powered generators in the information supplied on the 8th September was an error. There will be two (2 No.) gas powered generators (gas engines) and one (1No) gas flare. The two gas engines and the flare a will not run concurrently. The flare is provided as a backup when the engines are not available to combust the gas, i.e. during commissioning.

     Drawing No 3 Rev C, dated 6th May 2011 shows the relevant emission points: - A2-5 for gas engine No 1, A2-4 for gas engine No. 2 and A2-3 for the Gas Flare. A copy of the Drawing is enclosed.

   - *Update all associated drawings with the correct number of air emission reference points (including the gas flare).*

     The correct references for the emission points are shown on Drawing No 3 RevC.

   - *Update all applicable parts of the application including sections B, F and I and the air dispersion modeling report to ensure all current aspects of the application are addressed. In that regard, state why the gas flare was not included in the air dispersion modeling and revise the model accordingly and as appropriate.*

     The flare was not included in the air quality impact assessment for the following reasons:

     a) The flare will only run in case of gas engine shutdown during servicing, which will be less than 2% of an operating year. The flare is not likely to run under any other circumstance.

     b) When the flare is in use, one gas engine will be operational. The levels of Oxides of nitrogen, Sulphur dioxide and Carbon monoxide in the emission will be approximately 20% of the emission limit values (ELV) set for the emissions from the gas engine and will be as follows:

Carbon monoxide = 50 mg/Nm^3 ref 3% O_2
Oxides of nitrogen = 150 mg/Nm^3 ref 3% O_2.

Since the emissions from the flare are lower than the gas engine, and taking into account that the dispersion model is based on the two gas engines operating 24/7/365, the model address the worst case for air quality impact.

c) This source is therefore considered negligible and worst case air quality impact has already being account for in the presented results.

2. *Clarify how excess heat generated by the combined operation of the CHP plant and biomass boiler that is not required for the operation of the biomass dryer and the biological treatment facility will be handled.*

   Excess heat generated from the CHP plant will be used to heat the percolate for the digesters and in the pasteurisation/drying tunnels when available. Surplus heat may be used in the RDF drum Dryer.

   Excess heat from the biomass furnace will be used to dry the biomass fuel and heat the air to the furnace via the heat exchanger.

3. *Describe the sources and uses of heat and how they interchange/act and are controlled. State whether the CHP and/or biomass boiler are the primary source of heat for the various users of heat at the facility.*

   The biomass furnace is the primary source of heat for the RDF Plant and the CHP Plant is the primary source of heat for the AD/Composting Plant.

   The heat from the biomass furnace will be primarily used to provide a thermal load to the drum dryer. Any surplus heat will be used to dry the biomass fuel and heat the air intake to the furnace.

   The heat from the CHP plant will be primarily used for heating percolate for the digesters, and the pasteurisation/drying tunnels. Surplus heat may be used in the RDF drum Dryer.

   There is no interchange/action between the heat sources. Both systems will be controlled by a SCADA system.

4. *Confirm the thermal rated input (to be expressed in Megawatts) of the CHP plant.*

   The thermal rated input for the CHP Plant is 7.32MW

5. *Confirm if the 'finished compost screening and loading hall' mentioned in section 4.6.1.4 of the odour assessment report is the same area as the 'clean area (finished product)' identified on drawing no. 2009-101-202 and whether air is being extracted from the finished product clean area and being routed to the biotrickling filter for treatment.*

The 'finished compost screening and loading hall' mentioned in section 4.6.1.4 of the odour assessment report is the same area as the 'clean area (finished product)' identified on drawing number 2009-101-202. The air will be routed to the bio trickling filter.

6. *Clarify how it is intended to handle and control the compost after the pasteurisation process.*

   After the pasteurisation process, the compost will be loaded into closed trucks and taken off site via the access road to the north of Building 1, thereby avoiding any incoming waste traffic. Refer to Drawing Number 2009-101-103 of the application.

7. *Clarify the effectiveness of the biotrickling filter in preventing the release of pathogenic organisms to air prior to pasteurisation.*

   The proposed bio-trickling filter is considered BAT for the treatment of air from such facilities. This technology is installed on more than 15 facilities in the Republic, including 6 operating under Waste Licenses, and at least 10 facilities in Northern Ireland. To date, there has been no reported issue with respect to pathogenic organisms from facilities where activities similar to that proposed at this facility (e.g. handling and processing of food waste within an enclosed building) are carried out.

8. *Clarify how it is proposed to mitigate against pathogenic organisms being released to air during the maintenance of the biotrickling filter and in particular during the removal of spent biofilter media.*

   The biofilter is designed with 100% duty and 50% standby capacity. This ensures that the building will be maintained under negative pressure during the replacement of the biofilter media. The media will be kept wet to ensure no dust emissions occur during its removal, which will be done using a vacuum tanker fitted with build in particulate filters. Similar techniques are used to remove media from biotrickling filters treating odorous air in waste water treatment plants located throughout Ireland.

   The media will only have to be removed approximately once every twenty years, due to its nature (inorganic and inert).

9. *Clarify how is it proposed to mitigate against odour and bioaerosol emissions during movement of partially treated waste from the composting tunnels in building 1 if they are used a pre-treatment step prior to transfer to the biological treatment facility in building 4.*

   Partially treated waste from the composting tunnels in Building 1 will be transported to the Building 4 in enclosed trucks, which will mitigate against odours and bioaerosols.

Refuse derived fuel manufacture:

10. *The initial process flow submitted for building 3 stated that the dryer was fuelled by LPG or biomass; however, an updated process flow submitted for building 3 on 8 September 2011 stated that dryer is fuelled solely by biomass.*

    Confirm whether natural gas is a standby fuel for the biomass furnace.

