BOC Kooragang DA 8354 Response to Request for Response to Submissions June 2017

BOC Limited Kooragang Island

22 June 2017

Office 1, Level 2 • 335 Wharf Road • Newcastle NSW 2300 • Telephone 02 4926 4222 • Facsimile 02 4929 4944 • ABN 21 089 600 019 • ACN 089 600 019

BOC Kooragang DA 8354 Response to Request for Response to Submissions June 2017

BOC Limited Kooragang Island

22 June 2017

MJM Environmental Pty Ltd
ABN 21 089 600 019
Office 1, Level 2
355 Wharf Road
Newcastle, NSW, 2300
Telephone: 02 4926 4222
Facsimile: 02 4929 4944
E-mail: enquiries@mjmenvironmental.com.au

Document Control				Approved for Issue		
Project No.	Rev	Author	Reviewer	Name	Signature	Date
034-1675	0 - Draft	B Kelly	M. Majerowski	M. Majerowski	Monica Majerowski	21/06/2017
034-1675	1	B Kelly	M. Majerowski	M. Majerowski	Monica Majerowski	22/06/2017

Table of Contents

List of Figures

List of Tables

Appendices

1 Introduction

1.1 BOC Limited Kooragang Island

The following report has been prepared by MJM Environmental Pty Ltd for BOC Limited Kooragang Island, herein referred to as BOC Kooragang. The report is intended for submission to the NSW Department of Planning and Environment (the Department) and NSW Environmental Protection Authority (EPA).

BOC Limited Kooragang Island, herein referred to as BOC Kooragang, owns and operates a gas facility for the production and supply of gas products located at Lot 5 DP 1015754 9 Egret Street Kooragang, New South Wales. The facility operates 24 hours per day, 7 days per week. BOC Kooragang holds NSW Environmental Protection Authority (EPA) Environmental Protection Licence (EPL) 20165.

1.2 Development Application to the Department of Planning

BOC Kooragang currently possess two (2) cooling towers onsite. Currently the cooling tower blowdown (waste) water is produced at a rate of 18,200 litres per week. The effluent continues to two (2) 10,000 litre capacity storage tanks onsite, totalling a capacity of 20,000 litres of storage onsite. The wastewater is collected by an approved waste contractor approximately once per week. BOC Kooragang have performed internal investigations regarding the feasibility of utilising the cooling tower wastewater for irrigation purposes in grassed areas of the site.

BOC Kooragang's site is located within the '*Lease Area'* of the *State Environmental Planning Policy (Three Ports) 2013* (SEPP Three Ports 2013). Therefore, the Department of Planning and Environment (the Department) is the consent authority for modifications and development approval under the *Environmental Planning and Assessment Act 1979* (EP&A Act) intended for submission to the Department.

The land is owned by Port of Newcastle Lessor Pty Limited c/o Property NSW (PON) and approval was obtained from PON and is provided with the Development Application (DA).

On 20 March 2017 BOC Kooragang submitted a Development Application (DA) to the Department under *DA 8354 BOC Kooragang Irrigation of Cooling Tower Effluent*.

A *Request for Response to Submissions* was received for DA 8354 via email and dated 8 May 2017. The Request for Response contained queries from the following departments:

- Department of Planning and Environment
- Newcastle City Council
- NSW EPA
- Department of Primary Industries
- NSW Health Hunter New England Local Health District

The following report is intended for submission to the Department to provide responses to queries received about DA 8354.

The responses are provided in order of the responses received by the Department. Some of the queries may overlap and this is explained in the responses.

2 Site characterisation and baseline conditions

The Department has requested the following information:

> *Please provide additional information on the baseline soil conditions of the site and its suitability for irrigation.*
>
> *The Statement of Environmental Effects (SEE) includes a geotechnical investigation, however this investigation only identifies the type of soil and depth to groundwater. Other key soil properties are assumed in the SEE, making reference to previous investigation in the area. Please provide further details of these investigations and how these assumptions were made.*

Appendix A provides a copy of the soil and groundwater reports for sampling performed in May 2017. Further commentary is provided in the following sections.

2.1 Groundwater characterisation and baseline conditions

A summary of the groundwater monitoring results performed in May 2017 is presented in Table 2-1 and represents existing conditions at the site. Groundwater investigation levels (GILs) are shown as comparable guidelines.

Table 2-1: BOC Kooragang Groundwater Results – May 2017

Analyte	Units	BH1	BH2	BH3	BH4	BH5	BH6	GILs
pH	pH	7.78	7.43	7.69	7.57	7.84	8.04	-
Conductivity	µS/cm	713	673	492	694	670	722	-
Sodium Absorption Ratio	-	0.53	0.37	0.26	0.48	1.70	1.10	-
Total Alkalinity as calcium carbonate	mg/L	228	244	181	248	233	269	-
Chloride	mg/L	22	20	11	19	41	34	-
Sodium	mg/L	20	14	8	18	50	39	-
Nitrogen (total)	mg/L	52.0	33.4	9.1	60.8	2.8	4.0	-
Total Kjeldahl Nitrogen	mg/L	52.0	33.4	8.9	60.8	2.5	3.8	-
Nitrate	mg/L	0.01	0.05	0.20	0.03	0.32	0.15	50
Sulfate	mg/L	88	48	42	50	<50	10	500
Phosphorus	mg/L	29.8	24.2	14.0	51.2	1.93	2.60	-
Reactive Phosphorus	mg/L	0.02	<0.01	0.14	0.06	0.30	0.57	-
Total dissolved solids	mg/L	840	795	432	815	372	429	-
Fluoride	mg/L	0.5	0.8	0.6	0.9	0.8	0.9	-
Standing Water Level	m	2	2	1.5	2.5	2	2	-
Metals (dissolved)								
Arsenic	mg/L	<0.001	<0.001	0.002	<0.001	0.001	0.002	0.024 as As(III) 0.013 as As(V)
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001 as Cr(VI)
Copper	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.0014
Nickel	mg/L	<0.001	0.001	<0.001	0.001	<0.001	0.001	0.011
Lead	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0034
Zinc	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008
Mercury	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0006

[1] Levels considered appropriate for comparison here, taken from *National Environmental Protection (assessment of site contamination) Amendment Measure 2013; Schedule B1 'Guideline on Investigation Levels for Soil and Groundwater'; (Vol 2) Table 1C for fresh water aquatic ecosystems*

It can be seen that the results of the baseline groundwater sampling do not exceed any of the applied GILs.

It is therefore not expected that further investigation of the groundwater is required at this time. Groundwater will continue to be monitored as part of the proposed project.

2.2 Soil characterisation and baseline conditions

Appendix A provides the complete soil monitoring and analysis report for sampling performed in May 2017. Sampling was performed in the proposed irrigation area and at three (3) background locations. Sampling was performed in accordance with the sampling grid advised by NSW EPA's Soil Sampling guidelines and *AS4482.1-2005 – Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil*.

Further commentary is provided in the following sections. A summary of the soil monitoring results performed in May 2017 is presented in Table 2-2 and represents existing conditions at the site prior to irrigation occurring. Analytes below the limit of detection, such as additional VOCs and PAHs, are not included in the table. The full results report is available in Appendix A.

Average soil results have been compared to appropriate guidelines.

Table 2-2: Soil results - average results for irrigation area and background points

Analyte	Unit	Average Irrigation Area result		Average Background Result		Health Investigation Levels
		Surface	Sub surface	Sub surface	Sub surface	
pH	pH Unit	8.1	8.7	8.3	8.7	-
Fluoride	mg/kg	56	30	60	67	-
Chloride	mg/kg	7	<10	<10	<10	-
Conductivity	µS/cm	74	50	68	61	-
Cation Exchange Capacity	meq/100g	1.9	1.1	2.2	2.0	-
Exchangeable Calcium	meq/100g	1.9	1.1	2.2	1.9	-
Exchangeable Magnesium	meq/100g	<0.2	<0.2	<0.2	<0.2	-
Exchangeable Potassium	meq/100g	<0.2	<0.2	<0.2	<0.2	-
Exchangeable Sodium	meq/100g	<0.2	<0.2	<0.2	<0.2	-
Moisture	%	3	2	2.5	2.5	-
Nitrate	mg/kg	1	0	1.9	1.0	-
Nitrogen (total; TKN + NOX)	mg/kg	704	227	640	343	-
Total Kjeldahl Nitrogen (TKN)	mg/kg	704	227	640	343	-
Phosphorus (total)	mg/kg	141	69	188	190	-
Phosphorus Sorption Capacity	mg P sorbed/kg	311	146	478	470	-
Bray Phosphorus *	mg/kg	10	2	20.5	12.5	-
Collwell Phosphorus **	mg/kg	16	10	28	20	-
Arsenic	mg/kg	<5	<5	<5	<5	3,000
Cadmium	mg/kg	<1	<1	<1	<1	800
Chromium	mg/kg	4.7	2.7	5	5	3,000 (as CrVI)
Copper	mg/kg	7.6	<5	5.5	5.5	25,000
Lead	mg/kg	27	8	15	9	1,500
Nickel	mg/kg	3	2	3	4	4,000
Zinc	mg/kg	106	39	76	61	400,000
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	4,000 (inorganic)
Suspension Peroxide Oxidation – Combined Acidity and Sulfate (SPOCAS)						
pHKCl	pH Unit	9.3	9.6	9.4	9.5	-

Analyte	Unit	Average Irrigation Area result		Average Background Result		Health Investigation Levels
		Surface	Sub surface	Sub surface	Sub surface	
pH OX	pH Unit	7.5	8.2	7.8	8.0	-
KCl Extractable Sulphur	% S	<0.02	<0.02	<0.020	<0.020	-
Titratable Actual Acidity	mole H+ / t	<2	<2	<2	<2	-
Titratable Peroxide Sulphur	% pyrite S	<0.02	<0.02	<0.020	<0.020	-
Acidity - Peroxide Oxidisable Sulphur	mole H+ / t	12.3	<10	11	9	-
Net acidity excluding ANC† (sulfur units)	%S	0.02	<0.02	0.02	0.01	-
Net acidity excluding ANC† (acidity units)	mole H+ / t	12	<10	11	9	-
Liming rate excluding ANC†	kg/$CaCO_3$/t	0.9	<1	0.7	0.7	-
Volatile Organic Compounds (VOCs)						
Dichlorodifluoromethane	mg/kg	<5	<5	<5	<5	-
Chloromethane	mg/kg	<5	<5	<5	<5	-
Vinyl chloride	mg/kg	<5	<5	<5	<5	2
Bromomethane	mg/kg	<5	<5	<5	<5	-
Chloroethane	mg/kg	<5	<5	<5	<5	-
1,2-dichloroethane	mg/kg	<0.5	<0.5	<0.5	<0.5	-
Tetrachloroethene	mg/kg	<0.5	<0.5	<0.5	<0.5	-
Trichloroethene	mg/kg	<0.5	<0.5	<0.5	<0.5	-
1,1,1-trichloroethane	mg/kg	<0.5	<0.5	<0.5	<0.5	-
cis-1.2-Dichloroethene	mg/kg	<0.5	<0.5	<0.5	<0.5	-
Carbon Tetrachloride	mg/kg	<0.5	<0.5	<0.5	<0.5	-
Naphthalene	mg/kg	<1	<1	<1	<1	11,000[2]
Polycyclic Aromatic Hydrocarbons (PAHs)						
Sum PAHs	mg/kg	<0.5	<0.5	0.4	0.7	4,000
Naphthalene	mg/kg	<0.5	<0.5	0.4	0.4	-
Acenaphthylene	mg/kg	<0.5	<0.5	<0.5	<0.5	-
Fluorene	mg/kg	<0.5	<0.5	<0.5	<0.5	-
Phenanthrene	mg/kg	<0.5	<0.5	<0.5	<0.5	-
Anthracene	mg/kg	<0.5	<0.5	<0.5	<0.5	-

