Report

Energy from Waste Facility – Ozone Impact Assessment

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Pacific Environment Pty Ltd: ABN 86 127 101 642

BRISBANE
Level 19 24 Queen Street
Brisbane Qld 4000Qld 4000
Ph: +61 7 3004 6400
Fax: +61 7 3844 5858

SYDNEY
Suite 1, Level 1, 146 Arthur Street
North Sydney, NSW 2060
Ph: +61 2 9870 0900
Fax: +61 2 9870 0999

ADELAIDE
The Hub, 5 Peel Street
Adelaide SA 5000
Ph: +61 8 8332 0960
Fax: +61 7 3844 5858

PERTH
Level 1, Suite 3
34 Queen Street, Perth WA 6000
Ph: +61 8 9481 4961
Fax: +61 2 9870 0999

EXECUTIVE SUMMARY

INTRODUCTION

The Next Generation NSW Pty Ltd (TNG NSW) proposes to construct and operate an Energy from Waste (EfW) facility on land adjacent to the Genesis Xero Waste facility in Eastern Creek. This development site is part of a proposal to construct and operate NSW's largest EfW facility using residual waste as fuel which would otherwise be landfilled, to allow for a "green" electricity generation facility.

The Proponent clarifies that the current State Significant Development Application (NSW DPE reference: SSD 6236) seeks approval only for Stage 1 of the EfW facility and is the subject of this technical assessment. Any future Stage 2 is to be the subject of a separate and future development application. Operation of Stage 1 is proposed to have an engineering capacity of up to 675,000 tonnes annually and a planned operation to treat 552,500 tonnes per annum of residual waste fuel.

Unlike earlier iterations of this air quality assessment report, the current document therefore assesses potential impacts associated with operation of *two combustion lines reporting to a single stack*. This is in contrast to previous versions of the ozone impact assessment that evaluated four combustion lines, two stacks, and treatment of 1,105,000 tonnes of residual waste fuel per annum.

A reasonable worst case emission scenario has been adopted, assuming that emissions from the stack are continuously operating at the European Union Industrial Emissions Directive (IED) daily emission limit for oxides of nitrogen (NO_x). Typically during normal operations of the plant, the in-stack NO_x concentrations are anticipated to be lower. The facility will employ Best Available Technology (BAT) in the form of Selective Non-Catalytic Reduction (SNCR) to limit the daily average NO_x emissions (the dominant ozone precursor released from the facility) to 120mg/m^3. Volatile organic compounds (VOCs) will also be minimised through combustion control with additional controls afforded from activated carbon injection as part of the flue gas treatment.

The significance of impact of this reasonable worst case emission scenario on ground-level ozone in the NSW Greater Metropolitan Region (GMR) has been assessed referencing the NSW Environment Protection Authority (EPA)'s screening impact level (SIL) of 0.5 ppb ozone, and maximum allowable increment of 1 ppb ozone.

The effectiveness of the SNCR abatement technology has been demonstrated using the NSW EPA's Screening level 1 assessment **(Environ 2011)** to comply with the 0.5 ppb SIL.

In summary, it is considered that the adoption of an optimised SNCR system, with the ability to achieve daily average in stack NO_x concentrations of 120 mg/m^3, represents a best practice approach to tropospheric ozone abatement.

Adoption of a maximum daily average in stack NO_x concentration of 120 mg/m^3 should be considered a statement of commitment for the project, which may be incorporated within the environmental protection licence (EPL) for the facility.

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1 INTRODUCTION

The Next Generation NSW (TNG) proposes to construct and operate an Energy from Waste (EfW) facility on land adjacent to the Genesis Xero Waste facility, located at Honeycomb Drive, Eastern Creek, Sydney. The currently proposed (Stage 1) EfW will process volumes up to an engineering capacity of up to 675, 000 tonnes annually but treating a planned 552,500 tonnes per annum for thermal conversion and generation of electrical power.

Pacific Environment has been engaged by TNG to prepare an Ozone Impact Assessment as part of an Environmental Impact Statement (EIS), required under State Significant Development provisions under Section 78A(8A) of the *Environmental Planning and Assessment Act* 1979 (EP&A Act).

1.1 Background and Context

The proposed EfW facility has been designed to comply with the NSW Environment Protection Authority (EPA) *Energy from Waste Policy Statement* ("the EfW Policy Statement"; **EPA, 2014**).

The development involves the construction and operation of an electricity generation facility, which will allow for unsalvageable and uneconomic residue waste from the Genesis Xero Material Processing Centre (MPC) and external bona fide recycling and resource recovery facilities to be used for generation of electrical power. The EfW facility is proposed to be located on Lots 2 and 3, DP 1145808.

This development site is part of a proposal to construct and operate NSW's largest EfW facility using residual waste as fuel which would otherwise be landfilled, to allow for a "green" electricity generation facility.

Pacific Environment was originally commissioned by TNG NSW to complete an ozone impact assessment for the operation of an EfW facility that processes up to 1.35 million tonnes of waste per year.

Within the current document, the Proponent clarifies that the current State Significant Development Application (NSW DPE reference: SSD 6236) seeks approval only for Stage 1 of the EfW facility and is the subject of this technical assessment. Any future Stage 2 addition is to be the subject of a separate and future development application.