    No standby fuel is required.

11. *Confirm the thermal rated input (to be expressed in Megawatts) of the biomass furnace,*

    The Thermal Rated input of the Biomass Furnace is 8 MW.

12. *Clarify how it is proposed to control heat to and process air from the RDF dryer when the furnace is heating up but is under the required minimum treatment temperature and how this links into the carbon filter air abatement system.*

    The furnace is activated and the RDF dryer brought up to full heat prior to introducing the waste. The system will be controlled by a SCADA system that will include monitoring of the temperature in the furnace.

    The carbon filter will be operated normally and the switch over to the furnace/dryer will only occur when the furnace/dryer are at capacity i.e. capable of dealing with the air from the building.

13. *Confirm whether the RDF will be manufactured to a recognised standard.*

    The RDF manufacturing will have regard to the requirements of CEN 15359 Solid Recovered Fuels Specifications and Classes, but initially it is not the intention to meet the specification requirements. The quality requirements of the end users will determine the quality criteria of the RDF.

General:

14. *Additional information submitted confirmed your intention to install a constructed wetland in 2012. It was also confirmed that the constructed wetland will receive water run-off from the existing yard area for treatment before being discharged to a stream on the facility boundary.*

    - *The application states that discharge to surface water was stopped in 2006 following agreement with the Agency. It has been stated in previous AERs that the stream at the boundary of the facility has been piped. Confirm how it is intended to discharge from the constructed wetland to the piped stream.*

      The discharge from the constructed wetland will be piped to an inspection chamber (SW-1) installed on the culverted stream. The location is shown on Drawing Number PWS/002.

- *Confirm whether you intend to discharge from the constructed wetland to the stream via emission point SW1 specified in Schedule B.2 of the licence.*

  The discharge to the wetland will be via emission point SW1

- *Clarify how you intend to route the discharge from the constructed wetland to the surface water emission point.*

  Drainage pipes will be laid from the outlet of the wetlands to emission point SW1

- *Confirm the location of SWI as drawing no. 3 revision C and drawing number PWS/002 identify SW1 at different locations. Update relevant drawings with the correct location of SW I (surface water emission) in accordance with Schedule B.2 of the licence.*

  The location of emission point SW1 is shown on Drawing No PWS/002

- *Clarify what level of treatment the constructed wetland will provide and state what emission limit values will be achieved.*

  Details of the level of treatment the wetland will provide and the emission limit values that will be achieved are presented in the report prepared by Bartley O'Suilleabhain, which is in Attachment 1.

- *Clarify why run--off from the yard area of the proposed extension is being routed to a soakaway rather than to the constructed wetland.*

  The wet land is not designed to take run-off from building roof and paved areas of the extension. There is no need to direct the run-off to the wetland, as waste handling and storage will not be carried out in the external paved areas. The run-off will pass through a Class I interceptor before discharge to the soakaway.

- *Provide an assessment of the proposed surface water discharge in terms of the requirements of the Environmental Objectives (Surface Waters) Regulations 2009.*

  The objective of the Environmental Objectives (Surface Waters) Regulations 2009 to ensure that water resources of high quality are preserved and that water resources of poor quality are improved.

  The overflow from the wetland will discharge to the culverted land drain at the southern site boundary. The drain flows from west to east and discharges into an unnamed third order stream, which is a tributary of the River Boyne. This stream enters the Boyne at Roughgrange, approximately four kilometres northeast of the facility.

  The tributary and it is not assigned any status under the Water Framework Classification (Ref EPA database on Water Framework Directive). The Boyne is classified as Moderate Ecological Status up and downstream of the confluence with the tributary. The water quality upstream of the confluence is classified as Good.

The current Licence sets the following Emission Limit Values

BOD	5mg/l
SS	25mg/l
Ammonia	1mg/l

The wetland is designed to achieve the following emission levels:

Phosphorous	0.5mg/l
Nitrogen	0.25 mg/l
BOD	5mg/l

It is considered that the discharge from the constructed wetland will have no measurable impact on the water quality in the Boyne, which is 4km from the discharge point and is the nearest water body assigned a Water Framework Status.

- *Provide an assessment of the proposed groundwater discharge in terms of the requirements of the Environmental Objectives (Groundwater) Regulations 2010, as amended.*

The objective of the Regulations is to ensure that groundwater bodies of high quality are preserved and that water bodies of poor quality are improved. The proposed changes to waste activities will not give rise to a direct discharge to groundwater. Run-off from the new paved area at Building 4 will discharge to a soakaway via a silt trap and Class 1 oil interceptor.

The local geological conditions were established by a review of databases maintained by the Geological Survey of Ireland (GSI) and Teagasc, an intrusive investigation carried out in 2009 in the proposed extension area, and the construction logs of two on-site groundwater wells.

The Teagasc soil map indicates that the subsoil is a till derived from Namurian Shales and Sandstones (TNSSs). The site investigation confirmed the subsoils comprise a brown clay to approximately 1m, which is underlain by a grey/black clay. The groundwater well logs indicate that the subsoils are at least 10-12m deep.

The site is underlain by the Balrickard Formation, which is described by the GSI as coarse sandstone, shale and is classified as a bedrock aquifer that is generally unproductive except for local zones (Pl). The Vulnerability Map for Meath indicates that the vulnerability at the site is Low, which is supported by the available data on the thickness of the subsoils (≥10m).

The pave open areas, from where the run-off will be generated, will not be used to store or process any waste or hazardous materials. The only potential contaminants will be minor oil leaks from vehicles that will travel across the yard.

The rainwater water run-off from the paved areas will pass through a silt trap and oil interceptor before discharging to the soakaway. The type and thickness of the subsoils will effectively mitigate any impact associated with the discharge.

