Orora WWTP – Preliminary Hazard Analysis

Proposal for: Orora Paper & Recycling

Issued: 6th April, 2016

scott lister

Amendment Record

Issue	Date	Author	Change Summary	Approved By
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010	6/4/2016	Leonard Gawecki		Simon Meiers

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Abbreviations

Abbreviation	Description
ALARP	As Low As Reasonably Practicable
AS	Australian Standard
NSW DP&E	NSW Department of Planning & Environment
HIPAP	Hazardous Industry Planning Advisory Paper
kL	Kilo Litres
kms	kilometres
kPa	kilo Pascals
kPag	kilo Pascals (gauge)
kV	kilo Volts
kW/m^2	kilo Watts per square metres
LEP	Local Environmental Plan
m	metres
m^2	square metres
m^3	cubic metres
m^3/hr	cubic metres per hours
Nm3/hr	Normal cubic metres per hour
p.a.	per annum
PFD	Process Flow Diagram
PG	Packaging Group
PHA	Preliminary Hazard Analysis
pmpy	per million per year
SEPP	State Environmental Planning Policy
SL	Scott Lister
tpd	tonnes per day
tph	tonnes per hour

1. Background

1.1 Introduction

Orora Paper & Recycling (formerly AMCOR Packaging and hereafter known as Orora) obtained project approval under Part 3A of the Environmental Planning and Assessment Act 1979 in 2007 (Application No. 05_120) for the construction and operation of the B9 Paper Mill at its site in Matraville, Sydney. The B9 Paper Mill has been built and commenced full production in early 2013.

The B9 Paper Mill uses significant quantities of water to process waste paper and manufacture finished paper products. Process water is currently treated in a Dissolved Air Floatation (DAF) Water Treatment Plant (WTP) located in the central area of the site – which is equivalent to primary treatment. Fresh water used in the paper making process is reused over 400 times before being discharged. All wastewater is discharged into Sydney Water's South Western Suburbs Ocean Outfall Sewer (SWSOOS) via a Trade Waste agreement. Orora is one of the single largest trade waste dischargers in the Sydney region.

Orora is seeking to upgrade the DAF WTP to include a secondary treatment of process wastewater before discharge into the SWSOOS. As part of the upgrade process a preliminary hazard assessment (PHA) of the proposed WWTP is required under SEPP 33 as the chemicals stored exceeds the SEPP 33 threshold requirements for Class 8 Acids and Alkalis.

In that regard, Orora has commissioned Scott Lister to conduct the PHA study and to report on the study findings, incorporating any risk recommendations so that Orora can implement these as part of the planning approval and prior to commencement of operation.

1.2 Purpose and Scope

The purpose of the Preliminary Hazard Analysis (PHA) is to determine the risk to people, property and the environment, and to demonstrate that such risks are acceptable under the NSW DP&E Risk Criteria annunciated in HIPAP 4 (Ref 2)

2. Site Description

2.1 Site Layout and Location of WWTP

The Orora site is located at Botany Road, Matraville, NSW as shown in Figure 1 – Regional Plan and Figure 2 – Orora WWTP Upgrade Proposal - Site Plan. The upgraded WWTP (Process tanks, flare and gas holder – as shown within the red rectangle) would be located in the central area of the site, adjacent to the existing WTP and the boiler house. The upgraded WWTP would be approximately 2500 m2 in area.

2.2 Surrounding Land Use

The surrounding area is characterised by industrial and commercial facilities and residential as follows:

- **West** – Commercial offices on the western side of McCauley Street and Light Industrial /warehousing facilities;
- **South** – Botany Road and Port Botany. The closest site is the CTAL Container Terminal a containers storage facility. Other uses (>300m away) include Bulk Liquids Storage Area, the P&O Container Terminal, and Patrick Container Terminal (Australian Stevedore) are located to the south and south-east
- **East and north east**- Residential.

Changes to the northern and eastern boundaries are also depicted in Figure 2. It is expected that these two sites will be subdivided and divested sometime in the future. Proposed uses for the site (subject to Council and / or NSW DP&E approval) will be warehousing or Port related uses, i.e. industrial uses.

Note that the upgraded WWTP (Process tanks, flare and gas holder) would be located, as depicted in Figure 1, to other land uses as follows;

– 180m to the nearest open space – Purnell Park
– 220m to the nearest residence located on Partanna Avenue, and
– 550m to the nearest pre-school - Sands and Stories Childhood Centre