Analyte	Unit	Average Irrigation Area result		Average Background Result		Health Investigation Levels
		Surface	Sub surface	Sub surface	Sub surface	
Pyrene	mg/kg	<0.5	<0.5	0.3	0.3	-
Benzo(a)anthracene	mg/kg	<0.5	<0.5	<0.5	<0.5	-
Benzo(a)pyrene	mg/kg	<0.5	<0.5	<0.5	<0.5	40
Benzo(b+j)fluoranthene	mg/kg	<0.5	<0.5	<0.5	<0.5	-
Benzo(g,h,I)perylene	mg/kg	<0.5	<0.5	<0.5	<0.5	-
Benzo(k)fluoranthene	mg/kg	<0.5	<0.5	<0.5	<0.5	-
Chrysene	mg/kg	<0.5	<0.5	<0.5	<0.5	-

*As Fluoride Extractable P
**As Bicarbonate Extractable P
***Peroxide Oxidation Combined Acidity and Sulphate for Acid Sulphate Soil
† Acid neutralising capacity
[1] Levels considered appropriate for comparison here, taken from *National Environmental Protection (assessment of site contamination) Amendment Measure 2013; Schedule B1 'Guideline on Investigation Levels for Soil and Groundwater'; (Vol 2) Table 1A(1) Health Investigation Levels for soil contaminants for land use Commercial Industrial (D)*
[2] *National Environmental Protection (assessment of site contamination) Amendment Measure 2013; Schedule B1 'Guideline on Investigation Levels for Soil and Groundwater'; Table 1A(6) Health Screening Levels Soil* for direct soil contact for industrial area.

The soil pH ranged from 7.8 to 8.9, and the background points showed a consistent pH range similar to the proposed irrigation area. Grassed areas are currently in existence. Optimum plant growth is between 6 and 7.5. The effluent pH has shown historically it will meet the irrigation threshold levels therefore it is not expected to have adverse effects on the baseline soil pH.

Fluoride was detected for most samples from 40 mg/kg to 90 mg/kg at the proposed irrigation area and background area. The rest of the samples were below the detection limit of 40 mg/kg. Fluoride is covered in the effluent guidelines as it concerns risks to grazing animals.

The majority of results for Chloride at the proposed irrigation area and background did not reach the limit of reporting.

The Conductivity results show a consistent range in both the proposed irrigation area and background soils, ranging from 42 µS/cm to 95 µS/cm (which converts to 0.042 to 0.095 dS/m). An indicator of salt (salinity) concentration is electrical conductivity of a soil sample. The Effluent Guidelines state that where the conductivity is less than 2 dS/m, effects on plants are mostly negligible, therefore the soil is suitable for this parameter.

The Exchangeable Cations Magnesium, Potassium and Sodium in the irrigation and background soil were below the limit of reporting. The Exchangeable Calcium and Cation Exchange Capacity ranged from 0.7 to 4.0 meq/100g which appears to be due to the Exchangeable Calcium. The surface soil had a higher range of 1.0 to 4.0 meq/100g, while the sub-surface soil range was 0.7 to 1.9 meq/100g. The cation exchange capacity (CEC) of a soil looks at the cations of calcium, magnesium, potassium, sodium and aluminium, and relates to soil structure. Higher CECs result in a good soil structure and nutrient availability. Sandy soils by nature have a low CEC. The soils at Kooragang possess a sandy topsoil with clay present from 3 metres deep. The grassed areas of site show that the soil is capable of providing structure and stability for the existing grasses. Organic matter can be added to soils with a low CEC if required.

Phosphorus is required for plant growth and Australian soils are able to immobilise phosphorus in soils, therefore many plants require the addition of phosphorus to enable plant growth. Alluvial soils and sandy soils have a relatively low phosphorus sorption capacity, which can result in leaching of phosphorus applied to land to sources such as groundwater.

Total Phosphorus in the surface soil of the proposed irrigation area range from 67 to 182 mg/kg, which appeared to show a slightly higher trend than the sub-surface samples ranging from 55 to 85 mg/kg. The surface soil in the background samples range from 59 to 356 mg/kg. The nitrogen appears to be comprised of mostly Total Kjeldahl Nitrogen (TKN) and the background samples appear comparable to the proposed irrigation area results.

Bray and Colwell Phosphorus are measures of the available phosphorus for plant uptake in the soil. The Bray Phosphorus (as Fluoride Extractable P) at the proposed irrigation area ranged from 1.3 to 21 mg/kg, which was comparable to the background results range of 1.3 to 34.2 mg/kg. The Colwell Phosphorus (as Bicarbonate Extractable P) at the proposed irrigation area ranged from 7 to 22 mg/kg, which was reasonably comparable to the background results range of 8 to 41 mg/kg. Therefore, it can be seen the current phosphorus available for plants in the soil is a low percentage compared to the total phosphorus measured.

Phosphorous sorption capacity ranged <250 to 404 mg of phosphorus absorbed per kilogram of soil (mg P sorbed/kg) at the proposed irrigation area, which was slightly lower than the background samples ranging from <250 to 910 mg P sorbed/kg. The effluent phosphorus concentration is expected to be approximately 0.02 to 1 mg/L. Therefore, as the current sorption capacity is non-detectable to low, the addition of low levels of phosphorus through irrigation with the effluent may be advantageous, as it may be taken up by the existing grass and used as a nutrient, and there is unlikely to be excess phosphorus available. Therefore, the phosphorus concentrations are not expected to cause adverse effects on the groundwater at Kooragang.

Total Nitrogen in the surface soil of the proposed irrigation area ranges from 230 to 1,250 mg/kg, while the surface soil in the background samples range from 140 to 940 mg/kg. The nitrogen appears to be comprised of mostly Total Kjeldahl Nitrogen (TKN), which reflects the organically bound nitrogen in ammonia and ammonium. The nitrogen present in the effluent is expected to be up to 5 mg/L therefore a low strength effluent (<50 mg/L).

Nitrate is the form of soil nitrogen most readily available for plant uptake, which ranged from 0.2 to 1.3 mg/kg in the irrigation area which is low in comparison to the total nitrogen.

The irrigation area and background points appeared to contain trace amounts of chromium, copper, lead, nickel and zinc in ranges consistent with those found in the background samples. One sample in the proposed irrigation area showed a trace detection of Mercury.

Arsenic and Cadmium were not detected in the proposed irrigation area samples or the background samples.

Polycyclic Aromatic Hydrocarbons (PAHs) were non-detectable with the exception of a low detection at background locations BG2A and BG2B. Volatile Organic Compounds (VOCs) were non-detectable.

The Suspension Peroxide Oxidation – Combined Acidity and Sulfate (SPOCAS) suite measures an 'acid trail' (determination of acidity produced by oxidation) and a 'sulfur trail' (determination of sulfur to predict potential acidity). The tests use an acid-base accounting method to calculate net acidity of a sample and estimate the quantity of materials required to neutralise the acid. The results for the SPOCAS suite appear to have low traces of acid forming sulphur and pyrite. The Acidity Trail results, including the Titratable Actual Acidity (TAA) and Titratable Peroxide Acidity results were below detection for all samples.

The Titratable Actual Acidity (TAA) results show a current pH (pHKCl) range of 8.9 to 9.6 in the irrigation area and background points. By oxidising the TAA, the results show a minor pH change in the irrigation and background soil, with a pH range between 7.4 to 8.2 as pH OX.

It can be seen that the samples taken at the proposed irrigation area had net acidity results below or close to the limits of detection. The calculated liming rates for potential treatment of the acid is also shown as less than the limit of reporting for most of the samples. Therefore, acid sulphate soils in the site's current state based upon the sampling performed is considered a low risk. The project does not intend to perform excavation to disturb potential acid sulphate soils.

It is therefore not expected that further investigation of the soil is required at this time. Soil will continue to be monitored as part of the proposed project.

3 Monitoring Programs

3.1 Request

The Department has requested the following information:

> *Please revise the monitoring program to ensure consistency with* Environmental Guidelines: Use of Effluent by Irrigation *(DEC, 2004).*
>
> *The Department notes the concerns raised by the EPA relating to the proposed effluent, groundwater and soil monitoring at the site. The listed parameters should be revised to align with the abovementioned guidelines. BOC should also consider the inclusion of biocides in the monitoring, or provide justification for its omission.*
>
> *The Department also requests the monitoring program be revised to include cumulative contaminant loading, as raised by the DPI, and in accordance with the* Australian and New Zealand Guidelines for Fresh and Marine Water Quality Volume 1, The Guidelines*.*

EPA also requested the following information:

> *The proposed baseline and ongoing effluent, groundwater and soil monitoring programs appear appropriate, however, the lists of parameters do not fully align with those recommended by DEC (2004).*
> *Effluent, groundwater and soil monitoring parameters should align with the document '*Environmental Guidelines: Use of Effluent by Irrigation*' (DEC, 2004). In particular, the following amendments are recommended:*
>
> - *monitor five-day biochemical oxygen demand of effluent;*
> - *monitor nitrate in groundwater;*
> - *monitor available phosphorus in groundwater and soils.*
>
> *Further, the biocides in the cooling tower does not get a specific mention. The proponents have tested for a range of pesticides. It is recommended that specific biocides that are used in the process should be documented and active constituents identified in relation to the list of chemicals (e.g. pesticides) samples. Any chemicals identified that are not part of the current sampling regime should be considered for inclusion in the monitoring of the irrigation water and any potential risk to human health (e.g. site workers/visitors from spray irrigation or other contact) and the environment should be assessed.*

The Department of Primary Industries (DPI) also requested the following information:

> *The monitoring program referred to in section 6.2 of the SEE should to include assessment of cumulative contaminant loading in accordance with section 4.2.6 of the* Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volume 1, The guidelines*.*

3.2 Monitoring Programs

Please find below the revised proposed monitoring programs.