15. *Clarify whether the land proposed to facilitate the construction of the biological treatment facility is owned by Panda Waste Services Ltd.*

The land is not owned by the applicant. Details of the landownership are provided in Section B1 of the application.

16. *Clarify the current status of operations/construction at the facility.*

Building 1

The operation of the composting tunnels, which involved pre-treatment of mixed MSW in Building 1, has been suspended. Timber shredding and plaster board processing has been moved to Building 1. The OEE have been informed of these changes.

Building 2

There has been no change to activities carried out in Building 2.

Building 3

Processing of the 'lights fraction' recovered from Building 2 to produce wet RDF. OEE have approved this process.

3. NON TECHNICAL SUMMARY

Introduction

Nurendale Ltd., trading as Panda Waste Services Ltd. (PANDA) is applying to the Environmental Protection Agency (Agency) for a review of the current Waste Licence (Reg. No. W0140-03) for its waste processing facility at Beauparc, Navan, County Meath. The objectives of the review are: -

- To extend the licence area to include a new building (Building 4), which will house a biological treatment system. The system, which is a combination of anaerobic digestion and composting, will treat organic waste to produce compost. Gases produced during the digestion stage will be used as a fuel to generate electricity and heat, which will be used at the facility and sold to electricity supply companies;
- To allow the processing of household and commercial waste to recover materials, for example paper and plastic, that are can be used as a fuel, for example in cement manufacturing. These materials are called Refuse Derived Fuel (RDF);
- To amend Condition 1.5.3 of the current licence to allow the continuous operation of the biological treatment and RDF manufacturing systems;
- To amend Condition 8.6 to allow the continued operation of the construction and demolition waste processing plant in a dedicated open area.

Nature of the Facility

The facility only accepts non-hazardous wastes, which are processed to recover wastes that are suitable for recycling and to reduce the amount sent to landfill. At present there are two main buildings (Building 1 and Building 2) used for waste processing. A third building, Building 3, will accommodate the RDF system. It is proposed to construct a new building, Building 4, to accommodate the biological treatment system.

Classes of Activity

It is not proposed to change the type of waste activities, as defined in Third and Fourth Schedules of the Waste Management Acts 1996 – 2008, that are carried out. These are:-

Third Schedule – Waste Disposal Activities

Class 12

"Repackaging prior to submission to any activity referred to in the preceding paragraph of this Schedule".

Class 11

"Blending or mixture prior to submission to any activity referred to in a preceding paragraph of this Schedule".

Class 13

"Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced".

Fourth Schedule – Waste Recovery Activities

Class 2

"Recycling or reclamation of organic substances which are not used as solvents, (including composting and other biological processes)".

Class 3

"Recycling or reclamation of metals and metal compounds".

Class 4

"Recycling or reclamation of other inorganic materials". (p)

Class 11

"Use of waste obtained from any activity referred to in a preceding paragraph of this Schedule".

Class 13

"Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where such waste is produced".

Quantity and Nature of the Waste to be Recovered or Disposed

There will be no change to the types and quantities of waste that are authorised by the current Licence. These are shown in Table 6.1.

Table 3.1 Waste Types and Quantities

WASTE TYPE	MAXIMUM (TONNES PER ANNUM) (Note 1)
Household waste	35,000
Commercial & Industrial	75,000
Construction and Demolition	120,000
Compostable	20,000
TOTAL	**250,000**

Note 1: The quantities of the different categories referred to in this table may be amended with the agreement of the Agency provided that the total quantity of waste specified is not exceeded.

Raw and Ancillary Materials, Substances, Preparations used on the Site

Diesel, lubricating oil and hydraulic oil are used in the waste processing equipment. Electricity is used to power some of the processing equipment and also in the offices and yard lighting. Drinking water is taken from the County Council mains. Groundwater from an on-site well, which is stored in a tank, is used to damp down the yards during dry weather so as to prevent dust.

Plant, Methods, Processes and Operating Procedures

The biological treatment system includes a series of fully enclosed tanks, called digesters, in which the wastes will be initially treated. At the start of the process, the oxygen in the air in the digesters will be used up by the microbes in the waste to produce anaerobic (no oxygen) conditions.

The microbes will break down the waste and, in the process, produce a number of different gases (biogas). The most common gas will be methane, which can be used as a fuel to generate electricity. The biogas will be cleaned (scrubbed) to remove contamination and fed into two gas powered electricity generators. The electricity from the generators will be supplied to the national electricity grid. A stand-by gas flare will be provided and will be used to burn the gas when the generators are being serviced.

The digesters will reduce the amount of organic material in the wastes. The waste will then be moved to the composting area, where the wastes will be composted in fully enclosed containers called tunnels. Air will be supplied to the tunnels to ensure that oxygen levels are kept at the level needed to complete the composting.

When the composting process is complete, the material will pasteurised using a high heat to ensure that all the microbes have been killed. This stage is required to meet the conditions set by the Department of Agriculture Fisheries and Food for the treatment of wastes containing meat and fish. The final product may be sold to farmers, market gardeners and landscape contractors and the general public. PANDA will also investigate alternative uses for the product.

Unprocessed household and commercial wastes contain water, in some cases up to 40% by weight, which affects the quality of the materials for use as fuel. The most favourable moisture content is around 15%, and therefore it is necessary to dry the wastes. It is proposed to dry the processed wastes in an air dryer in Building 3. The wastes will be placed inside a drying drum and the drum heated using a biomass fired furnace and heat from the on-site gas powered electricity generators.

Information Related to paragraphs (a) to (g) of Section 40 (4) of the Waste Management Acts 1996 2003.