Figure 1 – Regional Plan

Figure 2 – Orora WWTP Upgrade Proposal - Site Plan

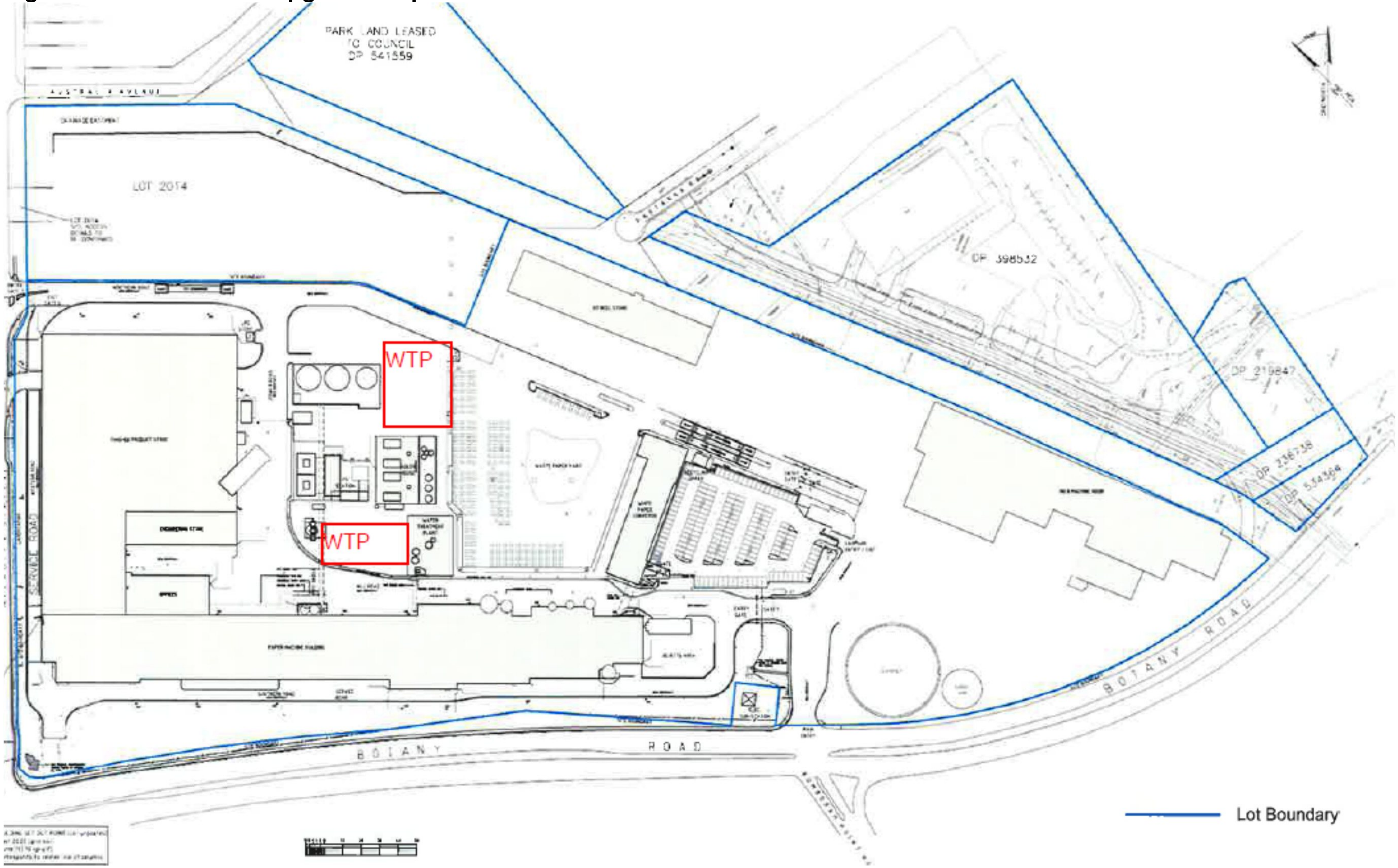
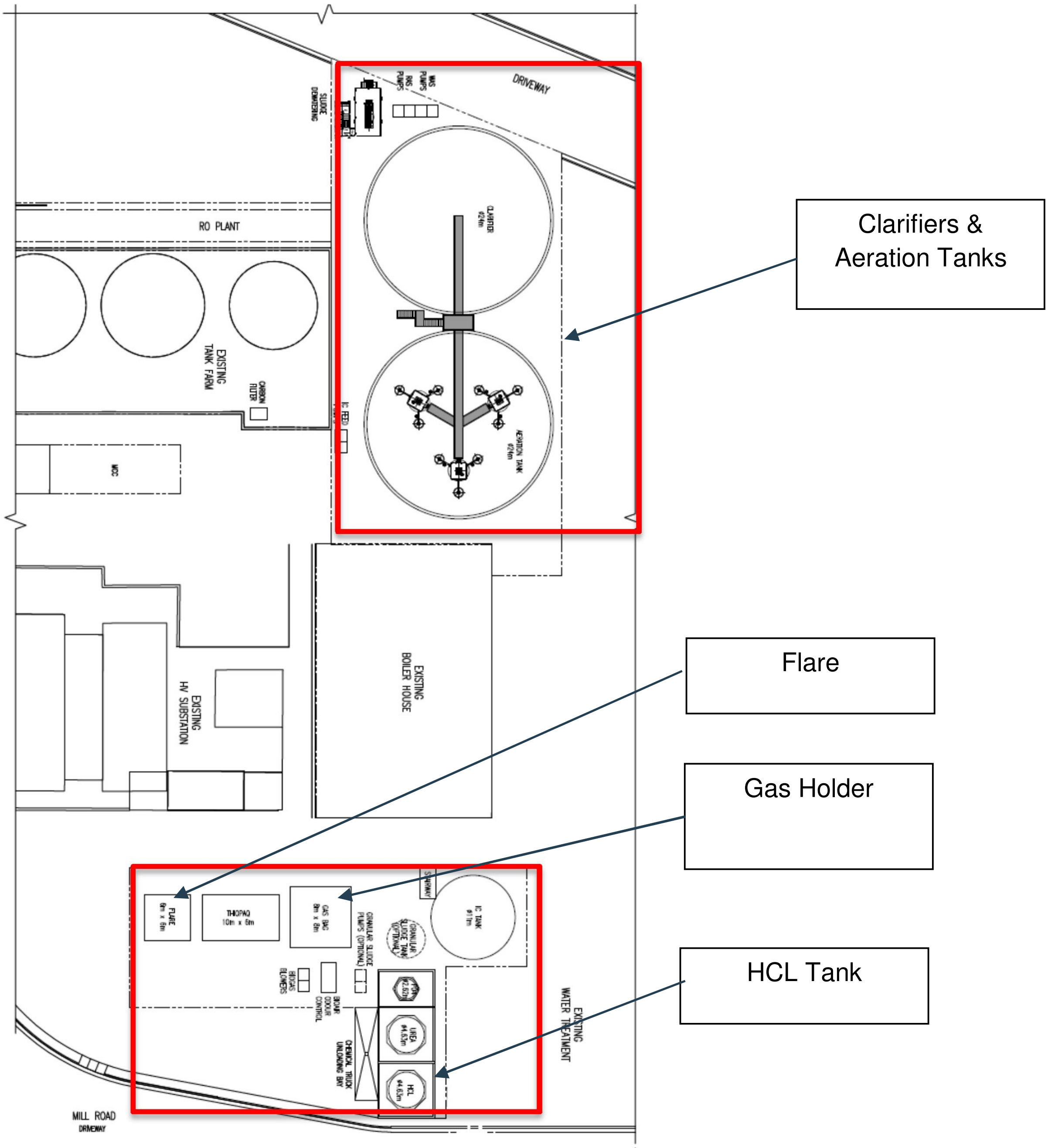