The construction and operation of Stage 1 with an engineering capacity of up to 675, 000 tonnes annually but treating a planned 552,500 tonnes per annum of residual waste fuel. Since the time of the original ozone impact assessment in 2015, there have been several iterations of the ozone impact assessment, a summary of each is as follows:

- **Pacific Environment (2015):** Pacific Environment prepared an ozone impact assessment for the proposed TNG EfW facility entitled: "Energy from Waste Facility – Ozone Impact Assessment". This document was published as part of the original Environmental Impact Statement (EIS) for the Project. The modelling was based on emissions that were derived from the European Union (EU) Industrial Emissions Directive (IED; Directive 2010/75/EU) half hourly or daily concentration limits.
- **Pacific Environment (2016):** Pacific Environment revised the ozone impact assessment, with this document exhibited as part of the 'Amended' EIS on public exhibition from 9 December 2016 to 1 March 2017. This assessment included additional detailed design work on oxides of nitrogen (NO_x) offsets, best practice approaches to minimise NO_x and a Level 1 ozone screening assessment.
- **Pacific Environment (2017):** Pacific Environment completed a further revision of the ozone impact assessment that identified that the Project is seeking approval for Stage 1 of the proposed development, however did not quantitatively assess the single stack Stage 1 project.

Within the current document, the Proponent clarifies that the current State Significant Development Application (NSW DPE reference: SSD 6236) seeks approval only for Stage 1 of the EfW facility and is the subject of this technical assessment. Any future Stage 2 addition is to be the subject of a separate and future development application.

1.2 Agency requirements

The NSW Environment Protection Authority (NSW EPA) has provided '*Agency Requirements*' for the Environmental Assessment of the proposed The Next Generation (TNG) Energy from Waste facility (EfW) at Eastern Creek, including a photochemical smog assessment, as follows:

> *Include a quantitative photochemical smog assessment in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2016)*

The Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (The Approved Methods; (**NSW EPA, 2016**)) state that advice should be sought from the EPA prior to undertaking a quantitative photochemical smog[a] assessment. In accordance with the Approved Methods, Pacific Environment has consulted with the EPA and NSW Office of Environment and Heritage (OEH) (refer **Table 1-1**).

[a] The terms photochemical smog and ozone are used interchangeably. Ozone is a secondary pollutant formed in a chemical reaction when precursor emissions of oxides of nitrogen (NO_x) and volatile organic compounds (VOCs) react in the presence of sunlight.

Table 1-1: Outcomes of consultation

Agency	Date	Discussion Point / Outcome
NSW EPA (Air Policy)	28/02/2014	The EPA Level 1 screening tool for ozone assessment was not publicly available. The project was likely to need a Level 2 detailed assessment (based on Western Sydney being an ozone non-attainment area and the emissions threshold being exceeded).
NSW EPA (Air Policy)	6/03/2014	The Level 2 assessment requirements were discussed and formal consultation (teleconference between EPA, OEH and Pacific Environment) was arranged to discuss the approach to the assessment
OEH (Climate and Atmospheric Science Branch)	20/03/2014	Detailed discussion of approach to the assessment. Agreement on the use of TAPM-CTM with CB05 chemical mechanism, 2008 emissions data from EPA GMR air emissions inventory, and methodology to select scenario days. It was suggested by OEH that a method paper is prepared for review by CSIRO
NSW EPA (Air Policy),	17/2/2015	Preliminary discussion of the reported results. EPA indicated that OEH should also be given opportunity to provide additional comment.
NSW EPA (Air Policy), OEH (Climate and Atmospheric Science Branch) and CSIRO	10/03/2015	Discussion around additional analysis of NO_2 and NO_x predictions prepared by Pacific Environment, in consultation with CSIRO, in advance of this meeting. Discussion identified that an updated version of TAPM-CTM and OEH emission inventory inputs files had become available since the original modelling and should be incorporated into the modelling.
NSW EPA (Air Policy), OEH (Climate and Atmospheric Science Branch) and CSIRO	1/04/2015	Teleconference to discuss outcomes of revised modelling incorporating the above updated model inputs.
CSIRO	10/04/2015	Completion of CSIRO peer review role, as summarised within letter report provided as **Appendix F**.

2 PROJECT DESCRIPTION AND STUDY AREA

2.1 Overview

The development involves the construction and operation of an electricity generation plant, which will allow for unsalvageable and uneconomic residue waste from the Genesis Xero Material Processing Centre (MPC) and external Waste Transfer Station (WTS) to be used for generation of electrical power.

This development site is part of a proposal to construct and operate NSW's largest EfW facility using as fuel, residual waste which would otherwise be land filled, to allow for a "green" electricity generation facility.

2.2 Proposed technology

The EfW facility will operate a well-established technology known as a moving grate system with water and air cooled grate bars. This system offers the most flexible and cost effective solution for the fuel mix being considered. Residual waste fuel is gravity fed onto the incinerator grate. The grate is continually moving thus promoting continuous mixing of the residual waste fuel with the combustion air, extracted from the tipping hall and introduced from beneath the grate into the heart of the fire. Further air is injected just above the fire to promote mixing and complete combustion of the gases.