The actual and potential emissions associated with the new waste activities include noise, dust, odour, trade effluent and rainwater run-off will not breach any applicable legal standard or emission limit. Trade effluent, which includes water from washing down the floors of the buildings, is collected and stored in a tank before being taken to the Council's Navan Sewage Treatment Plant.

The proposed site activities take into consideration the Best Available Technique (BAT) Guidance Note for the Waste Sector: Waste Transfer Activities published by the Agency and when carried out in accordance with the new Licence conditions, will not cause environmental pollution. It is not proposed to amend the current Management Team.

On 15th September 2009 Nurendale Ltd. was convicted at Navan District Court of an offence under the Waste Management Act for a breach of its previous Licence (W0140-02) relating to taking in more waste than approved under the licence. The current Licence (W0140-03), which was granted in March 2009, allows the acceptance of 250,000 tonnes per annum.

Emissions

Surface Water

Rainwater run-off from the existing concrete yards is collected in an underground tank and stored before being sent off-site for treatment. PANDA already has approval to change the drainage system to channel the water to a new reed bed, which will be installed in 2012. Rainwater from the roof of Building 4 will be collected in a tank and used at the site for spraying the yards to keep dust down. This tank is topped up with rainwater run-off collected in an underground storage tank. Rainfall on the new concrete yards will be collected and passed through an oil interceptor and into a soakaway.

Sanitary Wastewater

Sanitary and canteen wastewater is collected and treated in an on-site sewerage treatment plant. The treated wastewater goes to a percolation area. There will be no new sources of sanitary wastewater and the treatment plant has the capacity to cope with the estimated 15 new people that will work in Buildings 3 and 4.

Process Wastewater

Floor washings from Buildings 1 and 2 and water from the truck wash is collected in an underground tank and sent to the Council's Navan treatment plant. Additional wastewater will be produced in the biological treatment process. Much of this can be reused in the process, but any surplus will be sent to the Navan treatment plant.

Groundwater

The only emissions to ground are the treated sanitary wastewater from the on-site treatment plant and rainwater run-off from the new concrete yards. The rainwater will pass through silt traps and an oil interceptor before it enters the soakaway.

Dust

The main source dust emissions with the potential to cause a nuisance are vehicle movements over the concrete yards in dry weather and the Construction and Demolition Waste processing area. The new waste activities are also sources of dust, but these will be carried out inside the buildings, which will effectively prevent dust causing a nuisance.

Odours

A number of the different household and commercial wastes processed at the facility contain materials (for example foodstuff) that are a source of strong odours. The biological treatment and the manufacture of RDF are also sources of malodours. All odorous wastes are handled inside the buildings and are not processed or stored in open areas.

The existing composting tunnels are provided with an odour control system, which draws air from the tunnels into what is called a biofilter, where the substances that form the odours are removed. Building 3 and Building 4 will be provided with separate odour management systems designed to ensure that odours from the buildings will not be a cause of nuisance.

Air

The electricity generators, gas flare and the biomass furnace will be will be new emissions sources. The emissions will consist of combustion gases from the biogas and biomass fuels.

Noise

The noise sources include the Construction & Demolition waste processing, equipment operating inside the buildings and truck and car movements.

Assessment of the Effects of the Emissions

Surface Water

The proposed changes will not result in any new emissions from the site to adjoining or nearby streams. Rainfall on the concrete yards can become contaminated with silt and small quantities of oil that may leak from vehicle oil sumps. The rainwater run-off from the yards will pass through silt traps and interceptors, which will reduce the contamination to acceptable levels, before it enters either the new reed beds, or soakaway.

Sanitary Wastewater

The existing on-site sanitary wastewater treatment plant has the capacity to handle has the capacity to cope with the estimated 15 new people that will work in Buildings 3 and 4.

Process Wastewater

The biological treatment plant will produce a wastewater. Much of this will be reused in the process and any surplus will be collected and sent to the Navan sewage treatment plant.

Groundwater

There are no direct emissions to groundwater. Treated sanitary wastewater goes to a percolation area. The treatment plant is operating satisfactorily and has the capacity to handle the expected additional staff. Rainwater from the concrete yards will pass through silt traps and an oil interceptor before entering the on-site soakaway or reed beds. This will minimise the risk of groundwater contamination.

Dust

There are water mist sprays in Building 1 and 2 which effectively control dust emissions. The odour control systems that will be provided in Buildings 3 and 4 will also effectively control dust. The open yard areas are and will continue to be dampened down during dry weather. The dust monitoring carried out at the site has confirmed that current operations are not a source of dust nuisance.

Odours

The odour control system in Building 3 will involve the collection of air from inside the building and directing it to a biofilter. This system is broadly similar to the only that has successfully operated at the existing tunnels.

The control system in Building 4 will involve the collection of air inside the building and directing it to the biomass furnace, where the air will be subjected to high temperatures to reduce the levels of the odorous substances. A computer model assessment of the odour impacts has confirmed that the emissions from Buildings 3 and 4 will not be a cause of odour nuisance.

Air

The emissions from the generators and the biomass furnace will comply with the conditions set in the Licence. A computer model assessment of the emissions has shown that they will not cause environmental pollution.

Noise

Noise monitoring at the facility has consistently shown noise emissions measured at the nearest noise sensitive locations below the emission limit specified in the existing licence.

Nuisances

Birds can be attracted to sites where there is available foodstuff. The wastes accepted at the site include some foodstuff. All wastes that have the potential to contain food stuff are and will be processed and stored inside the building. This has already been found to eliminate bird attraction.

Monitoring and Sampling Points

The construction on Building 4 means that one of the current noise monitoring and dust monitoring points along the eastern boundary will be lost. It is proposed to replace these with alternative monitoring points, which will be located further to the east.