Figure 3 – Concept Layout for WWTP Upgrade



3. Process Description of WWTP

3.1 Waste Water Treatment Process

The upgraded WTP would utilise the existing DAF process and infrastructure to provide primary treatment of wastewater and also incorporate a two stage secondary treatment process comprising aerobic and anaerobic digestion to remove substances in the wastewater that generate high Biochemical Oxygen Demand (BOD). These substances include microscopic paper fibers, biological wastes attached the waste paper (e.g. Food), starches used in the paper making process and any bacteria in the waste paper or process stream.

A combination of anaerobic and aerobic treatment is typically used in the paper making industry as it requires less space, results in a higher level of BOD reduction and impacts such as odours (principally from H2S) can be readily controlled. Nutrients to feed the anaerobic bacteria used in the secondary treatment process would be supplied in the form of urea (nitrogen) and phosphate (phosphorus). PH balancing, if required, which would be done via dosing with hydrochloric acid. A full list of associated dangerous goods and chemicals storage required for the new WWTP is provided in Table 1.

As paper making wastewater generally has higher levels of sulphur compounds and bacteria (compared to domestic wastewater), a by-product of the anaerobic secondary treatment process is a mixture of gases with a high concentration of hydrogen sulphide (H2S). This mixture of gases would be treated through a biological de-sulphurisation process to remove H2S. The treated gases, now methane rich, would then pass to a gas engine to generate electricity for paper making. A gas flare will be provided for emergency situations (e.g. gas engine component failure)

Sludge removed from the wastewater would be de-watered continuously at the sludge dewatering facility. The dewatered sludge would be suitable for land application, soil manufacturing and other products that require a biological base.

The secondary treated wastewater would continue to be discharged via Orora's existing private sewer line into the Sydney Waters South West Suburbs Ocean Outfall Sewer via a new trade waste agreement negotiated with Sydney Water.

The upgraded WWTP would operate on a continuous (24/7) basis.

3.2 Equipment Description

The upgraded WWTP would consist of the following components:

- 1 x 24m diameter aeration tank
- 1 x 24m clarifier
- 1 x 4.6m diameter sludge storage tank
- 1 x 4.6m diameter urea storage tank (bunded)
- 1 x 4.6m diameter acid storage tank (bunded)
- 1 x 2.6m diameter phosphate storage tank (bunded)
- 1 x 11m diameter x 28m height anaerobic reactor
- 1 x 8m x 8m gas bag
- 1 x 14m x 4m De-sulphurisation facility
- 1 x 14m x 4m De-sulphurisation control room
- Odour control facilities
- Various pumps and blowers
- Sludge dewatering facility
- Gas flare in 6m x 6m enclosure
- Internal maintenance road, stairways and other access facilities

The tanks will be steel and lined to prevent corrosion. The three tanks containing process chemicals would be located in appropriately sized bunded areas in accordance with the appropriate Australian Standards.

An indicative layout of the upgraded WWTP is shown in Figure 3. The size and location of various components are indicative and may change slightly during the detailed design of the upgraded WTP – to optimize the process layout and minimize operating costs, but can be considered maximum for the purposes of this PHA review.

3.3 Chemical Usage, Storage and Transport

As the anaerobic treatment process is based on biological processes rather than chemical treatment, then only small volumes of relatively harmless chemicals are required to support the treatment process. This includes urea and phosphate to provide food for the treatment bacteria and hydrochloric acid and liquid caustic for pH balancing. A full list of dangerous goods, their class, UN number, quantity and packaging type in provided in Table 1. Other chemicals, deemed non-dangerous goods (NGD) that would be used include:

- Liquid polymer to assist in sludge dewatering
- Proprietary nutrients for the scrubber units (odour & sulphur removal)

Are provided in Table 2 for completeness.