As set out in the Project Definition Brief **(Ramboll, 2017)**, The Next Generation NSW's Electricity Generation Plant is proposed to have a maximum total engineering capacity of 675,000 tonnes per annum with a planned nominal operational input of 552,500 tonnes per annum when the residual waste fuel has a net calorific value of 12.3 MJ/kg.

- Tipping Hall and fuel storage
- Waste Bunker
- Combustion Line 1
- Combustion Line 2
- Two independent boilers
- Flue Gas Treatment systems
- One stack
- One turbine
- One Air Cooled Condenser
- Associated auxiliary equipment
- Control room, workshop, offices and amenities
- Laydown Areas
- Two back up diesel generator.

Unlike earlier iterations of this ozone impact assessment report, the current document therefore assesses potential impacts associated with operation of *two combustion lines reporting to a single stack*. This is in contrast to previous versions of the air quality assessment that evaluated four combustion lines, two stacks, and treatment of 1,105,000 tonnes of residual waste fuel per annum

2.2.1 Flue gas treatment

The proposed technology for the EfW facility is based on existing facilities in the UK and rest of Europe and will incorporate best available technology (BAT) for flue gas treatment. The flue gas treatment is designed to meet the in-stack concentrations limits for waste incineration set by the European Union's Industrial Emissions Directive (IED) (2010/75/EU). The flue gas treatment system includes:

- Selective Non-Catalytic Reduction (SNCR) for reducing emissions of oxides of nitrogen.
- Dry lime scrubbing for reducing emissions of acid gases, including hydrogen chloride (HCl) and Sulfur Dioxide (SO_2).
- Activated carbon injection for reducing emissions of dioxins and mercury.
- Fabric filters for reducing emissions of particles and metals.

Following flue gas treatment, emissions will be dispersed via a 100m stack. Further details of the flue gas treatment are discussed in detail in the Project Design Brief **(Ramboll, 2017).**

2.3 Study area

The proposed Energy from Waste Facility is located at Eastern Creek, approximately 36 km west of the Sydney CBD, in the Western Suburbs of Sydney, as shown in **Figure 2-1:** . The site is surrounded by the residential areas of Minchinbury, Mt Druitt and Rooty Hill to the north, Erskine Park to the east and Colyton to the northwest. The project is located within the Greater Metropolitan Region (GMR) that comprises the Sydney, Illawarra and Newcastle regions. The extent of the GMR is shown in **Figure** 2-2.

Figure 2-1: Project location

Figure 2-2: GMR (EPA, 2012a)

2.4 Comparison of test case emissions with other NO_x sources in air shed

Other significant NO_x sources in the Sydney and Greater Metropolitan Region (GMR) air sheds are primarily sourced from shipping, passenger vehicles, fuel production and heavy duty diesel vehicles, in addition to power generation facilities **(NSW EPA, 2015)**.

The annual NO_x emissions from the TNG EfW facility have been compared against other significant NO_X sources, as extracted from the NSW EPA GMR 2008 emissions inventory. A comparison of the top ten man-made NO_X emission sources within the Sydney air shed, as well as how the TNG EfW projected emissions, are shown in **Figure 2-3**. The TNG EfW facility ranks seventeenth compared to other grouped emission sources in the Sydney air shed. Relative to man-made sources within the GMR, where most electrical power generation sources are located, the TNG EfW facility would be placed significantly lower in ranking.