Prevention and Recovery of Waste

The aim of the Licence Review is to increase PANDA's recycling rates and reduce the amounts of waste sent to landfill.

Off-site Treatment or Disposal of Solid or Liquid Wastes

The new waste activities will not result in any changes to the types or method of off-site disposal of solid and liquid wastes. The Refuse Derived Fuel will be sent to off-site facilities for use as a fuel and this is classified as a recovery activity. The materials from the composting tunnels in Building 1 may be sent off-site for further treatment

Emergency Procedures to Prevent Unexpected Emissions

PANDA has prepared an Emergency Response Procedure for the facility, which sets out the actions to be taken in an emergency.

Closure, Restoration and Aftercare of the Site

The proposed changes to the current Licence will not affect the measures for the closure, remediation and aftercare of the facility.

ATTACHMENT 1

STORMWATER CONSTRUCTED WETLAND DESIGN

FINAL REPORT

06047

Prepared for:

PANDA WASTE SERVICES

1850-65 65 65

Prepared by:

Bartley & óSúilleabháin
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06047 Iuil 2006

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Project No:	06047
Report Title:	Panda Waste Constructed Wetland Design
Report Status:	FINAL
Date:	14 June 2006
Prepared by:	Dr. Pamela Bartley
Reviewed by:	Dr. Cormac Ó Súilleabháin

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Abbreviations

BOD	Biochemical Oxygen Demand
BÓS	Bartley & O'Suilleabhain Environmental Engineering
cm/d	centimetres per day
HLR	Hydraulic Loading Rate
mm/hr	millimetres per hour
m	metres
m^2	metres squared (area)
m^3	cubic metres (volume)
m bgl	metres below ground level
m/yr	metres per year
NH_4-N	Ammonical Nitrogen
OD	Over Datum
P	Phosphorus
R.L.	Reduced Level
SS	Suspended Solids
W.T.	Water Table

Executive Summary

This report presents the design document for a free water surface, horizontal flow, constructed wetland at Panda Waste, Co. Meath. The system has been designed to act as component of the stormwater drainage system. The system has been designed to provide attenuation of flows within the drainage system and provide passive treatment to collected surface water before discharge to the watercourse.

Before this system is commissioned all existing stormwater tanks must be emptied, desludged and cleaned. It is imperative that the wetland is not supercharged, during the establishment phase, with stormwater that may have a historic fingerprint of contaminants. Once established, the vegetated system will have the capacity to retain and, for in some cases, degrade contaminants. However, future performance will be enhanced if the system is safeguarded during establishment.

Summary Design Data

- Stormwater runoff area = 35,000 m^2
- Constructed wetland design area = 1880 m^2
- Wetland/Runoff area ratio = 5%

Irish research data (TCD & NRA, Higgins & Johnston, 2006) demonstrates that a stormwater wetland sized at 2% of the catchment runoff area acts to reduce by 70 - 80% the concentrations of suspended solids, total phosphorus and heavy metals. Further evidence is presented in the international literature (Kadlec et al., 2000) in relation to proven efficiencies for nutrient and metal removal from surface flow treatment wetlands. Therefore, the design area is deemed appropriate from a treatment perspective.

In addition, the system's hydraulic capacity has been tested for both annual and critical storm durations.

- Panda Waste's stormwater constructed wetland volumetric capacity = 925 m^3
- Average annual hydraulic detention time = 19 days
- Average annual HLR = 18.6 m/yr (5 cm/d)

Based upon model simulations, it is therefore envisaged that this constructed wetland will operate within loading and detentions times corresponding to mean performance criteria for treatment wetlands.

Potential stormwater volumes generated by critical storms events have been determined, as follows:

- 1 in 1 Year Return Period (60 minute duration) = 347 m^3
- 1 in 5 Year Return Period (60 minute duration) = 536 m^3
- 1 in 30 Year Return Period (60 minute duration) = 910 m^3
- 1 in 100 Year Return Period (60 minute duration) = 1190 m^3

The designed wetland system is therefore deemed adequate to accommodate critical storm events.

1. Introduction

1.1. Background

Bartley & Ó Súilleabháin Environmental Engineering (BÓS) was commissioned by Panda Waste Services to design a constructed wetland (reed bed) to act as a component of the stormwater drainage system at Beauparc Business Park, Slane, Co. Meath (referred to hereafter in this report as 'the site'). Three existing stormwater attenuation tanks will precede the constructed wetland. Discharge from the wetland system will be to an existing surface water drain at the site.

1.2. Scope of work

This report presents the design document for a free water surface, horizontal flow, constructed wetland and includes details as follows:

1. Volumetric and area sizings, definition of depth profiles in individual wetland cells within the system and design of appropriate hydraulic control structures to control water flows between wetland cells and ultimate discharge from the system.
2. Stormwater simulations for annual scenario and critical events.
3. Outline of proposed construction protocols.

1.3. Site Characteristics

The proposed location for this constructed wetland is at the Panda Waste processing facility at Beauparc Business Park, Slane, Co.Meath. The national grid reference for the site is *NGR 297957 268590*.

The soils of the area are mapped as the Ashbourne Series (An Foras Taluntais, 1983), a gley, derived from limestone and shale drift and Irish sea drift. The glacial geology can be summarised as shale enriched compact till, with a heavy texture, slow permeability, high water table and a drainage classification of 'imperfectly to poorly drained'. The topography of the general area of the site has been described as 'limestone lowland with Namurian and Silurian shale hills', in which the soils are generally classified as Grey Brown Podzolics with Gleys in the flatter areas (An Foras Taluntais, 1983). The bedrock underlying the site is classified as Namurian Undifferentiated, which is a shale of Palaeozoic age, and the aquifer is designated as a Poor Aquifer, with bedrock generally unproductive except in local zones (www.gsi.ie). The site appears to lie within the catchment area of the River Boyne but is close to the catchment boundary of the River Nanny.