BOC Kooragang propose to request EPA include monitoring points in EPL 20165 for the operation of the irrigation system. The following sections outline the proposed monitoring points and additional monitoring programs for EPA's consideration to place in EPL 20165 for:

- Cooling tower wastewater (effluent)
- Groundwater
- Soil

3.2.1 Effluent water monitoring program

It is proposed that the outlet of the irrigation system balance/ buffer tank be included as a monitoring point for effluent monitoring. The cooling tower blowdown water used for irrigation will be monitored for the analytes outlined in Table 3-1. It is proposed that the wastewater will be monitored quarterly for the first year of operation. After the first year of operation, the monitoring program may be reviewed to ensure suitability for subsequent years.

BOC Kooragang will have installed a flow meter as part of the treatment process, which will enable measurement of volume of flows proceeding to the irrigation area.

Table 3-1: Cooling tower wastewater monitoring analytes

Analytes	Unit
pH	-
Electrical conductivity	µS/cm
Sodium Absorption Ratio	-
Alkalinity as calcium carbonate (hardness)	mg/L
Chloride	mg/L
Sodium	mg/L
Fluoride	mg/L
Nitrogen (total)	mg/L
Total Kjeldahl Nitrogen	mg/L
Sulphate	mg/L
Total dissolved solids	mg/L
Phosphorus	mg/L
Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	mg/L
Biological oxygen demand (BOD)	mg/L
Volume	kL/year

3.2.1.1 Cooling tower dosing chemicals

Biocides are chemicals added to evaporative applications such as cooling towers to target organisms in the make-up water and reduce bacterial growth that can harm humans. Legionnaires disease is an example of an illness that can be prevented using biocides. Cooling towers can also be dosed with chemical treatments that prevent corrosion, scaling and fouling to extend asset life.

The cooling towers are dosed with the following substances comprised of the listed components. Safety data sheets (SDSs) are available in Appendix B.

Table 3-2: Cooling tower dosing chemicals used at BOC Kooragang

Substance name	Composition	Purpose
Nalco 7330 (manufactured by Nalco)	A mixture of: 5-chloro-2-methyl-2H-isothiazol-3-one and 2-methyl- 2H-isothiazol-3-one (3:1) 1-5 %	Biocide
3D Trasar 3DT188 (manufactured by Nalco)	Phosphoric Acid 5-10% Sulfuric Acid 1-5% Benzotriazole 1-5%	Corrosion protection and pH control in cooling tower

Research was performed into possibility of monitoring for the biocide. A number of independent laboratories were contacted in regard to the biocide compounds including:

- Australian Laboratory Services (ALS)
  - ALS advised that biocides were not something they could perform.
  - It was reported that the possibility was investigated in previous years in relation to cooling tower work however there was not enough interest to justify investment in methods for the work.
- Other laboratories were contacted and reported they were not able to assist.

At the time of writing there does not appear to be a viable method for biocide analysis in Australia by an independent laboratory. Should a method become available BOC Kooragang will look into implementation of the method as part of the monitoring regime.

The supplier Nalco was contacted for further information about the biocide, Nalco 7330. The substance contains an active biocidal component *5-chloro-2-methyl-2H-isothiazol-3-one and 2-methyl-2H-isothiazol-3-one.* The substance is an organic compound containing a heterocyclic (ring) structure. The substance is dosed at an initial concentration of 100 ppm to the cooling tower, which therefore means an initial concentration of the active substance of approximately 1.5 ppm. The cooling tower is then not permitted to blow down for two (2) hours following dosing. During the two hour period the active biocide degrades. Therefore, the active biocidal component is expected to be present in the blowdown water at a maximum concentration of 1.5 ppm at the start of dosing, and degrades further until it is non-detectable by Nalco equipment before blowdown.

As stated in the SDS the degradation of the active substance begins with the heterocyclic ring opening, and elimination of the chloride ion. The degradation leads to the formation of carbon oxides (carbon dioxide), and to a lesser extent a variety of small organic acids, elemental sulfur and methylamine. The ecological information is provided on the SDS in Appendix B, which states that the material is not expected to bioaccumulate and has no known ecotoxicological effects.

The SDS states that the biocide does not contain substances with an occupational exposure limit, and was cross checked against the *Safe Work Australia Workplace Exposure Standards for Airborne Contaminants*. Once diluted in the cooling tower water, the substance is expected to remain in the water. Use of drip irrigation will assist in controlling risk of potential exposure to employees and contractors.

Information provided from Nalco states that two hours after dosing the active substance is likely to degrade to the point is it non-detectable, or below 1 ppm, and therefore the concentration of the by-products is expected to be less than 1 ppm. Sulfur compounds are included in all proposed monitoring programs. Thresholds for methylamine were not available, however an applied threshold for dimethylamine is found in the ANZECC Irrigation Guidelines in *Table 4.4.5 Guidelines for chemical compounds in water found to cause tainting of fish flesh and other aquatic organisms,* which states a threshold of 7 mg/L for potential tainting of fish regarding human consumption. Although this is not a direct comparison, dimethylamine can occur in the same reaction as production of methylamine. The threshold of 7 mg/L is well above the expected concentration of 1 ppm, which converts to approximately 1 mg/L of methylamine as a conservative value. As methylamine is a by-product of degradation there is likely to be less than 1 mg/L present.

The supplier Nalco (through Ecotech) has advised that a test can be performed for the active component in the biocide at over $400 per sample and can be sent to their internal laboratory. It is therefore proposed that BOC Kooragang will perform the test for the biocide during initial commissioning and annually at the outlet of the treatment system. It is expected that the biocide will be at, or below detection levels due to the described degradation process. The value will be compared to the threshold in the ANZECC Irrigation Guidelines as a conservative assumption.

The substance 3D Trasar 3DT188 is dosed for corrosion inhibition and anti-fouling of the cooling tower equipment at concentrations up to 100 ppm maintained for continued operation. The substance contains phosphoric acid and sulphuric acid. The SDS for 3DT188 states that decomposition products may include sulphur oxides and oxides of phosphorus. Phosphorus and sulphate are included in the proposed monitoring programs. It is noted that the pilot scale filter unit also appeared to reduce phosphorus concentrations as a side-effect.

Benzotriazole acts as the corrosion inhibitor, which is also a heterocyclic compound and soluble in water. Benzotriazole operates by forming an inert layer (film) as a barrier on the surfaces of metals in such units as cooling towers. Dosing at 100 ppm means that the initial concentration of benzotriazole in the cooling tower water would be between 1 and 5 ppm (approximately up to 4.9 mg/L).

Benzotriazole is also used in photographic processes, art preservation, aircraft de-icers and as an ingredient in dishwashing detergents. Therefore, release to the environment can occur through a number of sources and is only partly removed in wastewater treatment plants. The substance is persistent and does not appear to readily biodegrade, although some studies have shown that UV light can assist in partial degradation. Reverse osmosis and ozonation methods appear to successfully remove benzotriazole, along with filtration through magnetic graphene. Successful removal has also been shown with a binary zinc-aluminium oxide filter media (Xu et al, 2010) a media which holds similarities to the proposed activated alumina filter (aluminium oxide).

The ecological information is provided on the SDS in Appendix B, which states that the material is not expected to bioaccumulate and has no known ecotoxicological effects. However further research was performed regarding benzotriazole.

Studies have been performed regarding interaction of plants with known organic contaminants in the environment, specifically phytotransformation (breakdown of organic contaminants in plants). *Phytotransformation of benzotriazoles* (Castro S et al, 2003) studied uptake of benzotriazoles in plant tissue. The study states that toxic thresholds for plants appear to be at doses of 100 mg/L. This appears to be reflected in other studies including *Benzotriazoles: Toxicity and Degradation* (X. WU, 1998) that showed benzotriazoles were toxic to plants at doses used of around 200 mg/L.

The study by Castro S et al stated that '*At levels below the toxic threshold of about 100 mg/L, triazoles appear to be incorporated into plant tissue. Their concentration in the aqueous phase of the culture decreases with time and they cannot be extracted from the plant material… Plants actively take up the triazoles at a rate greater than predicted*'. The study was performed with sunflowers.

Lefevre et al performed a study titled *Benzotriazole (BT) and BT plant metabolites in crops irrigated with recycled water* (2017). The study hypothesized that the results showed benzotriazoles '*may instead be assimilated by plants and regulated internally, thus resulting in similar observed residual levels regardless of exposure*'.

Corrosion inhibition is also an important part of maintaining irrigation equipment, especially where copper piping may be used.

It is therefore proposed that as the benzotriazole is below the toxic threshold for plants, and the use of the metal oxide (alumina) filter, that the proposed use for irrigation may be suitable.

In order to perform due diligence, benzotriazole will be monitored at the outlet of the treatment system, upon commissioning and annually.

BOC Kooragang will continue to monitor the proposed irrigation area visually, and through the monitoring programs. Should the irrigation area appear to be affected by the benzotriazole, BOC Kooragang will perform investigations into treatment of the substance, or through another alternative dosing substance.

3.2.2 GROUNDWATER MONITORING PROGRAM

It is proposed that the bores installed for baseline monitoring be included as monitoring points for groundwater monitoring.

It is proposed the analytes outlined in Table 3-3 will be monitored for the stated frequencies on the first year and subsequent years of operation. After the first year of operation, BOC Kooragang proposes the monitoring program can be reviewed to ensure suitability for subsequent years.

The site's existing CMMS will be utilised for this purpose as required.

Table 3-3: BOC Kooragang proposed groundwater monitoring program

Analytes	Unit	Frequency 1st year	Frequency subsequent years
Fluoride	mg/L	Quarterly	6-monthly
pH	-	Quarterly	6-monthly
Standing water level	m	Quarterly	6-monthly
Electrical conductivity	µS/cm	Quarterly	6-monthly
Sodium Absorption Ratio	-	Quarterly	6-monthly
Alkalinity as calcium carbonate (hardness)	mg/L	Quarterly	6-monthly
Chloride	mg/L	Quarterly	6-monthly
Sodium	mg/L	Quarterly	6-monthly
Nitrogen (total)	mg/L	Quarterly	6-monthly
Nitrate	mg/L	Quarterly	6-monthly
Total Kjeldahl Nitrogen	mg/L	Quarterly	6-monthly
Sulphate	mg/L	Quarterly	6-monthly
Phosphorus	mg/L	Quarterly	6-monthly
Available phosphorus (reactive phosphorus)	mg/L	Quarterly	6-monthly
Total dissolved solids	mg/L	Quarterly	6-monthly
Metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)	mg/L	Quarterly	Annually

EPA proposes to include conditions of approval which will be complied with by BOC Kooragang if EPL variation is granted.