Table 1: WWTP upgrade - List of Dangerous Goods Stored

Storage Type & Location	Name of DG	Un. No.	Class	PG	Max. Quantity (L)	Comparison to SEPP33 thresholds
Fixed cone roof tank. Fenced tank farm. Adjacent to existing boiler house	Hydrogen Chloride (HCL)	1789	8	II	45000 L (50 MT)	
Total by Class			8	II	50 MT	Threshold quantity set at 25 metric tonnes for Class 8 PG II. Exceeded and PHA required to accompany DA.

Note1: There are existing storages associated with paper recycling on the site, however these are covered by the current DG license and the existing PHA for the new mill. In any case they are not stored adjacent to the proposed WWTP chemical tank farm, and hence are not included in this PHA review. Refer to the List of Dangerous Goods storages above placard quantities, and their location map as provided in Appendix A.1

Table 2: WWTP upgrade - List of Non - Dangerous Goods (NDG) Stored

Storage Type & Location	Name of DG	Un. No.	Class	PG	Max. Quantity (L)
Fixed cone roof tank. Fenced tank farm. Adjacent to existing boiler house	Urea	1789	8	II	45000 L
	Phosphate Buffer Solution				15000 L

The anticipated dangerous goods truck movements to the site in respect of the WWTP are summarized in Table 3. As shown transport threshold movements when compared to the SEPP33 thresholds are not exceeded.

Table 3 - Predicted Dangerous Goods Movements

Product Name/ Description	Typical Products	DG Vehicle Max Movements/ Annum	NSW DP&E Annual Threshold	Comparison to SEPP33 thresholds
Class 8 PG II -	Corrosives including Caustic and Liquid Dye	3/mth x 12 = 36	500	Deliveries are generally made monthly Not exceeded

3.4 Process Hazards

The proposed upgrade to the existing WWTP will introduce a number of new process hazards. These are described in this section.

3.4.1 Biogas (80% Methane / 20% Carbon Dioxide)

The application of the use of biogas from the anaerobic system treatment in pulp and paper industry is a viable option for more readily biodegradable wastewater as the case of the production/recycling of corrugated paper. The biogas produced during the anaerobic digestion is composed mainly of CH_4 (55–80%) and CO_2 (20–45%) and can be used as an energy source, usually in the form of heat and/or after conversion into electricity by cogeneration. Orora intend to utilize the methane rich biogas to drive a gas engine and produce electricity. A gas holder will be used for storage (and will inflate or deflate according to process flows). The gas holder will operate at pressures up to 3bar (and a design burst pressure of 6 bar) and has a maximum volume of 60 m^3. (Note: Biogas Density @25 deg C, 6 bar = 4.5 kg/ m^3)

A gas holder explosion is possible, although unlikely, and will be considered in this study.

3.4.2 Flaring

Further, in case of process upset, or equipment failure or plant emergency, the entire biogas stream can be directed to flare. At this stage Orora anticipate the flare stack height to be 3m, with maximum flow rate (based on maximum biogas production and storage capacity) around 13 GJ/hr at 2.5 bar (approx. 325 kg/hr of Biogas). A flare calculation will be undertaken to ensure heat flux at ground levels are acceptable.

3.4.3 HCL release (evaporation of liquid pool)

Hydrochloric acid will be utilized for wastewater PH adjustment. Typical strengths for HCL for water treatment usage are 33% by weight, with the remainder aqueous. HCL will be stored in a dedicated fixed roof tank within a containment bund of 36 m^2. The HCL will arrive via Chemical road tanker (10 MT) on a monthly basis. A dedicated chemical tanker standing area is provided to contain minor spills.

3.4.4 Hydrogen Sulphide

As paper making wastewater generally has higher levels of sulphur compounds and bacteria (compared to domestic wastewater), a by-product of the anaerobic secondary treatment process is a mixture of gases with a high concentration of hydrogen sulphide (H_2S). Hydrogen sulphide will be removed from the biogas stream by scrubbing systems prior to the gas holder. As the flow rates of H_2S are low and there is no significant storage, these fugitive emissions are better handled in the air quality assessment. And therefore are not considered further in this risk assessment.