A site visit was undertaken on 2nd June 2006. This consisted of collation of relevant site data for design analysis, a general site walkover survey, a surface water features survey, logging of existing ditches and surface expressions of bedrock. Visual and hand sample analysis of the subsoil profile in the exposed ditch faces confirmed the findings of the desk study, that the subsoils have a high clay content. Surface water in the drainage ditches was 1.8 m bgl, approximately, which is assumed to provide an indication of saturated conditions in the subsoil and in this design case is assumed to represent the water table. The elevation of the watertable is determined to be 67.6 m OD, on average.

2 System Design

2.1 Design Criteria

- This constructed wetland has been designed as a system to attenuate and treat stormwater runoff from the paved areas of the Panda Waste Services facility. The design must service a hydraulic loading from a paved area of 35,000 m^2.

- Waste at the Panda Waste Services facility is processed indoors, with the exception of wood pallets, and the buildings are engineered with bunded underground structures. Therefore, stormwater management at this site is considered in the context of no potential for contamination with leachate from waste materials processed on site. Therefore, typical stormwater runoff hydrochemical characteristics have been adopted as the design influent characteristics.

- The chemical characteristic of Irish stormwater is not well documented. It is known that the hydrochemical characteristic of runoff is a function of traffic density and the associated pollutant hazards on site. An example of storm water hydrochemical composition is provided in Table 1 (sample of run-off from the N2, near Coolquoy, collected by Enterprise Ireland, June 2000). However, the chemical characteristic of stormwater varies widely and an average input characteristic is presented in Table 2, Section 2.2, for the design of the stormwater wetland for Panda Waste.

- Design effluent concentration data is dictated by the Waste Licence (Register Number 140-2) and are presented in Table 2, Section 2.2.

Table 1 Chemical analysis of storm water run-off from existing N2 (Roughan & O'Donovan, 2000).

Parameter	Result
Ph	6.3
Temperature, oC	9
Electrical conductivity, µS/cm, 20 °C	20
Biochemical oxygen demand, mg/l O_2	<2
Suspended solids, mg/l SS	>5
Ammonia, mg/l NH_4	<0.05
Phosphorus, total, mg/l P	<0.05
Nitrate, mg/l NO_3	0.4
Chloride, mg/l Cl	7
Sulphate, mg/l SO_4	5
Lead, mg/l Pb	<0.05
Iron, mg/l Fe	0.13
Total organic carbon, mg/l C	0.6
Odour	None
Hydrocarbons	No visible film

2.2 Constructed Wetland Sizing

The wetland design is based on iterations of the design area model/equation presented in numerous treatment wetlands design manuals (*e.g.* Kadlec *et al.*, 2000), as follows:

$$A = \frac{-Q}{K}\left[\ln\left(\frac{C_0 - C^*}{C_{in} - C^*}\right)\right] \qquad \text{Equation 1}$$

where,

A = Required area of constructed wetland (m^2)
Q = Design inflow to the wetland ($m^{3/}yr$)
K = Rate constant (m/yr) = Literature K values for P, NH_4-N, SS, BOD
C_o = Design discharge concentration (mg/l)
C_{in} = Design influent concentration (mg/l)
C^* = Background Concentration (mg/l) = Literature values for P, NH_4-N, SS, BOD

Simulation:

- The model is run for each parameter: P, NH4-N, BOD, SS.
- Simulation reiterations are performed, to include hydraulic requirements of rain falling directly on the wetland, until a stable area is yielded by model.
- Peak rainfall intensities for storm event scenarios, 1:1, 1:5, 1:30 and 1:100 year return periods, are simulated to determine the volumetric sizings required to ensure appropriate retention within the system for critical events. NERC (1975) methodologies have also been applied to prove the capacity of the system.
- For the characteristic influent and effluent strengths simulated in this design BOD was found to be limiting parameter, i.e. requires the largest area to treat the water to required discharge concentration.

Table 2 Design data and simulation results for the stormwater wetland at Panda Waste.

Parameter	C_{in} (mg/l)	C_o (mg/l)	C* (mg/l)	Wetland Area (m^2)
P	0.2	0.15[a]	0.05	1650
N	2	0.3	0.25	1300
SS	30	25	5	1540
BOD	80	35	5	**1680**

[a] Assumed, as concentration not specified in Waste Licence discharge criteria

The constructed wetland design surface area will be 1880 m^2.

2.3 Constructed Wetland Cell Configuration

- This design team suggests three wetland cells for the Panda Waste development. Cell 1 will act as the primary receiver. However, the system's pipe network will be engineered to facilitate bypassing cell 1, to cell 2, should maintenance be required. The system will be constructed by some excavation of beds and creation of embankments to contain the reed beds and influent stormwater. Design details are provided in Tables 3 and 4. The wetland system configuration is shown on the accompanying drawings of Site Layout and Constructed Wetland Sections. The first and final reedbed cells will contain portions that are deeper, in a central position, to aid denitrifying processes.

Table 3 Preliminary design details for the Panda Waste constructed wetland (refer to section drawing).

Cell No.	Area (m2)	Design Water Depth (m)	Elevation (m OD)			
			Inlet Pipe invert	Water level	Bed level	Outlet Pipe Invert level
1	825	0.3 - 1.2	69.3	69.2	68.9 & 68.2	69.2
2	525	0.4	69.1	69	68.6	69
3	400	0.3 - 0.8	68.9	68.8	68.4 & 67.8	68.8

Table 4 Inlet and outlet pipe details for the Panda Waste constructed wetland.