3.2.3 Soil monitoring program

It is proposed that the irrigation area be included as a monitoring point for soil monitoring. It is proposed the analytes outlined in Table 3-4 will be monitored for the stated frequencies. Soil sampling will be performed at the following locations:

- Sampling grid in the proposed irrigation area.
- Three (3) background samples in the immediate surroundings of non-irrigated areas.

For the irrigation area sampling grid, composite samples will be taken for:

- Top soils; and
- Sub-surface soils.

The site's existing CMMS will be utilised for this purpose as required. The soil sampling will be performed in accordance with the *Effluent Guidelines*.

Table 3-4: BOC Kooragang proposed soil monitoring program

Pollutant	Units	Frequency
Fluoride	mg/kg	Annually
Bray Phosphorus (as Fluoride Extractable Phosphorus, Available phosphorus)	mg/kg	Annually
Collwell Phosphorus (as Bicarbonate Extractable Phosphorus)	mg/kg	Annually
Cation Exchange Capacity	meq/100g	Annually
Chloride	mg/kg	Annually

Pollutant	Units	Frequency
Conductivity	dS/m	Annually
Exchangeable Calcium	meq/100g	Annually
Exchangeable Magnesium	meq/100g	Annually
Exchangeable Potassium	meq/100g	Annually
Exchangeable Sodium	meq/100g	Annually
pH	-	Annually
Moisture	%	Annually
Nitrate	mg/kg	Every 3 years
Nitrogen (total)	mg/kg	Every 3 years
Nitrogen Oxides	mg/kg	Every 3 years
Phosphorus (total)	mg/kg	Every 3 years
Phosphorus Sorption Capacity	mg/kg	Every 3 years
Total Kjeldahl Nitrogen (TKN)	mg/kg	Every 3 years
Cumulative contaminant loading	-	After first two data sets are available

4 Proposed irrigation area and water, nitrogen and phosphorus balances

4.1 Revision of proposed irrigation area

The Department has requested the following information:

Please clarify the dimensions of the proposed irrigation area in a revised site plan.

The EPA also requested the following information:

The irrigation area defined in Drawing 1637-01 (Appendix F of the SEE) is much smaller than the 1,314 m2 irrigation area proposed in the main document and appears to differ from the area defined in Figure 7-1 of the SEE.

A container appears to be partially within the proposed irrigation area shown in Figure 7-1. The container will preclude irrigation occurring over part of the irrigation area if it remains.

The proponent should:

- *provide a revised site plan, clarifying the dimensions and location of the proposed irrigation area; and*
- *clarify whether the container will remain partly within the proposed irrigation area (the proposed site plane and proposal should be amended to reflect adjustments to the irrigation area if the container remains).*

The original Figure 7-1 is reproduced in Figure 4-1 which was calculated at 1,314 m^2.

Figure 4-1: Original proposed irrigation area Figure 7-1 from SEE

Figure 4-2 shows the reviewed proposed irrigation area. The area has been measured and confirmed by site management and includes only grassed areas. The total revised area is 1,544 m^2 (0.15 hectare).

Figure 4-2: Reviewed proposed irrigation area

The calculated area is slightly larger than the originally calculated area of 0.13 ha. The water balance, nitrogen and phosphorus balance calculations have therefore been repeated in this document.

Appendix C presents the updated proposed site plan.

In the time between the submission of the DA BOC Kooragang has revised the original pipework which is also presented in Appendix C, and below in Figure 4-3.

Figure 4-3: Proposed revised irrigation pipework system diagram

4.2 Water balance

BOC Kooragang proposed to utilise a full-reuse scheme; that is, to fully utilise the effluent from the cooling towers where possible during normal operations and conditions. A water balance is required to calculate the amount of water and nutrients that can be applied to meet crop requirements, while avoiding runoff and percolation. As per the Effluent Guidelines, the water balance is comprised of:

Precipitation + effluent applied = evapotranspiration + percolation + runoff

Rainfall data was obtained from the Bureau of Meteorology's (BOM) Automated Weather Station 61055 – Nobby's Signal Station approximately 6 kilometres from the BOC Kooragang site.

Table 4-1: BOC Kooragang water flows

Item	Units	Value	Note / Description
Maximum amount of water generated by cooling tower	L/week	18,200	Cooling tower operation is constant and is not seasonal, therefore the maximum amount generated per week can be assumed to be constant for the full year.
	L/day	2,600	
Irrigation area	m^2	1,544	Shown in Figure 4-2.

Table 4-2 shows the calculations performed for the water balance at BOC Kooragang. The water balance calculations use the following data as input:

- Proposed irrigation area.
- Rainfall data. The availability of effluent to be used as irrigation varies with rainfall events.
- Expected effluent flow per day from press as shown in Table 4-1.
- Expected runoff volumes.
- Evaporation data. The availability of effluent to be used as irrigation water varies with amount of water evaporated to atmosphere.
- Evaporation data is used as input to estimate evapotranspiration, and applies a crop factor based upon plant productivity. Evapotranspiration is a more accurate estimation of evaporation from land surface where vegetation is present.

The above data sources are used to estimate the *percolation* at BOC Kooragang in the water balance. Percolation is the '*movement of water down through the soil profile*' as per the Effluent Guidelines, and occurs naturally through rainfall. Percolation also occurs from irrigation in addition to rainfall.

Table 4-2: BOC Kooragang water balance to obtain percolation volumes

Mth	Rainfall averaged from monthly data (mm/day)	Precipitation over irrigation area, averaged[1] (L/day)	Evaporation at irrigation area (mm/month)[2]	Evapotranspiration at irrigation area (mm/day)[2]	Evapotranspiration at irrigation area (L/day)[2]	Runoff (L/day)[3]	Effluent applied over irrigation area (L/day)	Percolation over irrigation area (L/day)[4]	Percolation per m^2 of area (L/m^2.day)[4]
Jan	2.9	4,486	200	4.52	5,934	0	2,600	1,152	0.7
Feb	3.8	5,892	150	3.75	4,928	0	2,600	3,564	2.3
Mar	3.8	5,924	150	3.39	4,451	0	2,600	4,074	2.6
Apr	3.9	6,032	100	2.00	2,628	0	2,600	6,004	3.9
May	3.8	5,799	80	1.29	1,695	0	2,600	6,703	4.3
Jun	3.9	6,078	50	0.75	9,86	0	2,600	7,692	5.0
Jul	3.0	4,663	80	1.03	1,356	0	2,600	5,906	3.8
Aug	2.4	3,663	100	1.45	1,907	0	2,600	4,356	2.8
Sep	2.4	3,712	125	2.29	3,011	0	2,600	3,301	2.1
Oct	2.3	3,615	175	3.67	4,822	0	2,600	1,393	0.9
Nov	2.4	3,682	200	4.67	6,132	0	2,600	150	0.1
Dec	2.6	4,039	200	4.52	5,934	0	2,600	705	0.5

[1] Rainfall data was obtained from the Bureau of Meteorology's (BOM) Automated Weather Station 61055 – Nobby's Signal Station approximately 6 kilometres from the BOC Kooragang site for all available years of rainfall data (1862 to 2015). The values were obtained from the average of the daily rainfall values for each month.

[2] Evapotranspiration was calculated using the BOM's Evaporation Maps for each month available at http://www.bom.gov.au/jsp/ncc/climate_averages/evaporation/index.jsp. The maps are based upon data from 1975 to 2005. Evapotranspiration was calculated as per the Effluent Guidelines Table 4.1 assuming a crop factor for *Pasture* of 0.7.

[3] For a full reuse scheme the runoff is to be zero.

[4] *Percolation = (precipitation + effluent applied) – (evapotranspiration) – (runoff)*

The water balance in Table 4-2 shows the amount of water expected each month to proceed to percolation at BOC Kooragang.

Table 4-3 uses the percolation obtained from Table 4-2 to estimate the approximate rate of percolation through the soil in centimetres per hour.

The percolation rate is based upon utilising the proposed irrigation system for a conservative estimate of two (2) hours per day. It is likely the irrigation will be performed and operated during daylight hours for approximately 2 hours, over which time the system will discharge the daily rate of effluent to the irrigation area. Therefore, the system will not be operating over 24 hours.

The estimated rate of percolation is then compared to the soil type's permeability rates based on literature data.

Table 4-3: BOC Kooragang percolation assessment

Mth	Percolation per m^2 of area ($L/m^2.day$)[4]	Irrigation hours per day (h)	Estimated Rate of irrigation percolation (cm/h)	Rate of percolation for typical soil type (cm/h)[1]
Jan	0.7	2	0.04	2 – 5
Feb	2.3	2	0.12	2 – 5
Mar	2.6	2	0.13	2 – 5
Apr	3.9	2	0.19	2 – 5
May	4.3	2	0.22	2 – 5
Jun	5.0	2	0.25	2 – 5
Jul	3.8	2	0.19	2 – 5
Aug	2.8	2	0.14	2 – 5
Sep	2.1	2	0.11	2 – 5
Oct	0.9	2	0.05	2 – 5
Nov	0.1	2	0.005	2 – 5
Dec	0.5	2	0.023	2 – 5

[1] Soil permeability and therefore percolation rates for sandy soils can range from 2.5 to 5 cm/h; it is considered a 'moderate' speed permeability class.

It can be seen that the estimated percolation rate of the proposed effluent irrigated at BOC Kooragang for each month is well below the typical range of percolation rates for the soil type at the facility.

The soil type is therefore able to handle the capacity of the effluent applied based upon percolation rates.

Therefore, the addition of effluent is unlikely to cause ponding or waterlogging of the proposed area at the estimated rate of application, and the effluent is expected to percolate freely through the soil type.

4.3 Nitrogen assessment and balance

Nitrogen can be added through effluent and fertiliser. It is not intended to utilise additional fertiliser at BOC Kooragang therefore the added nitrogen is assumed to be from effluent only.

Nitrogen behaviour in plants and soils can be a limiting factor based upon the uptake of nitrogen by the plant, and the nitrogen losses. A nitrogen balance can be performed to compare total nitrogen usage of each plant with the amount of total nitrogen available.

A nitrogen balance was performed as per the Effluent Guidelines' *Equation 6 Nitrogen-limiting loading*. Equation 6 is shown below.

$$R_y = \frac{U}{TNE_y}$$

where R_y = annual effluent loading in year y in ML/ha/yr
U = annual crop uptake of nitrogen in kg/ha/yr
TNE_y = total plant-available nitrogen in year y in kg/ML

Table 4-4: BOC Kooragang nitrogen balance

Item	Value / Calculation	Note / Description
TNE	3 kg/ML	The TNE for plant uptake was assumed to be the Total Nitrogen concentration measured in the treated water in order to be conservative.
U	= 14,000 kg/ha/yr * 2.4% = 336 kg/ha/yr	Using Table 4.2 of Effluent Guidelines for an appropriate crop *Fescue* (a species of grass) which is in season all year. Fescue has: - a yield of 14 tonnes per hectare (14,000 kg/ha) - nitrogen uptake of 2.4%
R_y	= 336 kg/ha/yr ÷ 3 kg/ML = 112 ML/ha/y	
Proposed effluent flow	= 18,200 L/wk = 0.95 ML/y	Based on constant flow.
Proposed effluent irrigation area	1,544 m^2 = 0.15 ha	
Actual effluent loading	= 0.95 ML/year ÷ 0.15 ha = 6.2 ML/ha/y	

The actual effluent loading of 6.2 ML/ha/y is much lower than the annual limiting effluent nitrogen loading of 112 ML/ha/y. The actual load therefore comprises only 5% of the limiting load for nitrogen.

As the nitrogen limiting value of 112 ML/ha/y was significantly above the actual load of 6.2 ML/ha/y while assuming conservative nitrogen uptake values, it was not deemed necessary to perform further calculations.

4.3.1 Nitrogen and Harvesting

The Department has requested the following information:

> *4. Nitrogen Balance*
> *The nitrogen balance calculation incorporates annual crop intake of nitrogen. This calculation assumes crop harvesting to remove nitrogen. Please confirm if harvesting will take place or amend the nitrogen balance assessment accordingly.*

The EPA also requested the following information:

> *Nutrient Balances*
> *The nitrogen removal rate used in the nitrogen balance assessment is based on the nitrogen content of harvestable portions of the crop (DEC, 2004). The removal rate, therefore, assumes harvesting is undertaken to remove biomass and associated nitrogen. The nitrogen removal is likely to be overestimated, as the proposal does not appear to include harvesting.*

BOC Kooragang currently perform mowing and associated lawn maintenance on the proposed grassed area on a monthly basis, and when required during periods of high growth. The lawn mowing, maintenance and disposal of the green waste with an approved contractor is considered '*harvesting*' for the purposes of the proposed project.

BOC Kooragang intend to continue the lawn maintenance at the same frequency and will increase frequency during periods of high growth as necessary. The irrigation equipment will be designed so that it is able to be easily moved to maintain lawn maintenance of the irrigation area.

4.4 Phosphorus sustainability balance

Phosphorus is removed from effluent through processes in the soil, and can be determined through the phosphorus sorption capacity of the soil. Take-up of phosphorus in the soil can prevent leaching of phosphorus to other water sources such as groundwater; the sorption capacity can assist in determining how much phosphorus can be taken up before the site is saturated.

A phosphorus sustainability calculation was performed as per the Effluent Guidelines based upon expected effluent quality.

Table 4-5: BOC Kooragang phosphorus balance

Item	Value / Calculation	Note / Description
Phosphorus sorption capacity of soil	125 mg/kg	Obtained from baseline soil monitoring program. Results ranged from <250 mg/kg to 575 mg/kg in the proposed area. Therefore half the limit of reporting (<250 mg/kg) was used to be conservative.
Critical phosphorus sorption capacity of soil	= 125 mg/kg ÷ 10 = 12.5 mg/kg	Conservative value that one-tenth of the total sorption capacity can be used before leaching occurs. Most soils have a low to moderate P sorption where one-third of the capacity can be used.
Soil depth	1 metre	From geotechnical report
Soil density	1,600 kg/m^3	General guidelines for sandy soil
Irrigation area	0.15 ha	-
Total P in effluent	0.02 mg/L	-
Volume effluent applied per year	0.95 ML/y	-
Total P adsorbed before leaching	= (P sorption capacity (critical) * depth * density * area m^2) = (12.5 mg/kg) * (1m) * (1,600 kg/m^3) * (0. ha*10,000 m^2) * (1e-6 mg/kg) = 31 kg	-
Total P applied in effluent per year	= 0.02 mg/L * 0.95 ML/yr = 0.019 kg	-
Total P removed by crop per year	0	Used 0 as a conservative figure, therefore assumes all P removed by soil
Site irrigation period	= (31 kg) / (0.019 kg/yr – 0 kg removed) = 1,626 years	-

Therefore, when looking at the phosphorus concentration in the effluent, it can be seen that the phosphorus concentration is low enough to allow irrigation for a long period of time.

5 Existing effluent systems

5.1 General

The Department has requested the following information:

5. Existing Effluent Systems
Council has advised that two human waste effluent systems are currently in place on-site, which were not addressed in the Statement of Environmental Effects (SEE). Please provide details of these systems and any potential impact on the proposed irrigation of cooling tower effluent.

In a related request Council requested the following information:

It is also noted that there are two existing human waste effluent systems onsite which were not addressed in the SEE. One of these systems is a collection well and pump-out system, the other disposes of effluent to an absorption trench. While Council does not consider these systems to significantly impact upon the proposed cooling tower effluent system their existence should have been addressed in the SEE.

BOC Kooragang currently have Council Approval for two (2) existing effluent systems, which are referred to as:

- Septic Tank and Collection Well Pump Out (herein referred to as the *septic system*); and the
- Septic tank and Absorption Trench/Evapotranspiration Area (herein referred to as the *absorption trench*)

5.2 Existing septic system

BOC Kooragang operates a septic system with a pump-out performed for disposal. The system's location is shown in Figure 5-1.

Figure 5-1: Septic system and absorption trench locations

The system is located outside an amenity block and receives wastewater from the following sources:

- The amenities block (sinks, toilets, showers)
- Sink in the administration building's break room

The wastewater from the amenities block and administration break room proceeds through a PVC pipe to an underground 4,500 litre septic tank, and continues to an underground 22,500 litre concrete holding tank.

Pump out is performed by an approved waste contractor on a regular schedule. The system also has a high-level alarm system with flashing lights to alert site personnel if the system approaches a high level and requires earlier maintenance.

BOC Kooragang have reported that there have been no instances of overflow from the system.

The septic tanks are not impeding the proposed irrigation area as they are outside the proposed irrigation area.

The cooling tower wastewater has not and does not proceed to the septic system. The two wastewater streams are not generated by the same processes and do not come into contact.

The wastewater collected in the septic collection tanks will not be used for irrigation. The septic tanks are to be continued to be used in their current form with no changes planned.

If personnel are to be in the vicinity of the septic system such as for pump outs, irrigation at the proposed area will be ceased for work health and safety and comfort of workers.

Therefore, it is unlikely that the continued operation of the septic system will have any impact upon the proposed irrigation project.

5.3 Existing absorption trench system

BOC Kooragang operates an absorption trench system with location shown previously in Figure 5-1.

The absorption trench system is located on the eastern (process) side of the plant and receives wastewater from the following sources:

- One toilet
- One sink

The absorption trench was installed in approximately the 1970s and therefore is difficult to locate operational data on the trench. The external measurements are diameter 1.6 metres and depth approximately 2 metres.

The use of the absorption trench has been limited in use since the newer amenities block and sewage system was installed.

The streams that feed into this trench are inside the plant area and therefore access is restricted. This limits the use of these facilities to plant personnel and almost all personnel use the main amenities facilities.

Volume of wastewater would be an estimate of on average one person using the toilet and sink once per day on operational days (Monday to Friday).

BOC Kooragang have reported that there have been no instances of overflow from the system, and that odour is not noticeable.

The absorption trench is not impeding the proposed irrigation area as it is outside the proposed irrigation area.

The cooling tower wastewater has not and does not proceed to the absorption trench. The two wastewater streams are not generated by the same processes and do not come into contact.

The wastewater collected in the absorption trench will not be used for irrigation. The absorption trench is to be continued to be used in its current form with no changes planned.

If personnel are to be in the vicinity of the septic system such as for pump outs, irrigation at the proposed area will be ceased for work health and safety and comfort of workers.

Therefore, it is unlikely that the continued operation of the septic system will have any impact upon the proposed irrigation project.

6 Remaining Council queries

6.1 Designated Development

Council has requested the following information:

> 1. *Designated development*
> *It is noted that the maximum volume of wastewater produced over a year by the cooling tower operation is just below the threshold for designated development. If consent is granted to the development it is recommended an appropriate condition be included which requires that the volume of effluent produced is not to increase under any circumstances above 946 tonnes per year.*

The total volumes of wastewater produced at BOC Kooragang were described in detail in the SEE. Further sections of the SEE summarise upgrade works to be performed that will further reduce the volume of effluent produced by BOC Kooragang. The volume of effluent produced will not be increased under any circumstance above 946 tonnes per year.

BOC Kooragang will have installed a flow meter as part of the treatment process, which will enable measurement of volume of flows proceeding to the irrigation area.

BOC Kooragang therefore welcome the condition for volume of effluent produced on the EPL and/or in the Secretary's requirements.

6.2 Reticulated sewer system

Council has requested the following information:

> 2. *Reticulated sewer system*
> *It is noted that the SEE does not address the potential option of connection to the reticulated sewer system. It is understood that nearby premises have connection to sewer and this would be the ideal long term environmental option if possible which poses less environmental risk.*
> *It is recommended the applicant be requested to consider connect the effluent discharge to the sewer system or other options such as part irrigation and part sewer discharge and emergency connection to sewer.*

BOC Kooragang do not have a connection to sewer which is typical of facilities on Kooragang Island. Most of the commercial facilities at Kooragang Island are in the position of treating their trade wastewater onsite, and then irrigate, or the very expensive option of sending trade wastewater via tankers to a licensed waste treatment facility.

For financial reasons BOC Kooragang preferred the option of connecting to sewer as opposed to disposal offsite to a waste treatment facility. BOC Kooragang has previously performed an extensive application process with Hunter Water to investigate the option of connection to sewer.

The process, for a number of reasons, proved to be quite exhausting to the point that BOC Kooragang determined it was not feasible due to bureaucracy, financial considerations, and delayed timelines.

A summary of actions that occurred are provided here. It is not intended that the summary below is complete; more to show the comprehensive attempts BOC Kooragang has performed over the last two (2) years to obtain Hunter Water approval.

Table 6-1: BOC Kooragang summary of correspondence with Hunter Water and stakeholders

Date	Action
Aug 2014	BOC Kooragang performed water sampling on the effluent to investigate possibility of irrigation onsite. Levels of fluoride in the effluent were shown to be above irrigation guidelines (as the water source is originally town-supplied potable water and is dosed with fluoride).
Aug to Nov 2014	Following the sampling in August, BOC Kooragang requested an initial investigation into possibility of connecting to Hunter Water sewer. The outcome of the investigation at the time were: - Feedback from Michael Evans of Hunter Water was that '*there is an existing sewer network through Kooragang island that discharges to Shortland WWTW. Some trade waste sites on Kooragang island have not connected to the system due to the costs involved….if sites that wish to discharge to sewer can prove their discharge quality will be of an acceptable quality, than from a trade waste perspective, there shouldn't be an issue with accepting the wastewater. It would then be up to Hunter Water's Wastewater Planning and Developer Services groups to determine any capacity or cost issues with the application.*' - It was determined through preliminary correspondence that: • A 'capital contribution' of $15,000 would need to be paid to Hunter Water. • The approximate cost of an infrastructure build including rising main would be $100/metre. Hunter Water advised the closest discharge point was at intersection of Cormorant Street and Egret Street, approximately 440 metres away. Therefore, the approximate cost to install the rising main (once off) is 440 * $100/m = $44,000. • The question was asked of Hunter Water whether the rising main be shared by more than one company and therefore they would share the costs. Hunter Water have said this was possible. • At this time excluding sharing installation costs with other companies the one-off installation cost was approximately $44,000 + $15,000 = $59,000. - A concept design was performed by approved Hunter Water consultant RPS. - In order to proceed BOC Kooragang was required to complete a form for Servicing Advice from Hunter Water and pay a fee. BOC Kooragang completed the form for high-end servicing advice from Hunter Water.
Feb to Apr 2015	Water quality results were sent to Hunter Water. BOC Kooragang and MJM correspondence with other companies in the area to see if they were interested in sharing a line. No companies were interested as: - A company already had a private line in place for years and were not interested in sharing; and - A company was proceeding with their own separate application which was for a high volume, more complex analytes and high pressure flow which was not compatible with BOC Kooragang's flows; and - Other companies did not produce trade waste effluent and did not require the service. - Other companies engaged further in the discussions and ultimately advised the costs were prohibitive. Preliminary service advice was received from Hunter Water on 26 March 2015 and a meeting was requested with Hunter Water. Hunter Water advised that the wastewater quality met their standards.
Apr to Aug 2015	A meeting was held with Hunter Water on 29 April 2015. The outcomes of the meeting were: - BOC Kooragang will likely not be able to share the trade waste connection with other neighbours, therefore the planned asset would be privately owned by BOC and not owned by Hunter Water. - To proceed with a development application BOC will need to lodge an application with Hunter Water to determine a Notice of Formal Requirements which will then be issued. - The works required to be completed were: • Section 50 application for a Notice of Formal Requirements and a fee ($467) • Trade Wastewater Agreement Application • Hydraulic Works application • Non-standard connection agreement • Obtain a design for the rising main with an approved consultant

Date	Action
	• Obtain Council for approval to install the connection on their footpath. BOC Kooragang continued the applications with Hunter Water with a view for a private line which would be owned by BOC Kooragang.
Sep 2015 to Feb 2016	The required concept design, hydraulic design, trade waste application, connection agreements were completed with approved subcontractor RPS. The design, associated contracts and trade waste applications were approved by Hunter Water. Quotes were sourced from plumbers with a view to begin building the approved works and begin discharging to sewer.
Feb 2016	The owner of the land that leases to BOC is Port of Newcastle (PON). PON became involved in the project. PON stated that they did not want additional private sewer lines installed without their approval and they did not approve the planned works. Therefore, the project could not continue. The two options put forward by PON were: 1. Install a public line and look at the option of Cargill connecting to that line 2. Install a private line, but that line is to follow Cleanaway's private line. It appeared at this point that communication between Hunter Water and PON had not been optimal. A separate trade waste application had also been submitted by different company on Kooragang Island that PON had not been informed about. Options discussed included connection to Cleanaway's private line. However, this would then require Hunter Water to take ownership of the Cleanaway private line as a public asset. It is worth noting here that the Cleanawy private line was designed by the previously Hunter Water owned consultancy company Hunter Water Australia, and that all of the design was completed to the standards required by Hunter Water.
May to Jun 2016	PON and Hunter Water begin further internal discussions. An asset management meeting was held on 12 May. Correspondence was entered into between MJM, BOC and a representative of Cleanaway. At the time Cleanaway appeared to agree to the proposal that BOC could connect to their private line. It was communicated that this was '*a new process*' for Hunter Water to undertake and as such would need Hunter Water's due process and be approved by Development. Hunter Water requested that the design of the Cleanaway line be reviewed, including the pressure rating, to determine it met Hunter Water standards. It was believed that the Cleanaway line had been approved previously by Hunter Water at the time of installation so BOC and MJM requested clarification. Pressure rating was provided to Hunter Water. Quotes for an updated hydraulic design were requested. At the end of May it was communicated that Hunter Water would need approximately 2 weeks to assess the Cleanaway line option. At this point it had been over 3 months of discussions between Hunter Water and PON. It was reported by Hunter Water via email that by 16 June 2016 that meetings had been held with Hunter Water's asset management, a recommendation made, and seeking of internal approval had begun. Timing of the decision could not be advised.
Jul 2016	Hunter Water advised that key people were still unavailable to assess the Cleanaway line option. On 5 July a meeting was scheduled by PON with Hunter Water and stakeholders. Hunter Water cancelled the meeting for two (2) weeks. On 11 July PON requested another meeting and Hunter Water advised that they were unable to schedule the meeting. At this point it had been over 4 months of internal discussions in Hunter Water and a decision not communicated. An urgent meeting was requested at end of July 2017 for Hunter Water, PON and BOC. It is also worth noting that for a comparatively simple engineering solution, BOC had spent two years just trying to get through bureaucracy hold ups.

Date	Action
Aug to Sep 2016	A meeting was held between Hunter Water and PON to outline viability for a public asset line which would be owned by Hunter Water. Hunter Water commissioned a servicing strategy report from a subconsultant GHD which was supplied to PON. The servicing strategy was required by Hunter Water to be revised as it did not contain enough detail expected by Hunter Water including confirmation of pipe sizes.
Oct to Nov 2016	PON scheduled a meeting with Hunter Water on 19 October. The summary of the meeting was that Hunter Water would continue the assessment started by PON and GHD regarding pipe sizes and main design. Hunter Water advised that BOC could begin approval processes, a Review of Environmental Factors and an Odour Assessment Report. Hunter Water requested information on expected water quality and volumes from BOC. MJM sent the information, much of which had previously been provided in the original approval, to Hunter Water. The expected timelines for this work were again unattainable to BOC. BOC decided to begin investigating alternative options for management of the cooling tower wastewater including revisiting the irrigation option.
Nov 2016	Due to the continuous bureaucracy setbacks by parties outside the control or influence of BOC, BOC decided the only practical solution was to cease work on the sewer connection project. On 23 November 2016 MJM informed Hunter Water on behalf of BOC that as a result of the lengthy process BOC has had to navigate, BOC sought alternative options for trade waste removal. The costs to BOC because of the many delays were significant at over $100,000 at this point.

BOC Kooragang have therefore investigated the option of connection to sewer over a total period of two (2) years, encompassing a number of variations to design, and including communication with nearby premises that have connection to sewer.

The investigation ceased after two years and three months of work due to the following making the project not feasible:

- Considerable expenses to BOC of over $100,000 performing designs, approvals, and communication with Hunter Water and PON.
- Bureaucracy within Hunter Water.
- PON's opinions as owner of the site.
- Length of time spent to this stage with no progress towards a solution.

Therefore, it was not determined to be feasible to continue the investigation.

Council has noted that BOC Kooragang should be requested to consider connect the effluent discharge to the sewer system or other options '*such as part irrigation and part sewer discharge and emergency connection to sewer*'. This option would still require the same level of approval as the original sewer connection investigation. As above the project was determined to be not feasible.

If an emergency connection to sewer is required by specific Council legislation, BOC Kooragang would expect Hunter Water's assistance in enabling an emergency connection.

If in the future a connection to Hunter Water sewer was available and considered feasible, BOC Kooragang will re-open the investigation.

6.3 Groundwater

Council has requested the following information:

> *5. Ground water*
> *If consent is granted to the proposed irrigation system, it is recommended an appropriate condition is imposed requiring ground water conditions to be monitored and any impact onto adjoin properties being resolved as part of an on-going maintenance/monitoring program.*

As per the SEE and the response from EPA, BOC Kooragang plan to perform regular groundwater monitoring as part of baseline and ongoing monitoring conditions. It is likely these will form part of the EPL.

As per the original SEE BOC Kooragang plan to perform the following regarding impacts offsite:

- The proposed irrigation system will use drip irrigation, which is known to prevent aerosol drift offsite.
- No additional surface water sources are planned for the proposed project and all effluent storage is to be in the nominated tanks.
- Therefore, it is not expected that BOC Kooragang's irrigation practices will impact upon neighbouring businesses' stormwater or surface management systems.
- BOC Kooragang will put an Irrigation Management Plan in place which will cover the above issues and additional items.

7 Remaining Department of Primary Industries (DPI) queries

7.1 Sampling bottles

DPI has requested the following information:

> *Section 4.1 on page 15 of the SEE states that plastic bottles SEE states that plastic bottles were used for collection of samples for all analytes. Glass bottles should be used for collection of samples for analysis of organic contaminants.*

The above statement from DPI was correct as the SEE did state the following:

> *The water samples were then transferred into clean plastic bottles provided by a NATA accredited laboratory. The water quality reports including laboratory results are presented in Appendix A.*

The statement made in our SEE was in error and MJM Environmental would like to take the opportunity to revise the statement based upon the feedback from DPI.

Our sampling bottles are provided by a NATA-accredited laboratory. Upon receipt of the sample bottles the laboratory assesses sample container and preservations compliance and provides a statement in the sample receipt notification (SRN). Please see Appendix D for three (3) SRNs from the laboratory for the monitoring performed for the report *034-1264 - BOC Kooragang Cooling Tower Wastewater Report (2014-09-19)* which compiles the results of three (3) sampling events in 2014 and was provided with the SEE.

All three SRNs state on the second page that '*No sample container / preservation non-compliance exists*'. This therefore shows that the appropriate bottles and preservatives were used during the sampling.

MJM Environmental will ensure the statement is revised in future to reflect that our bottles were of appropriate material and preservatives where applicable, and remove the statement regarding '*plastic*'.

7.2 Effluent water quality reports

DPI has requested the following information:

> *The NATA accredited laboratory results referred to in sections 4.1 and 4.2 are not reported in Appendix A of the SEE. The proponent should provide these results.*

MJM Environmental has revised our email correspondence and can confirm that the three (3) analysis reports and the pilot trial reports were sent to Joanna Bakopanos on Monday 20 March 2017 at 12:24. The NATA-accredited laboratory reports are attached in the appendices of each of these reports.

MJM Environmental have not received feedback from the Department, EPA, Council or other departments that the attachments were not received so this may have been an IT issue. Nonetheless the reports are attached in Appendix E along with a copy of the original email correspondence.

8 NSW Health Hunter New England Local Health District queries

8.1 Guidelines for Water Recycling

NSW Health Hunter New England Local Health District (NSW Health) requested the following:

> *Even though the above trial appears to have been successful it is recommended that the CTASR (Cooling Tower Analysis Sampling Report) be reviewed against the provisions of the Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) (2006).*

The *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1)*, will herein referred to as AGWR.

MJM Environmental understand that recycling water requires protection of the environment and health. We believe our original SEE comprehensively covered the potential environmental and health concerns with the use of the Effluent Guidelines.

It is noted that the risk management framework in the AGWR is based upon the framework detailed in the *Australian Drinking Water Guidelines* (ADWG) and therefore not all aspects of the AGWR may be applicable to BOC Kooragang's proposed irrigation project.

It is also noted that the AGWR focuses on three (3) specific situations, being:

- Water recycled from sewage.
- Water recycled from greywater.
- Stormwater.

The above three situations are not applicable to BOC Kooragang as the proposed project would utilised treated cooling tower effluent.

The AGWR also states on page 35 of 415 that '*These guidelines do not deal specifically with recycling of water from industrial and commercial sources; such waters can have very specific characteristics relating to quality, variability and quantity. However, the generic approach described here can be applied to these sources.*'

In the interests of compliance with all stakeholders the BOC Kooragang proposal is assessed against relevant sections of the AGWR.

8.1.1 Chapter 2 Framework for management of recycled water quality and use

When managing a recycled water system a number of factors are required to be considered along with risk and hazard assessment.

The source to end use of the effluent in the proposed project is:

- Potable water from the Hunter Water supply is provided to the cooling towers.
- Cooling tower operates.
- The evaporated water leaves dissolved salts behind in the bulk of the water which has not been evaporated, thus raising the salt concentration in the circulating cooling water.

- To prevent the salt concentration of the water from becoming too high, a portion of the water is drawn off/blown down for disposal. Fresh water make-up is supplied to the tower basin to compensate for the loss of evaporated water, the windage loss water and the draw-off water.
- The blowdown water is treated through proposed filter system and proceeds to the irrigation area through pipework.
- The receiving environment is the grassed area to the north of the site. There are no other receiving environments.
- The intended use is onsite full reuse irrigation.

The source to end use therefore does not contain a lot of complexity, and does not contain multiple inputs. Potential for cross-connections are therefore considered non-existent. There is full segregation of the system from the potable water supply as the pump operates in one flow direction only and non-return valves are used to prevent backflow.

The system was assembled by a team with appropriate knowledge and expertise in water treatment and plant design, including appropriate construction materials for tanks, connections and pipelines. Flow diagrams and schematics were provided in the original SEE. Regular inspections and maintenance programs will be performed on the system.

Source water, storage, treatment system, design, distribution systems and assessment of treated water characteristics were assessed in detail in the SEE.

Reliability of source water can be considered very consistent as it is obtained from the water utility's (Hunter Water) potable water supply. The cooling tower operation is not intended to be altered and monitoring of the water quality will assist in control of the treated water quality. The effluent does not originate from sewage, greywater or stormwater which, among other characteristics, can present variable quality. Rate of application is controlled as per the process controls in the SEE. Target criteria are the ANZECC guidelines presented in *Section 4: Primary Industries - 4.2 Water Quality for irrigation and general water use*. Therefore, it is not considered necessary to further assess 'changes' in the water supply as would have to be performed for other water sources.

The irrigation proposal is considered an alternative route for disposal of the effluent as disposal to sewer was not feasible. The irrigation operation is considered ancillary to BOC Kooragang's operations.

It is unlikely that exposure will occur offsite as BOC Kooragang's site is fenced and secured. All visitors are required to enter the site through an automatic gate and proceed to the administration office. The irrigation area is fenced. The grassed area to the north and east of the proposed irrigation area is also controlled by BOC and separated from the irrigation area with a locked electric fence, therefore people should not be present in those areas without authorisation from BOC Kooragang. The fencing and security will also prevent inadvertent uses or unauthorised uses due to the barriers in place preventing access to the irrigation area and the cooling towers.

Risk and hazard assessment in an important part of any new process. It is believed that the SEE adequately covered risk identification, management and mitigation of a range of potential hazards including:

- water quality – expected effluent quality
- soil and groundwater
- climate and flood management
- stormwater and surface water
- sediment, runoff and erosion control
- flora and fauna
- land use and amenity
- traffic and access
- air quality
- noise and vibration
- heritage
- trees and vegetation
- interaction with current facility regarding hazards and risk
- waste management
- storage
- work health and safety

- For due diligence and good engineering practice BOC Kooragang will perform a detailed design and construction plan, and perform a Hazard and Operability study (HAZOP).

The pilot scale filter trial has validated the ability of the process to treat fluoride in the effluent. Monitoring and maintenance will validate processes to ensure risks are controlled. If variations in conditions such as effluent water quality occur, the process will be measured and re-validated.

8.1.2 Chapter 3 Managing health risks in recycled water

The AGWR states that the main focus for health is on microbial hazards, along with consideration of chemicals. Microbial health is considered a far greater risk for human's due to potential for diseases and infections. Standard and legislative operation of all cooling towers requires treatment to remove microbial hazards such as legionella to reduce risk of exposure and this is performed at BOC Kooragang. It can be seen in the SEE that microbial hazards are minimal with expected Enterococci results of ~5 CFU/100mL and expected Faecal (thermotolerant) Coliforms of ~1CFU/100mL. It is therefore not considered that the microbial risk requires further disinfection and further assessment has not been performed.

The effluent does not present variable water quality as explained previously.

Routes of exposure to people is to be considered through ingestion, inhalation or contact with skin.

It is reiterated here that the effluent originates from the potable water supply and is recycled through a cooling tower operation. The effluent does not originate from sewage, greywater or stormwater.

The effluent is stored in tanks or pipelines until it reaches the irrigation area. Therefore, the most likely exposure point treated effluent may occur to people onsite in the irrigation area. Ingestion is unlikely, including through consumption of crops as the area is grassed only. BOC Kooragang will install appropriate signage and labelling to indicate the irrigation system uses non-potable water and is not suitable for drinking. BOC Kooragang will also encourage hand washing and other work health and safety procedures to ensure reduction of employee exposure.

The AGWR states that application methods can influence exposure and that drip irrigation can reduce exposure to pathogens by at least 2 logs. The proposed irrigation system will use drip irrigation, which is known to prevent aerosol drift offsite.

The site and therefore the irrigation system and area are not open to the public. BOC Kooragang's site is fenced and secured as described above therefore people should not be present in those areas without authorisation from BOC Kooragang. The fencing, buffer distances and security assists in preventing inadvertent uses or unauthorised uses due to the barriers in place preventing access to the irrigation area and the cooling towers.

The biological oxygen demand (BOD) results for the effluent reflect a low-strength effluent at 4 mg/L and therefore further assessment is not considered necessary.

The cooling tower dosing chemicals have been covered in Section 3.2.1.1.

It is therefore believed that health risks are managed appropriately in accordance with the AGWR.

8.1.3 Chapter 4 Managing environmental risks in recycled water

The process used to assess environmental risks is to first identify water sources, uses, users and routes of exposure. Following this, the recycled water system and water quality data are assessed; and finally, hazards are identified and the overall risk assessed.

Microbial hazards were assessed and shown not to adversely affect the environmental in Section 8.1.2. It is acknowledged therefore that potential chemical hazards are required to be assessed for the BOC Kooragang proposed project. Chemical risks are acknowledged to be greater risks to the environment than microbial hazards.

Target criteria are the ANZECC guidelines presented in *Section 4: Primary Industries - 4.2 Water Quality for irrigation and general water use*, which are referenced in Chapter 4 of the AGWR. The target criteria will be the critical control points.

The AGWR recommends the following factors are considered. It is believed BOC Kooragang has sufficiently addressed these factors in detail in the original SEE and earlier sections of this document:

- characteristics and proximity of receiving waters (surface water and groundwater)
- characteristics of soils at the point of application (i.e. receiving environments)
- site hydrology (groundwater, soil permeability, drainage)
- the type of crops or plants to be irrigated (i.e. endpoints of the irrigation process)
- application rates
- on-site storages
- climatic conditions and evapotranspiration rates
- characteristics and proximity of sensitive or protected ecosystems
- process controls including backflow prevention
- quantities required, time of application, spatial variability of application across a district or catchment.

Water quality will be consistently controlled utilising the proposed treatment system, which includes process control systems for flow control for prevention of cross connections and unintentional discharges.

The proposed area will not be used for crops for consumption or for grazing animals.

The cooling tower effluent and soil in the proposed irrigation area has the following characteristics:

- Total metals concentrations low or below detection
- Acceptable pH, sulphate, TDS, nitrogen and phosphorus levels when compared to the irrigation guidelines
- Low BOD
- Possibility that the SAR may raise the exchangeable sodium percentage in the soil; however, the sandy soils possess an initially low sodicity and exchangeable sodium levels, therefore is deemed acceptable.
- Additionally, an indicator of salt (salinity) concentration is electrical conductivity of a soil sample. The Effluent Guidelines state that where the conductivity is less than 2 dS/m, effects on plants are mostly negligible. The baseline monitoring showed results of 0.042 to 0.095 dS/m therefore the soil is suitable for this parameter.

The cooling tower dosing chemicals have been covered in Section 3.2.1.1.

It is therefore believed that environmental risks are managed appropriately in accordance with the AGWR.

8.1.4 CHAPTER 5 MONITORING

Baseline monitoring has been performed for soil and groundwater.

Validation of effluent quality will be performed through quarterly monitoring. Operational soil and groundwater monitoring will be performed as part of the proposed project at BOC Kooragang. The AQWR references ANZECC guidelines for monitoring which has already been completed for the proposed project. Monitoring will be statutory requirements as part of the EPL and be according to recognised sampling and analysis methods.

Verification monitoring will be performed through site inspections, irrigation management plan practices, and cumulative contaminant loading monitoring

It is therefore believed that based upon the health and environmental risks assessed, monitoring will be managed appropriately in accordance with the AGWR.

8.1.5 CHAPTER 6 CONSULTATION AND COMMUNICATION

Consultation has been performed BOC Kooragang through the application process with a number of authorities and the owner of the land (PON).

The end user of the irrigation water is BOC Kooragang, and therefore consultation about use of recycled water with company's other than BOC Kooragang is not considered necessary.

BOC Kooragang does not possess residential neighbours. Industrial neighbours are aware of the proposal and complaints have not been received to date.

Regarding crisis communication, BOC Kooragang as an EPL holder and industrial company are required to have an emergency management plan, and pollution incident response management plan (PIRMP) which will be utilised should an incident occur. BOC Kooragang also possesses robust media and communications policies.

8.2 Guidelines for Water Recycling

NSW Health Hunter New England Local Health District (NSW Health) requested the following:

> *Even though the above trial appears to have been successful it is recommended that the CTASR (Cooling Tower Analysis Sampling Report) be reviewed against the provisions of the … NSW Department of Primary Industries Office of Water* Recycled Water Guidance Document: Recycled Water Management Systems *(2015)*

The *Recycled Water Guidance Document: Recycled Water Management Systems* will herein referred to as RWGD.

As a lot of information has been covered in previous sections, Table 8-1 shows the elements of RWGD and comment on evaluation.

It is also noted here that the RGWD focuses that '*recycled water comes from an inherently unsafe source, sewage*' which does not apply to BOC Kooragang, and the RGWD also refers to the Effluent Guidelines as a source of information.

Table 8-1: Summary of elements of RWGD

Element	Evaluation
1 – Commitment to responsible use and management of recycled water quality	The SEE and this document show that BOC Kooragang have performed the following: - Reviewed regulatory and formal requirements with a number of agencies - Intend to formally obtain all appropriate licences and approvals for the proposed project - Planned appropriate conditions including monitoring and review periods - Recipients/end users of recycled water are not applicable as it is proceeding to an onsite irrigation area - Risk assessment and evaluation of effluent quality - Evaluation of current soil and groundwater quality prior to irrigation
2 – Assessment of the recycled water supply system	The SEE and this document show that BOC Kooragang have performed the following: - Identified source and location, intended uses, receiving environments and routes of exposure - Produced a flow diagram, and a process and instrumentation drawing - Review and analyse water quality data - Evaluated quantity of wastewater - Identified end uses of water - Hazard identification and risk assessment of effluent based upon quality and receiving environment
3 – Preventive measures for recycled water management	The SEE and this document show that BOC Kooragang have performed the following: - Used a proven treatment process for removal of target analyte fluoride. Treatment process is required and acts as a critical limit. - Set water quality targets using of irrigation water quality guidelines. - Evaluated effluent quality risks and exposure risks (minimal bacteriological risks present as effluent does not originate from sewage) - If effluent does not meet critical limits, preventive actions are readily available including disposal offsite with a licensed waste contractor - Backflow prevention utilising non-return valves

Element	Evaluation
4 – Operational procedures and process control	The SEE and this document show that BOC Kooragang have performed the following: - Operational procedures for the treatment and irrigation system will be implemented, including an Irrigation Management Plan. - Managed potential periods of sudden change in the water quality. Water quality changes are unlikely to occur due to the effluent originating from the potable water supply. - Monitoring of effluent quality will provide information on filter performance and media lifespan remaining. - Monitoring equipment will be installed to measure and control flows from storage to the irrigation area. - Appropriate process control including flow meter, feedback to a PLC to show operation, and non-return valves are to be utilised. - Operational monitoring parameters will be covered by the effluent monitoring program to acceptable water quality targets. - Materials of construction for all aspects of the treatment system are appropriate for water storage and filtration.
5 – Verification of recycled water quality and environmental performance	The SEE and this document show that BOC Kooragang have performed the following: - Performed extensive water quality monitoring and can verify expected effluent water quality - Can verify that effluent water quality environmental targets (irrigation guidelines) are being achieved - Regular and ongoing monitoring programs based upon environmental performance and relevant to irrigation guidelines are planned, and will be implemented for continued verification of quality and environmental performance
6 – Management of incidents and emergencies	- BOC Kooragang have in place detailed emergency procedures, spill procedures, Major Hazard Facility (MHF) plans, and a pollution incident response management plan (PIRMP) maintained as per current procedures and in accordance with the appropriate legislation. - Review and upkeep of emergency and incident response procedures will occur in line with the proposed irrigation project. - Contact lists for emergencies are included as part of the PIRMP documentation which is available in hard copy onsite as per legislative requirements. It is therefore believed that BOC Kooragang have appropriate management documentation for incidents and emergencies.
7 – Operator, contractor and end user awareness and training	The proposed treatment system will be semi-automated and performance feedback will be provided to plant systems. Therefore minimal operator input is required for the treatment system and additional human resources are not required for operation of the system. BOC Kooragang will train operators and employees in all aspects of operation of the proposed system. The end use(r) is within the boundaries BOC Kooragang's facility therefore additional training is not considered necessary for people outside the company.
8 – Community involvement and awareness	Consultation has been performed BOC Kooragang through the application process with a number of authorities and the owner of the land (PON). The end use(r) of the irrigation water is BOC Kooragang, and therefore consultation about use of recycled water with companies other than BOC Kooragang is not considered necessary. BOC Kooragang does not possess residential neighbours. Industrial neighbours are aware of the proposal and complaints have not been received to date. BOC Kooragang also possesses robust media and communications policies.
9 – Research and development	BOC Kooragang has performed research and development for treatment of the effluent using a pilot scale filter to achieved quality meeting the irrigation guidelines, as described in the SEE. Commissioning and validation testing of the filtration system will be performed prior to application of the effluent to the proposed area.

Element	Evaluation
	Regular and ongoing monitoring programs based upon environmental performance and relevant to irrigation guidelines are planned, and will be implemented for continued verification of quality and environmental performance.
10 – Documentation and reporting	BOC Kooragang will implement, review and store all documentation and records relevant to the proposed irrigation project in accordance with their document control policies including, but not excluded to: - Approvals and licences required for operation - Operation and maintenance manuals for the system - External monitoring requirement reports and results in meaningful summaries - Inspections of system and irrigation area - Internal reporting on performance of the system, such as toolbox meetings - Operational records of treatment and irrigation system, including flow times and volumes - Maintenance records (preventative and corrective) - Waste records - Emergency procedures and records as covered in Element 6
11 – Evaluation and audit	Specific procedures from Element 10 will be audited and reviewed on a regular basis. The elements of the proposed irrigation project will be included in BOC Kooragang's internal audit and inspection program. The program will include all process units and instrumentation, and include preventative maintenance and improvement plans. Long term evaluation of results will be performed using monitoring data, and cumulative contaminant loading along with regular inspections of the irrigation area. It is not expected that external audits of the system will be required as the effluent is proposed for use within the boundaries of BOC Kooragang's facility.
12 – Review and continual improvement	The SEE and this document show that BOC Kooragang will perform the following: - Ongoing and regular water quality monitoring to review and verify expected effluent water quality - Can verify that effluent water quality environmental targets (irrigation guidelines) are being achieved - Regular and ongoing monitoring programs based upon environmental performance and relevant to irrigation guidelines are planned, and will be implemented for continued review and improvement, where necessary.

It is therefore believed that BOC Kooragang have assessed the project based on the provisions provided in the RGWD and can operate the project appropriately in accordance with the RGWD.

8.3 Mosquito Management

NSW Health Hunter New England Local Health District (NSW Health) requested the following:

> *HNEPH recommends that a mosquito management plan focusing on exotic species identification should be included in a vector management strategy. A mosquito risk assessment should be included in the EIS to ensure any potential mosquito breeding sites are identified e.g. natural or constructed wetlands, stormwater drains, lagoons, ponds and low-lying areas. The mosquito management plan will also assist to prevent both nuisance biting mosquitoes and disease transmitting mosquitoes affecting employees, visitors and the local population.*

A mosquito management plan for the site is included in Appendix F.

9 Conclusion

BOC Kooragang owns and operates a gas facility for the production and supply of gas products located at 9 Egret Street Kooragang, NSW and holds NSW Environmental Protection Authority (EPA) Environmental Protection Licence (EPL) 20165.

A *Request for Response to Submissions* was received for DA 8354 via email and dated 8 May 2017. The Request for Response contained queries from the following departments:

- Department of Planning and Environment
- Newcastle City Council
- NSW EPA
- Department of Primary Industries
- NSW Health Hunter New England Local Health District

The report has provided responses to each of the queries from the above departments.

10 References

EPA Atlas Search; accessed 02/02/2017
http://www.environment.nsw.gov.au/atlaspublicapp/UI_Modules/ATLAS_/AtlasSearch.aspx

State Environmental Planning Policy (Three Ports) 2013
http://www.legislation.nsw.gov.au/#/view/EPI/2013/228

NSW EPA Environmental Guidelines: Use of effluent by irrigation (2004).

Living with Mosquitoes in the Hunter and Lower Mid-North Coast Region of NSW - Second edition. Dr Cameron Webb and Prof C Russell December (2009).

Benzotriazoles: Toxicity and Degradation (X. WU, . Chou, D. Lupher, and L.C. Davis). 1998 Proceedings of the 1998 Conference on Hazardous Waste Research.

Castro S, Davis LC, Erickson LE (2003). *Phytotransformation of benzotriazoles*.

Castro S, Davis LC, Erickson LE (2004). *Temperature and pH effects on plant uptake of benzotriazoles by sunflowers in hydroponic culture.*

Gregory H. LeFevre, Alicia Lipsky, Katherine C. Hyland, Andrea C. Blaine, Christopher P. Higgins and Richard G. Luthy (2017). *Benzotriazole (BT) and BT plant metabolites in crops irrigated with recycled water*.

Bingbing Xu, Fengchang Wu, Xiaoli Zhao, Haiqing Liao (2010). *Benzotriazole removal from water by Zn–Al–O binary metal oxide adsorbent: Behavior, kinetics and mechanism*.

Appendix A – Baseline soil and groundwater reports

Appendix B – SDS for cooling tower dosing chemicals

Appendix C – Updated proposed site plan

Appendix D – Sample receipt notifications

Appendix E – Previous effluent monitoring reports

Appendix F – Mosquito management plan