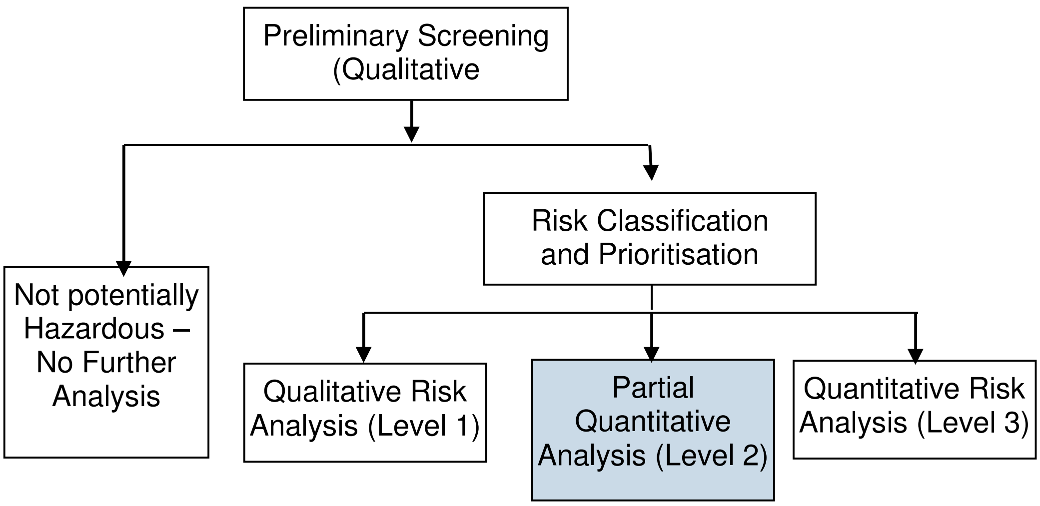
4. Level of Assessment

The NSW Department of Planning (NSW DP&E) Multi Level Risk Assessment (Ref.5) approach was used for this study. The approach considered the development in context of its location and its technical and safety management control. The Multi-Level Risk Assessment Guidelines are intended to assist industry, consultants and the consent authorities to carry out and evaluate risk assessments at an appropriate level for the facility being studied.

The Multi-Level Risk Assessment approach is summarised in **Figure 4**. There are three levels of assessment, depending on the outcome of preliminary screening. These are:

- **Level 1** – **Qualitative Analysis**, primarily based on the hazard identification techniques and qualitative risk assessment of consequences, frequency and risk;
- **Level 2** – **Partially Quantitative Analysis or Semi-Quantitative Risk Analysis**, using hazard identification and the focused quantification of key potential offsite risks; and
- **Level 3** – **Quantitative Risk Analysis (QRA)**, based on the full detailed quantification of risks, consistent with Hazardous Industry Planning Advisory paper No.6 – Guidelines for Hazard Analysis.

FIGURE 4 - THE MULTI LEVEL RISK ASSESSMENT APPROACH



The document "Applying SEPP 33" (Ref.1) guideline may also be used to assist in the selection of the appropriate level of assessment. This guideline states the following:

"It is considered that a partially qualitative PQRA may be sufficient in the following circumstances:

- *where materials are relatively non-hazardous (for example corrosive substances and some classes of flammables);*
- *where the quantity of materials used are relatively small;*
- *where the technical and management safeguards are self-evident and readily implemented; and*
- *where the surrounding land uses are relatively non-sensitive.*

In these cases, it may be appropriate for a PQRA to be relatively simple. Such a PQRA should:

- *identify the types and quantities of all dangerous goods to be stored and used;*
- *describe the storage/processing activities that will involve these materials;*
- *identify accident scenarios and hazardous incidents that could occur (in some cases, it would also be appropriate to include consequence distances for hazardous events);*
- *consider surrounding land uses (identify any nearby uses of particular sensitivity); and*
- *identify safeguards that can be adopted (including technical, operational and organisational), and assess their adequacy (having regards to the above matters).*

A sound qualitative PQRA which addresses the above matters could, for some proposals, provide the consent authority with sufficient information to form a judgement about the level of risk involved in a particular proposal".

The proposed WWTP facility is currently located within the Orora site, as depicted in Figure 2 and 3 in an area zoned industrial, approximately 150m west of the nearest area zoned residential on Partanna Avenue, Botany. Based on the separation from sensitive receptors and the potential for domino incidents to adjacent industrial sites, a level 2 analysis (partially Quantitative or Semi-Quantitative) has been selected as the most appropriate level of assessment for the site.

5. Preliminary Hazard Analysis

The four major steps involved in the preliminary hazard analysis, namely incident identification, consequence analysis, probability and frequency estimations, leading to a partially-quantitative risk assessment (PQRA) result are presented in this section.

5.1 Hazard Identification

The nature of the materials stored or processed on site is an important part of the PQRA because it establishes whether fire, explosion or toxic releases are possible and to what degree. For example, the storage and transfer of flammable liquids or gases such as Biogas presents potential fire and explosion hazards.

5.1.1 Nature and Quantity of Materials Stored / Processed on Site

The WWTP will require the additional storage and handling of corrosives, including acids and caustic. The storage type, class, and Hazchem code, heath & environmental effects and the safeguards employed are summarised in Table 3 – Hazardous Nature & Quantity of Materials Stored. The Material Safety data sheets for those material listed, are held on-site, and can be provided on request.

5.1.2 Hazard Identification and selection of Major Accident Events

A hazard identification table has been developed and is presented in Table 4, and summarises those hazards identified to have a potential impact offsite. These consequences and likelihood of these events are then assessed in detail in the following section of this document.

TABLE 3: HAZARDOUS NATURE OF MATERIALS

MATERIAL / QTY	HEALTH HAZARDS & PHYSICAL PROPERTIES	ENVIRONMENTAL HAZARDS	SAFEGUARDS
Hydrogen Chloride (33 % HCL) / 45 m3 tank	Hydrochloric acids are classified as corrosive liquids Class 8 PG II. Contact with people could result in necrosis of the skin and other soft tissue. Vapours could impact the mucous membranes.	Acids and alkalis can cause burns, avoid contact with skin or eyes. PPE required. All products are miscible in water. Corrosive liquids could impact the biophysical environment if released beyond the confinement systems at the plant. Decomposition under fire conditions liberates toxic fumes.	Pressure Relief Vent (PRV) valve provided Comprehensive emergency plan and procedures provided for the site. MSDS held for all materials. Emergency Spill kits provided. Annual fire and evacuation training to be conducted.
Biogas (Methane 80% / carbon dioxide 20%)	Compressed biogas is classed as a 2.1 Flammable gas, and can form explosive mixtures with air in the range 5 – 16 % by volume.	N/A – mainly a fire risk (explosion risk very unlikely in open areas)	SCADA and emergency shut-down systems; Gas Detection

Note: Further details of safety handling procedures and emergency response are provided in the Material Safety data Sheets (MSDS) – Appendix B.