Panda Waste Stormwater Wetland Inlet and Outlet Pipe Details				
Pipe ID	**Pipe Diameter (mm)**	**Pipe Slope 1:X**	**Pipe length (m)**	**Fall**
Inlet cell 1	225	1:100	20.0	0.2
Inlet cell 2	225	1:100	4.5	0.045
Inlet cell 3	225	1:100	5.5	0.055
Outlet	375	1:100	60	0.6

- With respect to plant-life, acceptable design water depth ranges in a constructed wetland are 0.2 - 0.5 m. Deeper sections are not vegetated, by design.

- An artificial liner will be installed to ensure environmental protection. It is envisaged that a 2.5mm HDPE impermeable liner will be set on quarry dust. An experienced lining company will supply and install both the HDPE impermeable liner and protective geotextile layer. Pipe penetrations will be appropriately engineered.

2.4 Annual & Critical Event Stormwater Simulations

- The hydraulic capacity of the system has been tested with respect to both the generated annual hydraulic loading (after Kadlec et al., 2000) and for storm scenarios (after NERC, 1975).

- With respect to stormwater attenuation on site, the following capacities have been determined:
  - Existing Stormwater Tanks Capacity (3 on-site tanks) = 350 m^3
  - Constructed Wetland hydraulic capacity = 925 m^3
  - Total stormwater volume capacity on site = 1275 m^3

- With respect to average annual hydraulic loading, the following have been determined:
  - Average annual hydraulic detention time = 19 days
  - Average annual HLR = 18.6 m/yr (5 cm/d)

- These data suggest that this constructed wetland will operate within loading and detentions times corresponding to mean performance criteria for treatment wetlands.

- With respect to runoff from the paved areas (35,000 m^2), employing NERC data (1975), potential stormwater volumes generated by critical storms events have been calculated, as follows:

  - 1 in 1 Year Return Period (60 minute duration = 9.9 mm) = 347 m^3
  - 1 in 5 Year Return Period (60 minute duration = 15.3 mm) = 536 m^3
  - 1 in 30 Year Return Period (60 minute duration = 26 mm) = 910 m^3
  - 1 in 100 Year Return Period (60 minute duration= 34 mm) = 1190 m^3

- With respect to critical events, the designed constructed wetland can accommodate the 60 minute duration, 1 in 1 year, 1 in 5 year and 1 in 30 year return period storms.

- Construction phase will ensure drainage pipe network construction that facilitates bypassing the wetland and discharge directly to the final discharge point for rainfalls exceeding the 1 in 30 yr design scenario. The environmental risk associated with this scenario is deemed low because the 'first flush" of contaminants will have been carried to the wetland system by the runoff prior to system bypass.

- For a 'Time of Concentration' greater than 10 minutes a peak rainfall intensity of 25mm/hr should be adopted (DoEHLG, 2004). Therefore, for this design scenario the peak hydraulic capacity required is determined to be 875 m^3. For this design situation, the time of concentration is determined to be greater than 10 minutes because of the stormwater holding tanks on site. Therefore, a design rainfall intensity of 25 mm/hr was adopted. For this design scenario, the system is shown to have the capacity to retain the required hydraulic loading.

3 Design Conclusions

- Nutrient and suspended solids loadings to the wetland will be relatively low as a consequence of the nature of the stormwater influent and the influence of the stormwater tanks preceding the wetland.

- The total surface area of the constructed wetland cells will be 1880 m^2.

- The volumetric capacity of the wetland will be 925 m^3.

- This system has been modelled and drainage pipe network designed to accommodate hydraulic surges caused by critical storm events. However, pipe drainage networks must be constructed to facilitate bypassing of cells for future maintenance operations.

- In addition, it is recommended that extreme storm events, having a return period greater than 1:30 years, bypass the wetland system to prevent scour and sediment mobilisation to the receiving environment.

- The base of the wetland system will be engineered to prevent infiltration to the groundwater system. Soil and topsoil characteristics suggest that engineering of local soil could be an appropriate methodology for prevention of leaching to groundwater. However, management at the facility have indicated a preference for HDPE lining, which will ensure no leakage from the wetland.

- The wetland will be constructed, planted and established according to BÓS construction protocol specifications (available upon request). Indigenous species are favoured. The most robust species are cattails (Typha spp.), bulrush (Scirpus spp.) and common reed (Phragmites australis). Other plants such as waterlillies, wild iris and yellow flag will also be planted for the purposes of habitat generation and biodiversity.

4 Constructed Wetland Protocols

BÓS have developed protocols based on international best practice and experience in Ireland. These will be presented for approval prior to construction. The protocols provide details for each of the following:

1. Wetland System Construction
2. Sealing
3. Inlet Structures
4. Outlet Controls
5. Appropriate Plants & Methodologies
6. System Establishment
7. Monitoring & Aftercare