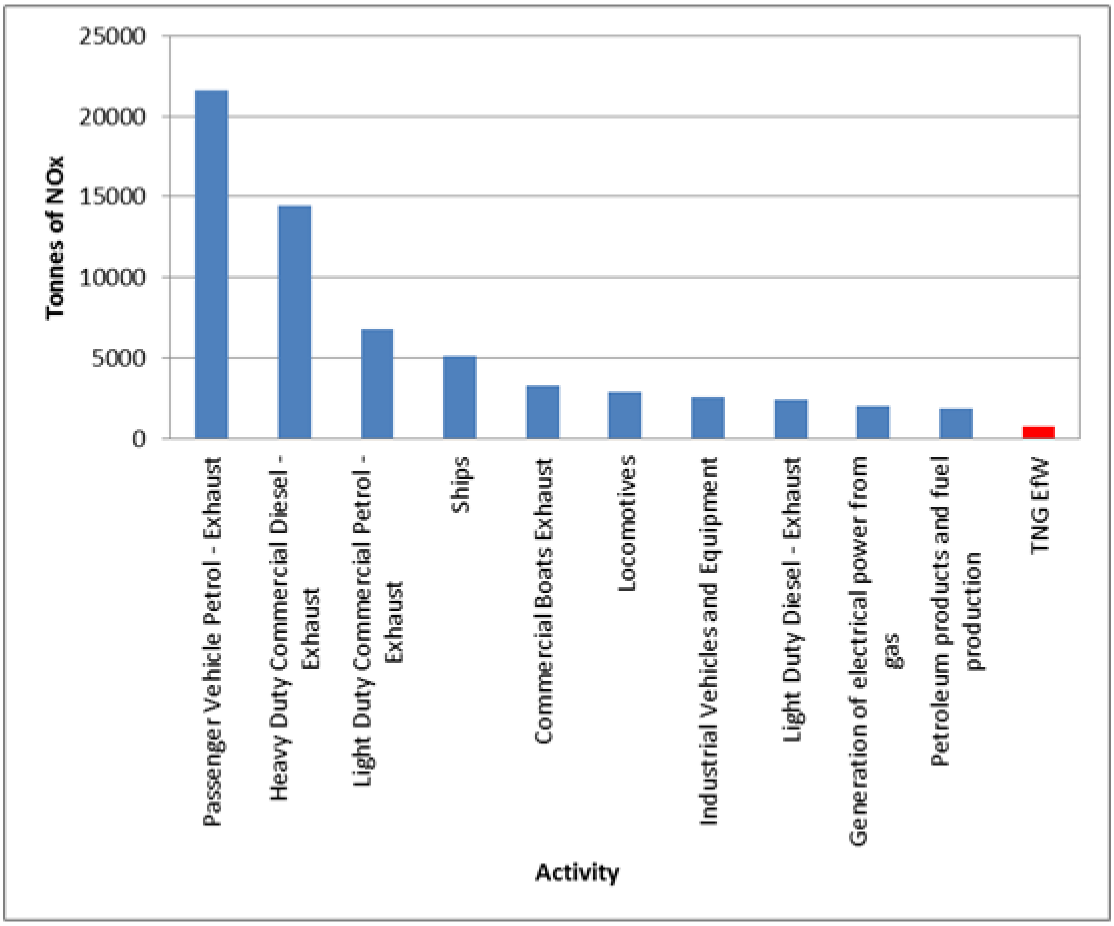

Figure 2-3: Top ten NO_x emission sources in the Sydney air shed compared with projected TNG EfW emissions

3 OZONE ASSESSMENT FRAMEWORK

3.1 Overview

This ozone impact assessment has been prepared in accordance with the NSW *Tiered Procedure for Estimating Ground-Level Ozone Impacts from Stationary Sources* **(Environ, 2011)** and released to the public in May 2015. This is the first project in NSW to be assessed under the ozone assessment framework.

An overview of the framework is shown in **Figure 3-1**. The proposed EfW facility requires consideration of ozone impacts as it satisfies all the following:

- It is an activity listed under Schedule 1 of the *Protection of the Environment Operations Act 1997*.
- It will release ozone precursors as part of the project's proposed operations.
- It is located within the NSW GMR as defined within the *Protection of the Environment Operations (Clean Air) Regulation 2010*.
- It is a requirement of the Secretary's Environmental Assessment Requirements (SEARs) for the project.

An assessment of ozone impact follows the steps outlined in the framework (**Figure 3-1**) and is discussed in the sections below.

It is noted that a significant body of work was completed in assessing the potential ozone impacts associated with a two stack, 1,105,000 tpa capacity project before the release of the ozone assessment framework **(Pacific Environment, 2015; 2016)**, including the availability of the Level 1 Screening Assessment tool. As at the time of writing the original ozone impact assessment the level 1 Screening Tool was not available, through consultation with the relevant regulatory agencies (see **Section 1.2**), it was agreed that a level 2 Refined modelling assessment would be completed, of which was the subject of **Pacific Environment (2015; 2016)**.

As the level 1 Screening Tool is now available and the Project has undergone significant modifications to design (now only one stack and processing half the volume of waste), the adopted assessment pathway has been streamlined compared to that adopted previously **(Pacific Environment, 2015; 2016)**.

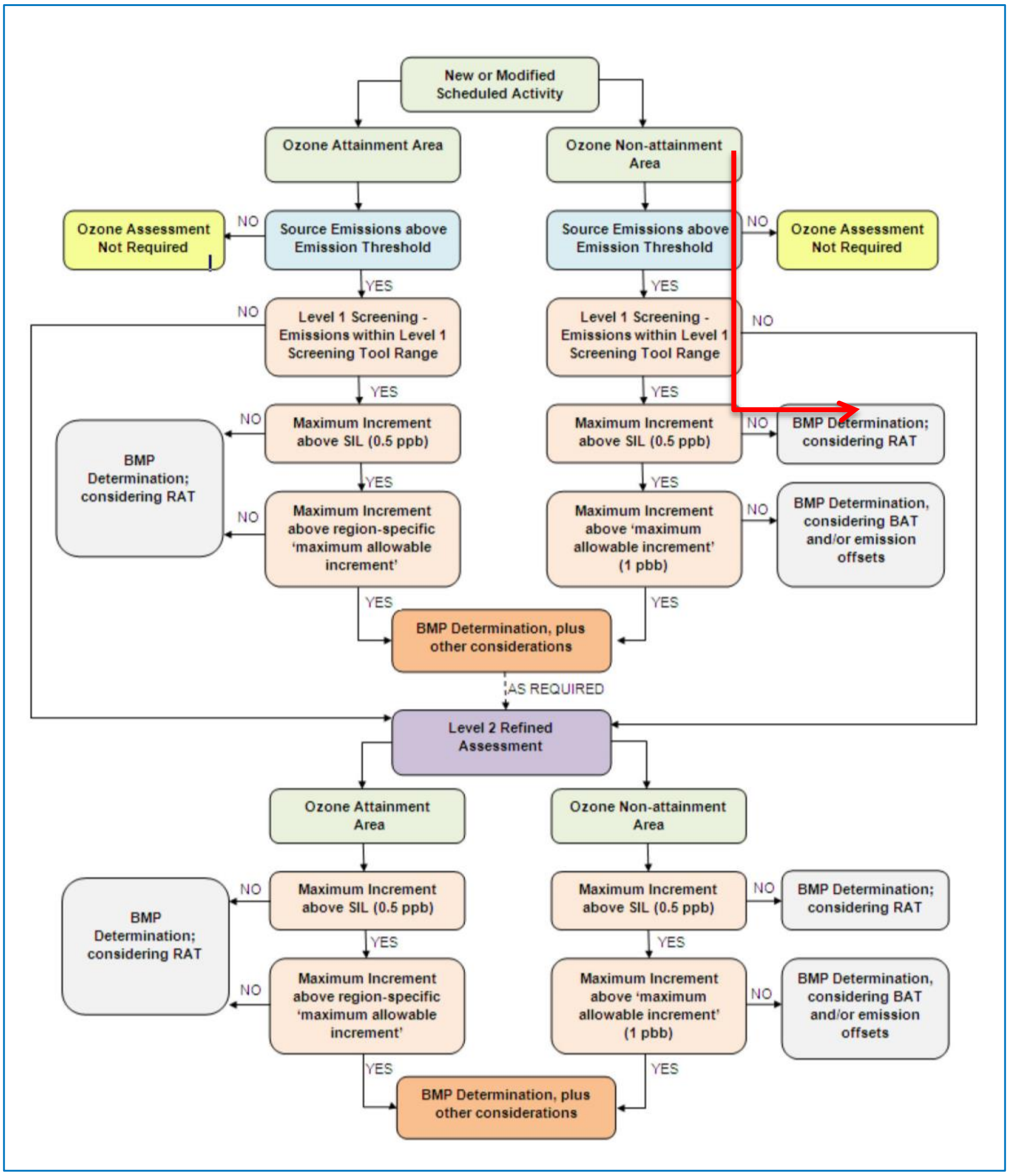

Figure 3-1: Ozone impact assessment procedure and current assessment pathway

3.2 Step 1 - Classification of region as ozone attainment or ozone non-attainment area

The first step in the process is to determine if the project is located within an "attainment area" or "non-attainment area". Ozone attainment and non-attainment areas are defined based on comparison with the ambient air quality (NEPM[b]) goals.

As established within **Pacific Environment, 2015; 2016**, the Sydney region is classified as an ozone non-attainment area. The right hand side of the ozone assessment framework flow chart (**Figure 3-1**) becomes the applicable pathway.

[b] National Environment Protection Measures for Ambient Air Quality (referred to as the Ambient Air-NEPM) (**NEPC, 1998**)

3.3 Step 2 - Emissions threshold

The second step evaluates the annual NO_x and VOC emissions from the project and compares them with the emission thresholds, shown in **Table 3-1**. Scheduled activities that trigger the relevant emissions threshold are required to assess the significance of the incremental ozone contributions.

Table 3-1: Emission thresholds for Schedule 1 activities located in non-attainment areas

Regulatory requirement	Source type	NOx / VOC Emission rates (tonnes/year)
Any scheduled activity listed in Schedule 1 of the *POEO Act* (2007)	New	>90
	Modified	>35

The annual NO_x emissions for the TNG EfW facility have been estimated based on the facility meeting, through application of SNCR, an in-stack NO_x concentration limit of 120 mg/Nm^3, expressed as a daily average, NO_2 equivalent. . Assuming the EfW facility emits NO_x at this limit for 333 days a year (or 8,000 hours of the year), the annual NO_x load to the Sydney air shed would be in the region of 294 tonnes/year. At this emission rate, ozone assessment is triggered and the next step in the framework is a Level 1 screening assessment.

3.4 Ozone Assessment Criteria

The NSW EPA's ozone assessment framework defines criteria for assessment of increments to ground level ozone concentrations in the GMR.

The framework defines a screening impact level (SIL) and maximum allowable increment as follows:

- Screening impact level (SIL) of 0.5 ppb
- Maximum allowable increment of 1 ppb

4 BEST PRACTICE APPROACHES TO MINIMISE NO_X

Under the protocols documented within **Environ (2011)**, the project must demonstrate best management practice (BMP) for the emission source and consider Best Available Technology (BAT) and/or emissions offsets.

During the detailed design stage for the project, and as a result of a post-exhibition submission by the EPA, the facility chose to demonstrate Best Available Technology (BAT) in the form of Selective Non-Catalytic Reduction (SNCR) to limit NO_x emissions, the dominant ozone precursor released from the facility. Pacific Environment has since revaluated the NO_x emissions associated with the use of SNCR.

A technical memorandum on the subject of Best Available Technology for ozone abatement has been produced by the owner's engineers, Ramboll, and is included as **Appendix A**. This document identifies several relevant points with respect to the Ozone Assessment / BAT:

- Ramboll note that the SNCR technology can be optimised to reach in-stack NO_x concentrations of 120 mg/Nm^3 as a daily average. The original limit was proposed to be 200 mg/m^3 as a daily average **(Pacific Environment 2015; 2016)**. The increased efficiency can be achieved through additional consumption of ammonia within the SNCR system.
- Ramboll have revised down the flue gas volume to be 127 Nm^3/s from 139.3 Nm^3/s as adopted in previous assessment **(Pacific Environment 2016; 2017)**.
- TNG now propose to reduce the scale of the project to allow for the processing of two combustion lines with the plant now having an engineering capacity of up to 675,000 tonnes annually but treating a planned 552,500 tonnes per annum of residual waste fuel.

- The above actions are anticipated to result in NO_X loads to the Sydney air shed of the order of 294 tonnes per year.

5 LEVEL 1 SCREENING ASSESSMENT

The implications of the project's consideration of BAT for ozone abatement can be readily demonstrated through the use of the EPA's Level 1 screening tool for ozone assessment[c] that accompanies the NSW Ozone Procedure. This allows for the quantification of impact reduction without having to revisit the regional modelling exercise previously completed within **Pacific Environment 2015, 2016; 2017**. This approach is considered valid since any impacts of a single stack proposal will, by their nature, be less than those previously assessed, which were found to be acceptable.

Table 5-1 shows the outputs of the Level 1 screening tool under the currently proposed, optimised SNCR emission scenario. The graphical outputs of the screening assessment are provided in **Appendix B**.

Table 5-1: Summary of Level 1 Screening Tool for Ozone under single stack emission scenario

	Incremental Ozone Concentrations (ppb)		Cumulative Ozone Concentrations (ppb)	
Emission Scenario [1]	Maximum 1-hr Incremental	Maximum 4-hr Incremental	Maximum 1-hr Cumulative	Maximum 4-hr Cumulative
SNCR optimisation NOx @ 120 mg/m³ = 0.88 tpd (1,2)	0.31	0.27	110.1	99.1

Note 1: The emission scenario assumes emissions of the following: CH_4 – 0.00tpd, CO – 0.25tpd, VOC – 0.013tpd, default VOC reactivities. 2. Assumes NO_x ratio of 95% NO and 5% NO_2 **(Pacific Environment 2015; 2016)**.

As described in **Section 3.4**, the NSW Ozone Procedure defines a screening impact level (SIL) and maximum allowable increment as follows:

- Screening impact level (SIL) of 0.5 ppb
- Maximum allowable increment of 1 ppb

Thus, inspection of **Table 5-1** indicates that adoption of the optimised SNCR scenario (operating at a daily average of 120 mg/Nm³ NO_X) yields outputs that are below the SIL for ozone assessment.

6 NO_X OFFSETS

As part of the detailed design process after the exhibition of the original ozone impact assessment report **(Pacific Environment, 2015; 2016)**, the feasibility of emission offsets to reduce the proposed facility's contribution of ozone precursors to the Sydney basin was investigated.

The concept of emission offsets is referenced within the NSW EPA's *Tiered Procedure for Estimating Ground Level Ozone Impacts from Stationary Sources* ("the NSW Ozone Procedure"; **Environ, 2011**).

The most straightforward approach to evaluating the potential for offsetting of ozone precursors is through evaluation of the outputs of the NSW EPA air emissions inventory (**NSW EPA, 2012**).

In referring back to **Figure 2-3,** is meaningful in the context of potential to offset ozone precursors from other sources in lieu of the TNG EfW contribution.

Of the top ten anthropogenic NO_X sources located within the Sydney basin, the first eight are transport related. There are issues related to establishing offsets within such emission sectors. Principally, these relate to the sources being many and disparate. It is not considered practicable on either a logistics or financial

[c] http://www.epa.nsw.gov.au/resources/air/150507-ozone-procedure-tool.xls

basis to create a meaningful offset opportunity given the multitude of stakeholders and physical sources involved. For an offset to be economically viable, it is considered that it should involve an emission reduction at a discrete (industrial) location, based on a single activity (i.e. introduction of an abatement technology). Neither of these aspects are aligned with an offset approach within the transport sector.

The two remaining significant sectors (defined as emission sources greater than 294 t NO_X / annum) are shown in **Figure 2-3** as:

- Generation of electrical power from gas; and
- Petroleum products and fuel production

The NSW EPA air emissions inventory (**NSW EPA, 2012**) provides data on a sectoral basis, and does not provide information on a facility basis.

It is anticipated that gas fired power generation sources within the Sydney basin have already been optimised in terms of NO_X abatement technologies. This is since such projects would not be supported by the regulator without having demonstrated such technologies (e.g. as a minimum, the use of low-NO_X burners). For this reason, it is not considered that there is potential to pursue meaningful offsets within this sector.

Lastly, it is anticipated that the petroleum products and fuel production sector is dominated by two emission sources, namely the refineries at Clyde and Kurnell.

It is envisaged that the 2008 emission inventory does not take account of the current / impending closure of these facilities for fuel production. Given that both facilities are being decommissioned, there is no opportunity to consider offset scenarios here.

It is highlighted that the TNG EfW facility is the first development application to operate under the NSW Ozone Procedure, and thus to consider the concept of emissions offsets in this context. In view of lack of any precedent in this area, as well as the significant (contractual, financial, technological, logistical) barriers it is considered that further regulatory guidance should be provided if offsets are to be considered as a practicable scenario.

7 CONCLUSION

An ozone impact assessment, based on the EPA's ozone assessment framework for NSW, has been completed for the proposed TNG EfW facility, based on operation of *two combustion lines reporting to a single stack*. This is in contrast to previous versions of the ozone impact assessment that evaluated four combustion lines, two stacks, and treatment of 1,105,000 tonnes of residual waste fuel per annum.

A reasonable worst case emission scenario has been adopted, assuming that emissions from the stack are continuously operating at the European Union Industrial Emissions Directive (IED) daily emission limit for oxides of nitrogen (NO_x). Typically during normal operations of the plant, the in-stack NO_x concentrations are anticipated to be lower. The facility will employ Best Available Technology (BAT) in the form of Selective Non-Catalytic Reduction (SNCR) to limit the daily average NO_x emissions (the dominant ozone precursor released from the facility) to 120mg/m^3. Volatile organic compounds (VOCs) will also be minimised through combustion control with additional controls afforded from activated carbon injection as part of the flue gas treatment.

The significance of impact of this reasonable worst case emission scenario on ground-level ozone in the NSW Greater Metropolitan Region (GMR) has been assessed referencing the NSW Environment Protection Authority (EPA)'s screening impact level (SIL) of 0.5 ppb ozone, and maximum allowable increment of 1 ppb ozone.

The effectiveness of the SNCR abatement technology has been demonstrated using the NSW EPA's Screening level 1 assessment **(Environ 2011)** to comply with the 0.5 ppb SIL.

In summary, it is considered that the adoption of an optimised SNCR system, with the ability to achieve daily average in stack NO_x concentrations of 120 mg/m^3, represents a best practice approach to tropospheric ozone abatement.

Adoption of a maximum daily average in stack NO_x concentration of 120 mg/m^3 should be considered a statement of commitment for the project, which may be incorporated within the environmental protection licence (EPL) for the facility.

8 REFERENCES

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Appendix A RAMBOLL MEMO – BEST AVAILABLE TECHNOLOGIES

RAMBOLL

ENERGY

MEMO

Job TNG Energy from Waste Facility, Eastern Creek, Ground level Ozone
Date 2015-08-31
From Tore Hulgaard

Date 2015-08-31
Revised, 2015-10-26

Ramboll
Hannemanns Allé 53
DK-2300 Copenhagen S
Denmark

T +45 5161 1000
F +45 5161 1001
www.ramboll.com

File; TNGWTE-141-003-DAD30
Ozone memo 20.docx
Ver. 3

1. Introduction

We understand that limit values for ground level ozone concentrations in greater Sydney area may be a challenge, and that ground level ozone is affected by the NO_x emissions from the Waste-to-Energy facility.

Here we clarify a few issues on NO_x emissions which may be relevant for dispersion modelling and hence, ground level ozone modelling. And we point to opportunities for reducing impact.

We have looked through the Ozone Impact Assessment report of 2015-04-15.

NO_x is the sum of NO and NO_2 counted as if all is NO_2. Only a small share of the NO_x is emitted as NO_2 – usually less than 5%, as it is pointed out in the report.

Local guideline/practice will determine how NO-conversion to NO_2 in the atmosphere should be considered in modelling.

2. NOx Emissions and emission limits

The NO_x-emission stack limit values are the same as stated in the EU-industrial Emissions Directive (IED).

Limit values are given with reference to dry flue gas at 11% O_2 (Nm³ are normal cubic meters, i.e. at standard temperature and pressure, 0 °C and 101.3 kPa), daily average limit value NO_x – emission 200 mg/Nm³.

We note that the Ozone report conservatively assumes the daily average limit value for dispersion modelling.

Rambøll Danmark A/S
DK reg.no. 35128417

Member of FRI

RAMBOLL

3. Observation on the Ozone Impact Assessment

We refer to table 6-1 of the Ozone Impact assessment and the Concept Design Report of 2015-03-11.

Table 6-1: Modelled emission rates

Parameter	Value
Stack location (m, MGA, Zone 56)	298633 (E), 6257734 (N)
	298575 (E), 6257741 (N)
Base elevation (m, AHD)	~65
Stack Height (m)	100
Stack Diameter (m)	2.5
Temperature (°C)	120
Flue Gas Flow (Nm^3/s)	139.3
Gas Exit Flow Rate (Am^3/s)	175.8
Gas Exit Velocity (m/s)	35.8
NO emission rate (95% of NO_x) (g/s)	26.5
NO_2 emission rate (5% of NO_x) (g/s)	1.4

We have the following comments:

- Our calculations show slightly lower flue gas flow rate: less than 130 Nm^3/s (dry flue gas at 11% O_2) (this makes the modelling on the conservative side).
- Gas exit velocity of 35.8 m/s is too high. We would probably not go much higher than 22 m/s in the nominal case (the base case) in order to limit noise emission under adverse conditions and to limit power consumption (pressure loss). The concept design report states "Flue gases will be emitted from the flues with a velocity in excess of 15 m/s." So 15 m/s would be the conservative choice.
- 120 °C exit temperature is conservative (i.e. low side compared to our expectations of around 140 °C).
- NO emission rate is listed at 26.5 g/s. Note this rate is not a mass flow of NO as one may understand the table, but a mass flow of the corresponding amount of NO_2. The mass flow of **NO is only 26.5/46*30=17.3 g/s as NO** (considering 200 mg/Nm^3 NO_x (as NO_2) corresponds to 0.2*139.3=27.9 g/s as NO_2).

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4. Potential to further reduce the NOx-emissions and -impact

We see the following possibilities of reducing the NO_x-impact.

- Increasing stack height (though some restrictions may apply, e.g. aviation)
- Reducing NO_x-emission. The SNCR technology can be optimised to reach for instance 120 mg/Nm³ for a sophisticated SNCR (as daily average). The increased efficiency comes with a modest increase of CAPEX and additional consumption of ammonia.

5. Conclusions

- We are of the opinion that the Ozone Impact assessment calculates an NO emission which is too high. The correct number is 17.3 g/s (instead of 26.5 g/s).
- The Ozone Impact assessment of 2015-04-15 should be redone using the values listed above [which has been done subsequently].

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ENERGY

MEMO

Job	**Compounds of Potential Concern (COPC) for HHRA**
Client	**DADI TNG NSW**
Memo no.	**1**
Date	**13/09/2015**
To	**Lesley Randall (AECOM)**
	Damon Roddis (Pacific Environment)
From	**Martin Brunner**
Copy to	**Ian Malouf (DADI)**
	Phill Andrew (Savills)
	Mary Likar (Savills)
	Amanda Lee (AECOM)
	Skye Playfair Redmann (Urbis)
	Geert Stryg (Ramboll)
	Tore Hulgaard (Ramboll)
	Ruedi Frey (HZI)

Date 13/09/2015

Ramboll
Hardturmstrasse 132
CH-8005 Zürich
Switzerland

T +41 44 500 35 80
F +41 44 500 35 89
www.ramboll.com/energy

1. Reference and basis

Reference is made to the following memos:

a) "TNG Energy from Waste Facility – Inputs to Human Health Risk Assessment", dated 11. September 2015 by Damon Roddis (Pacific Environment)
b) "Advice to address EPA comments", dated 29. January 2015 by Rosalind Flavell (Fichtner)

In line with the above information we have evaluated the in stack concentrations for normal and upset operation based on real data of 4 plants (7 lines and 7 different measuring campaigns) with identical Air Pollution Control system (APC) as planned to be installed at the TNG facility. We have further considered general literature on emission factors of WtE plants. Where no such data was available the concentration was calculated on the expected particulate emission and appropriate concentration of the compound in fly ash. More detailed description of the data used will follow in a separate memo. All values are given based on the following assessment:

Normal operation: Maximum value out of the following:

- Any measured value from the plants with identical APC system
- Literature emission factor for WtE plants

Upset operation: Definition of "Upset Operating Conditions" see memo b) chapter 1. Maximum value out of the following:

- Particulate emission of 150 mg/Nm3, emission based on specific compound concentration in fly ash
- Gas flow of 10% of total gas flow to stack bypassing APC (e.g. bag failure)
- Value of 10 times normal operation

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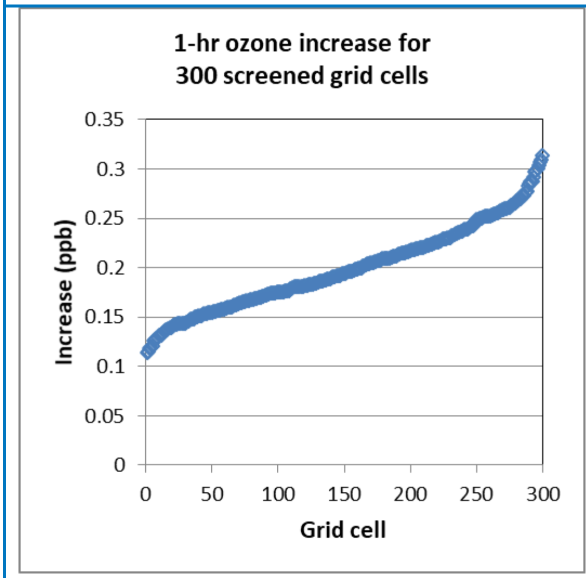
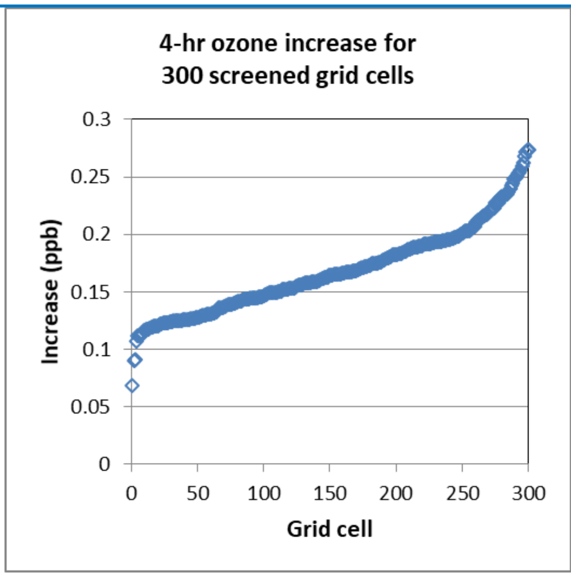
Appendix B SCREENING LEVEL 1 OUTPUTS





Cumulative results