TABLE 4: GENERALISED HAZARD IDENTIFICATION TABLE AND SELECTED MAE'S

FACILITY/EVENT	CAUSE/COMMENTS PHYSICAL PROPERTIES	POSSIBLE RESULTS CONSEQUENCES	PROPOSED/ TYPICAL SAFEGUARDS
Gas Holder Enclosure (GHE)	- joint or pipe failure, leading to build up of gas in GHE, followed by ignition - failure of gas bag, ignition and explosion -	- Leak/rupture, ignition, explosion	- Gas detection to be provided within the enclosure - Gas Holder enclosure is vented with fans or pressurised to deal with fugitive emissions - fire detection installed in the enclosure (linked to fire-fighting system) - fire hydrants, hose reels and extinguishers available on site
Hydrochloric Acid (33%) / 45 m3	- Class 8 Corrosive liquid - Corrosive acid, damaging to the environment, and causes visible necrosis of the skin within 3 to 60 minutes of exposure, exothermic reaction with water.	- Dangerous to aquatic life in high concentrations. - Aquatic Toxicity: LC50 Flounder 100 to 330 mg/l/48 hr aerated water/Conditions of bioassay not specified; LC50 Shrimp 80 to 90 mg/l/48 hr aerated water	- Acid Spills collected in a bund of 110% of tank capacity. - Tanker hard stand area to drain to a hard sump - Comprehensive emergency plan and procedures provided for handling HCL - MSDS held for all materials - Emergency Spill kits provided

5.2 Consequence Analysis

The major accident events identified for further analysis include;

- Biogas Leak (Gas Holder Enclosure)
- Flaring during emergency
- Hydrochloric Acid release into bund

These events will be reviewed to determine whether off site effects are possible, and potential risks levels at the site boundary or whether further controls, other than those already identified, are required for risk reduction purposes.

5.2.1 Biogas Bag Failure

The biogas produced during the anaerobic digestion is composed mainly of CH4 (taken as 80%) and CO2 (20%) and can be used as an energy source, usually in the form of heat and/or after conversion into electricity by cogeneration.

The gas holder will operate at pressures up to 3bar (and a design burst pressure of 6 bar) and has a maximum volume of 60 m3. (Note: Biogas Density @25 deg C, 6 bar = 4.5 kg/m3).

Under normal circumstances should a gas leak occur within the gas holder enclosure (GHE), the enclosure ventilation fan would extract the gas and disperse it externally without incident.

However, in the event of the gas holder failing, and ignition, a gas explosion could occur. This explosion would result in destruction of the gas enclosure and local blast impact. To estimate the magnitude of the blast wave the multi-energy method was used, based on the maximum quantity of fuel (270 kg) available when the full gas bag (60 m3) ruptures or fails, and source parameters as summarised in Appendix A2 - For Blast curve selection. Explosion overpressure results are presented in Appendix A.3. The distance to overpressure results are summarised in Table 5. This gives an overpressure at the site boundary/ residential area (170m away) of around 7 kPa.

Distance (m) from the cloud centre to overpressures of concern (kPa)				
7kPa	**14kPa**	**21 kPa**	**35kPa**	**MEM Curve Type**
170	100	75	55	7 -10 (selected 9)

Table 5 - Distance (m) from the cloud center to overpressures of concern (kPa)

5.2.2Flaring

Further, in case of process upset, or equipment failure or plant emergency, the entire biogas stream can be directed to flare. At this stage Orora anticipate the flare stack height to be 3m, with maximum flow rate (based on maximum biogas production and storage capacity) around 13 GJ/hr at 2.5 bar (approx. 325 kg/hr of Biogas).

A flare calculation was undertaken to ensure heat flux at ground levels are acceptable, and given the low throughput, heat flux levels at ground level did not exceed 3kW/m2. Hence this event was not carried forward for cumulative risk assessment.

Flare calculation results using the chamberlain method are provide in Appendix A.4

5.2.3 HCL release (evaporation of liquid pool)

Hydrochloric acid will be utilized for wastewater PH adjustment. Typical strengths for HCL for water treatment usage are 33% by weight, with the remainder aqueous. HCL will be stored in a dedicated fixed roof tank within a concrete containment bund of 36 m2. The HCL will arrive via Chemical road tanker (10 MT) on a monthly basis. A dedicated chemical tanker standing area is provided to contain minor spills. It is assumed the transfer rate is 20 MT / hr

The method and calculations for the evaporation rate and dispersion modelling of a mixture of 33% HCL and water is provided in Appendix A5 – Hydrochloric Acid Spill.

Results for 33% HCL are given for daytime (D4) and night-time releases (F1.5) are summarised in Table 6.

The following assumptions have been made;

1. Tank failure leads to a semi-continuous release of 20 MT/hr (5.5 kg/s), over a period of 20 mins, i.e. a six tonne release into the tank bund.
2. Failure is from equipment or tank failure, or an overfill event, before action is taken (e.g. pump to other tank vehicle, or apply foam blanket over spill)
3. Corrective action is assumed to occur in 20 mins during daytime or night-time operations as the site is operational 24/7.

Concentrations of Interest (ppm) versus Distance (m)						
Release Condition	**Evaporation rate (kg/s)**	**1% LC**	**IDLH (280ppm)**	**ERPG 1 (3ppm)**	**ERPG2 (50ppm)**	**ERPG3 (120ppm)**
D4	0.082	0.25	1.5	58	12	2.5
F1.5	0.041	0.26	6.3	198	46	8.4

Table 6 – Comparative Evaporation Rates and Downwind Dispersion Results

HCL Toxicology for Inhalation

Exposure to 0.2 – 10 ppm hydrogen chloride does not appear to cause adverse respiratory effects in humans.

Irritation to the nose and throat, causing coughing, pain, inflammation and oedema of the upper respiratory tract was reported following inhalation of 5 ppm hydrogen chloride.

Exposure to 50 – 100 ppm was barely tolerable for 1 hour. Since it is highly water soluble, effects on the upper respiratory tract predominate following inhalation. In one study short term exposure to approximately 35 ppm produced sneezing, laryngitis, chest pain, hoarseness and a feeling of suffocation. This concentration was reported to be below the threshold for taste or eye irritation. Exposure can also produce ulceration of the nasal septum. Other effects that have been noted included headache, palpitations, shock, tachypnoea, tachycardia and circulatory collapse

At high concentrations it can cause corrosive burns to the eyes, mouth, nose and throat, nasoseptal perforation, constriction of the larynx and bronchi, necrosis of the bronchial epithelium, immediate onset of tachypnoea, blue colouration of skin, narrowing of bronchioles and rapid swelling and spasm of the throat, leading to suffocation. Chemical pneumonitis and pulmonary oedema may also occur. However, tolerance may occur and it has been reported that some individuals are capable of enduring short term exposure to concentrations as high as 670 – 1250 ppm hydrogen chloride [3].

Toxicological Definitions follow:

STEL – or short term exposure limit is defined as the average airborne concentration over a 15 minute period which should not be exceeded at any time during a normal eight-hour workday.

The IDLH or immediately Dangerous to life and Health is defined as the Level below which a worker can escape to safety in thirty minutes in the event of sudden exposure to a dangerous atmosphere, without respiratory protection and without impairing his ability to escape.

ERPGs are defined as follows:

ERPG-1 is the maximum concentration in air below which it is believed nearly all individuals could be exposed for up to **one hour** without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odour.

ERPG-2 is the maximum concentration in air below which it is believed nearly all individuals could be exposed for up to **one hour** without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

ERPG-3 is the maximum concentration in air below which it is believed nearly all individuals could be exposed for up to **one hour** without experiencing or developing life-threatening health effects.

ERPGs (Emergency Response Planning Guidelines)

Chemical	ERPG-1	ERPG-2	ERPG-3
Hydrogen Chloride (7647-01-0)	3 ppm ✪	20 ppm	150 ppm

✪ indicates that odor should be detectable near ERPG-1.

(AIHA, 2015)

Summary Results

Emergency Response Planning Guidelines (ERPG) 1, 2 & 3 levels (emergency response levels of 3, 50 and 120 ppm respectively) extend considerable distance but are generally contained on-sit, and hence there are no risk implications offsite. Therefore this event was not carried forward for cumulative risk assessment.

Note 1: All consequence modelling has been conducted using the latest version of TNO Effects V10.0.3. Refer Appendix A7 for details of the model.

Note 2. All input / output data and consequence analysis results are is provided in the Appendices to this PHA review report.

5.3 Frequency Analysis

Generalised Probability/Frequency data is given in Table 7 – Generalised Probability Data for the potential events that may have offsite effects.
The data is generally expressed on a per annum basis. The reference sources for all data used in this study, is also given in the table.

Event	Item	Failure Possibility	Name /Reference #
Gas Metering and Compression Pipework	Up to 150 mm Schedule 80	1 .9 x 10-7/m/yr	HSE Failure rates / 13
Gas Holder gas bag failure	Gas bag or membrane	1.0 x 10-5 per yr	OGP Risk Assessment data book (2010)
HCL Leakage into Bund due to tank failure	Fixed Storage Tank Road Tanker Area (hose failure)	3 x 10-6/ yr 4 x 10-8/hr	RAAD Study (OGP) Covo Study
Centrifugal Pumps	Casing failure Shaft failure Seal failure	3.8 x 10-6/yr 1 x 10-4/yr 1 x 10-2/yr	USAEC
Road tanker	Flexible hose failure	4 x 10-5 / yr	HSE Failure rates / 13
Transformer	Violent transformer failure leading to fire	1 x 10-4 / yr	Peterson / 18

TABLE 7 - GENERALISED FREQUENCY DATA

The above failure rates for equipment items are provided to illustrate their reliability. However, for the failure of the gas bag, the probability of ignition is taken as 1.0.

5.4 Cumulative Risk Assessment

The cumulative risk results are computed by combining the event frequencies and consequence distances (fatality effects) at the boundary of the site. These cumulative risk levels are then compared to the suggested Individual fatality risk criteria for adjacent land uses as shown in Table 8 - Land Use Safety Criteria.

Land Use	NSW DP&E Criteria (risk in a million per year)	Local Land Use / Comments
Hospitals, Schools, child-care facilities, old age housing	0.5	Located over 500m away
Residential , hotels , motels, tourist resorts	1.0	Closest residence at Partanna Street, 170 m from WWTP
Commercial developments including retail centres, offices and entertainment centres	5	
Sporting complexes and active open space , roads etc.	10	
Industrial land use	50	McCauley Street Industrial Precinct, situated 130m from WWTP

TABLE 8 – SUGGESTED INDIVIDUAL FATALITY RISK CRITERIA (NSW DP&E)

The land use safety implications for the proposed development are summarised in Table 9 – Overall Risk Evaluation for the nearest residential area at Partanna Ave, and in Table 10 for the nearest industrial area at McCauley Street.

The cumulative risk levels at the nearest residential boundary at Partanna Avenue, Botany where computed to be 0.1 per million per year, and at McCauley Street Industrial precincts 0.2 per million per year. The locations selected for cumulative risk summation are depicted in Figure 5 – Cumulative Risk Assessment Locations.

Both tables 9 & 10 summarise the events, event probability and risk as follows:

Event – the event is taken from the risk identification table. The event covers the likely mode of failure of the plan item or equipment.

Base Frequency x 10^{-6} – is the failure frequency of each event, taken from the generic failure rates given in Table 7 – Generalised Frequency Data.

PF (E) – is the probability of fatality to a person on the boundary from the event. Due to the fact that those external to the site would take shelter or emergency action the probability of fatality is estimated at less than 1.0. The probit method and chance of fatality computations are provided in Appendix A.6 – Probit Method for explosion overpressure and HCL Dose.

Risk x 10^{-6} – is the product of the frequency x probability of injury and is defined as the risk of exposure from the event.

CF-Risk – is the cumulative addition of the individual risk results at the nominated boundary of the site.

The suggested criteria for the adjacent land use, i.e. general industrial areas on the south and eastern sides, is given by the NSW DP&E as 50 in a million per annum (general industrial land use safety criteria. For open space activities, boundary risk levels should not exceed 10 in a million per annum, and for the closest residential areas at Partanna Avenue, Botany a risk level of 1 in a million per annum.

Hence the resultant risk levels computed for the scenarios selected, total 0.1 in a million per annum at the nearest residential area, and 0.2 in a million at the nearest industrial area adjacent, and hence are considered acceptable in land use safety terms when viewed against the NSW DP&E risk assessment criteria.

EVENT / #	Freq (x 10-6 /yr) from table 7	Distance to Boundary (m)	Effect at Boundary	Pf(E) Appendix A.6	Individual Risk x 10-6 At Boundary	Threshold / Comment
1. Biogas Gas Holder failure and explosion	10	170	Overpressure below 7kPa	0.01	0.1	1 x 10-6pa / Not exceeded
TOTAL RISK LEVEL at BOUNDARY					0.1	

Table 9 - Overall Risk Evaluation - Partanna Street Boundary

EVENT / #	Freq (x 10-6 /yr) from table 7	Distance to Boundary (m)	Effect at Boundary	Pf(E) Appendix A.6	Individual Risk x 10-6 At Boundary	Threshold / Comment
1. Biogas Gas Holder failure and explosion	10	130	Overpressure below 14kPa	0.02	0.2	50 x 10-6pa / Not exceeded
TOTAL RISK LEVEL at BOUNDARY					0.2	

Table 10 - Overall Risk Evaluation - McCauley Street Industrial precinct

Figure 5 – Cumulative Risk Assessment Locations

6. Conclusions and Recommendations

The findings of the PHA demonstrate that resultant risk levels of 0.1 per million per year (0.1 x 10^{-6} pa) are below the NSW DP&E land use safety criteria for residential land use of 1 per million per year (1 x 10^{-6} pa) at the eastern boundary of the site.

The operation of the proposal will include appropriate safety features, including all requirements of NSW DP&E and the relevant Australian Standards. These features should ensure acceptable levels of risk to adjacent landowners and the environment.

To ensure Safety in Design requirements are met and risk levels are as low as reasonably practical (ALARP), a number of risk recommendations are made and include;

- **Emergency Response Plan** – The Emergency Response Plan (ERP) will need to be reviewed and updated for the new WWTP
- **Construction Safety Study** – A construction safety study or similar Safety in Design review will need to be conducted for the proposed development, using suitable Construction Safety in Design review techniques. Such techniques include CHAIR review techniques.

  ***Note**: CHAIR (Construction Hazard Assessment Implication Review) is a safety in design technique to assist designers, constructors, clients and other key stakeholders to come together to reduce construction, maintenance, repair and demolition safety risks associated with design. Further details can be submitted on CHAIR methods on request.*

7. References

1. Modification #6 – Upgrade of Waste Water Treatment Plant (WWTP), Initial Assessment report prepared by ConsultInfra, dated February, 2016.
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4. State Environmental Planning Policy No.33 – Hazardous and Offensive Development Application Guidelines (1994), "Applying SEPP 33", Department of Planning NSW.
5. Multi-Level Risk Assessment, Department of Infrastructure, Planning and Natural Resources – 1997.
6. The Australian Code for the Transport of Dangerous Goods by Road and Rail (known as the Australian Dangerous Goods Code or ADG 7), Federal office of Road Safety, Canberra.
7. AS3780-2008, "The Storage and Handling of Corrosive Liquids", Standards Association of Australia, Sydney
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