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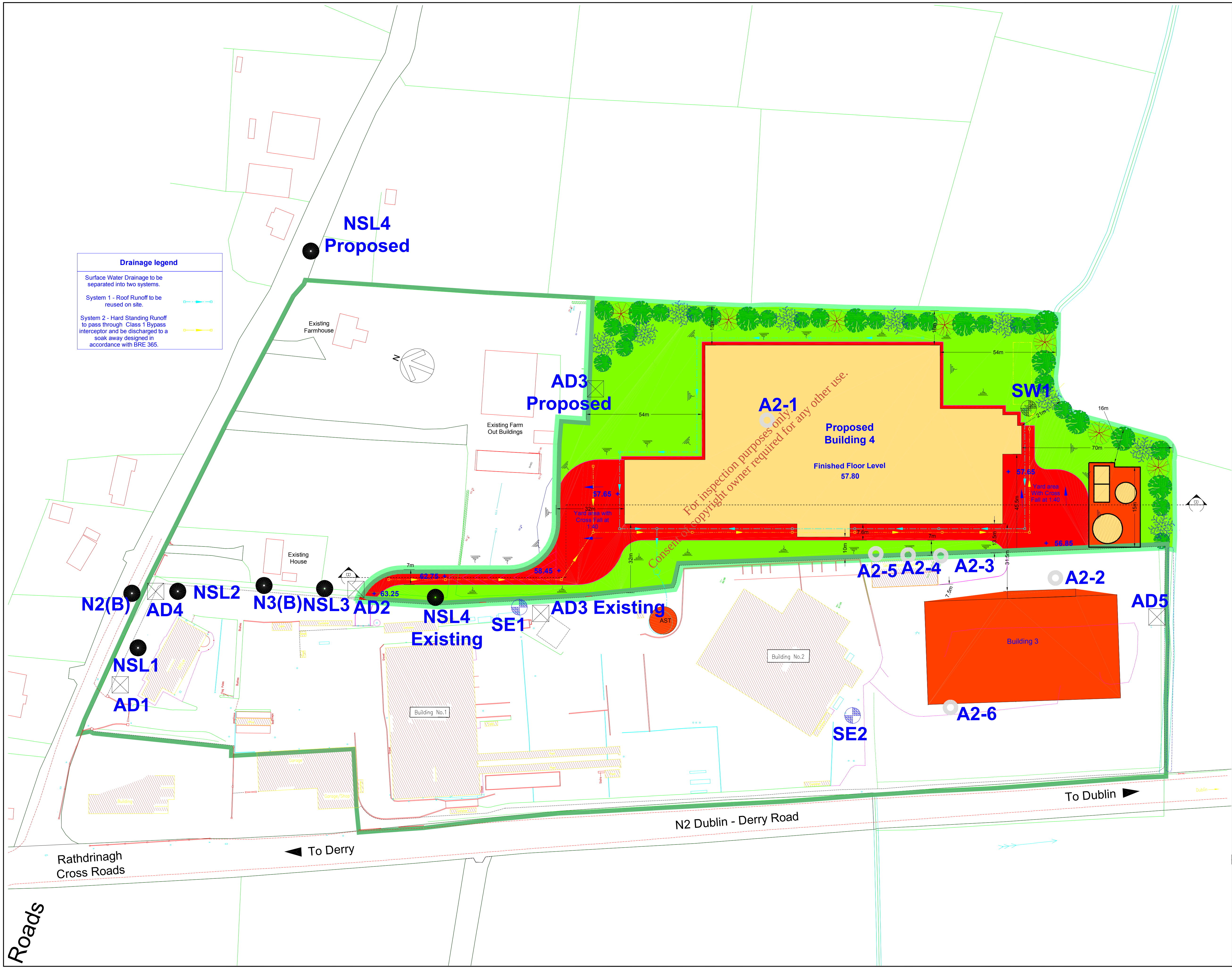
DRAWINGS



NOTES

LEGEND:

- Denotes Sewer Monitoring Location
- Denotes Surface Emission/Monitoring Location
- Denotes Noise Monitoring Locations
- Denotes Air Emission/Monitoring Point
- Denotes Dust Monitoring point

#	I.D.	EASTING	NORTHING
1	AD-1	297300	269480
2	AD-2	297374	269422
3	AD-3	297481	269324
4	AD-4	297352	269483
5	AD-5	297500	269028
6	NSL-1	297303	269484
7	NSL-2	297357	269479
8	NSL-3	297371	269430
9	NSL-4	297526	269481
10	N2(B)	297351	269487
11	N3(B)	297372	269437
12	SE-1	297406	269316
13	SE-2	297411	269151
14	SW-1	297585	269130
15	A2-1	297551	269250
16	A2-2	297519	269092
17	A2-3	297507	269126
18	A2-4	297498	269145
19	A2-5	297491	269163
20	A2-6	297435	269109

REV	DATE	DESCRIPTION	DRN	CHKD	APP
C	6/09/2011	FURTHER INFO	MW	JOC	
B	15/04/2011	ARTICLE 14	MW	JOC	
C	18/09/09	ISSUE	MW	JOC	**

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environmental management for business

CLIENT

PANDA WASTE SERVICES LTD

TITLE

PROPOSED MONITORING & EMISSION LOCATIONS

SCALE	DRAWING No.	REV.
1:600 A3	3	C

DOS Filename : *********

Point	X/E	Y/N
D1	297300.553	269480.094
D2	297374.008	269422.605
D3	297408.059	269310.486
D4	297352.128	269483.782
D5	297466.486	269019.564
NSL1	297398.012	269490.612
NSL2	297516.781	269427.533
NSL3	297247.509	269289.321
NSL4	297513.776	268873.680
F1	297406.146	269316.354
F2	297411.338	269151.295
S1	297390.258	269134.057
S2	297410.420	269143.350
SW1	297506.384	269035.437
CENTRE	297370.455	269284.332

Station CoOrdinates			
	X/E	Y/N	Z
ST1	297375.841	269123.132	70.377
ST2	297388.844	269120.091	70.167
ST3	297395.707	269081.951	69.732

PROJECT TITLE
Topographical Survey of Lands on N2 for Panda Waste Services

CLIENT
Panda Waste Services Ltd.

DRAWING TITLE
Monitoring Locations
Site Layout Plan

DRAWN BY	CHECKED BY	APPROVED BY

SCALE	DATE	DATE	DATE
1: 1250 (A2)	15 Sep 2010		

DRAWING STATUS: For Approval
PROJECT NUMBER:

DRAWING NUMBER: PWS/002
REVISION: