APPENDIX H

Air Quality Impact Assessment

AIR QUALITY IMPACT ASSESSMENT

Tomago Asphalt Plant

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Prepared for Lindsay & Dynan Pty Limited

by

Holmes Air Sciences
Suite 2B, 14 Glen St
Eastwood NSW 2122

Phone : (02) 9874 8644
Fax : (02) 9874 8904
Email : has@holmair.com.au

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GLOSSARY OF TERMS

BoM	Bureau of Meteorology
DECC	New South Wales Department of Environment and Climate Change
$g/m^2/month$	grams per square metre per month
$\mu g/m^3$	micrograms per cubic metre
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measures
NHMRC	National Health and Medical Research Council
$PM_{2.5}$	particulate matter less than 2.5 μm in diameter
PM_{10}	particulate matter less than 10 μm in diameter
TSP	Total suspended particulates
US EPA	United States Environment Protection Agency

1. INTRODUCTION

This report has been prepared by Holmes Air Sciences for Lindsay & Dynan Pty Limited who are acting for the proponent of a proposed asphalt plant at Tomago. The purpose of this report is to provide an assessment of the air quality impacts due to proposed operations at the plant. The main air quality issues relate to dust and odour, from both the exhaust stack and fugitive sources associated with the asphalt plant. Dust impacts have been assessed by comparing estimated levels with relevant NSW Department of Environment and Climate Change (DECC) air quality assessment criteria. The predicted dust impacts have been made using a modified version of the US EPA's short-term industrial source complex model ISCST3 (ISCMOD). An assessment of the impacts associated with the stack emissions has been undertaken using AUSPLUME.

The dispersion modelling was undertaken in accordance with DECC "Approved methods and guidance for the modelling and assessment of air pollutants in NSW" (**NSW DEC, 2005a**) (herein referred to as the DECC Approved Methods).

2. LOCAL SETTING AND PROJECT DESCRIPTION

2.1 Introduction

The proponent is proposing to construct and operate an asphalt plant in an industrial area in Tomago, NSW. **Figure 1** shows the location of the proposed plant. The terrain in the area is relatively flat and the site varies from approximately RL3.6 to RL4.2 AHD.

The surrounding area consists mainly of industrial land and the site proposed for construction is amongst a number of new development lots. Five residences are located within 2 km of the site, the locations of which are shown on **Figure 1**.

2.2 Process description

A batch mixing process with recycling capabilities is proposed. The aggregate would be dribble fed from the delivery trucks into a receival hopper and transported by an enclosed conveyor to the appropriate cold storage bin. From there it would be metered onto a conveyer and transferred to a rotary dryer. As the heated aggregate leaves the dryer, it would drop into a bucket elevator, be screened and dropped into different "hot" aggregate bins according to aggregate size. The aggregate size distribution is controlled by mixing and weighing components from various bins. Recycled asphalt pavement (RAP), hydrated lime and reclaimed dust may be added at this point. Meanwhile, liquid bitumen is pumped from heated storage tanks to a bucket and weighed for the desired mix. The dried and weighed aggregate is then dropped into the mixer (pug-mill), followed by the liquid bitumen where it is mixed until homogeneous. The resulting hot-mix would then either be transported by skips to the hot storage bin(s) or transferred directly to a delivery truck.

2.3 Site layout and proposed operations

A proposed site layout is shown in **Figure 2**.

Bitumen would be delivered to the plant in sealed tankers and pumped into enclosed storage tanks which would be fitted with carbon filters to capture volatile organic compounds (VOCs) and their odours as the tank is being filled and the internal air and vapour is displaced. Aggregate would be trucked to the site and unloaded at a receival hopper. The raw material would be transferred from the hopper to the aggregate storage bins via a covered conveyor. Aggregate would be conveyed from the bottom of the storage bins to the drier via a covered conveyor. There would be no external stockpiling of aggregate. The conveyor covers would be

hemispherical in shape and cover the conveyor on three sides, with a gap of approximately 300 mm between the conveyor and the cover. A baghouse would be used to de-dust the dryer stack emissions and water sprays would be used to control dust emissions at required points, for example, the truck unload area. RAP would be delivered by truck to a separate area of the plant, as shown on **Figure 2**, and stored in a shed. The enclosure and coarse nature of the material would mean that emissions from unloading RAP or wind erosion would not be significant.

It is proposed that the plant would have the capacity to produce an annual throughput of 150,000 t. The typical daily output would be between 200 t and 500 t of asphalt per day, with a maximum daily output of 1000 t (8-hour day) and 1500 t (24-hour day).

The site would generally operate between 6am and 5pm Monday to Saturday, and 6am to 4pm on Sunday. There would be approximately 125 nights per year when the site would operate the additional hours between 6pm and 3am.

For the purposes of dispersion modelling, two scenarios have been modelled:

1. a typical busy day with operating hours of 6am to 5pm and a production rate of 500 t per day for 300 days per year
2. a maximum day with continuous operating hours and a production rate of 1500 t per day for 250 days per year[1]

Table 1 presents a summary of the raw materials that would be required to produce asphalt at both production rates.

Table 1: Quantities of raw material for a typical and a busy day

Input raw material	Quantities of raw material (tonnes)	
	Production rate of 500 t/day	Production rate of 1,500 t/day
Aggregate	390	1170
Recycled asphalt pavement (RAP)	75	150
Bitumen	25	30
Filler	10	15

Source: **Lindsay & Dynan Pty Limited (2007)**

3. AIR QUALITY ASSESSMENT CRITERIA

3.1 Introduction

There are two issues regarding air quality impacts of the proposed asphalt plant. The main issue is dust and the short and long-term impacts associated with particulate emissions. The second is odour associated with stack emissions of VOCs, and also fugitive emissions of VOCs from unloading bitumen to the plant, and loading the hot asphalt to trucks. Both dust and odour have been considered in this report and the issues related to each are discussed here.

[1] The maximum production rate would not occur on a continuous basis. This scenario provides a worst-case estimate of impacts by ensuring the worst-case meteorological conditions are combined with the maximum operations.

3.2 Dust

The DECC Approved Methods specifies air quality assessment criteria for assessing impacts from dust generating activities (**NSW DEC, 2005a**).

These criteria are consistent with the National Environment Protection Measures for Ambient Air Quality (referred to as the Ambient Air-NEPMs (see **NEPC, 1998**)). However, the NSW DECC's criteria include averaging periods, which are not included in the Air-NEPMs and references to other measures of air quality, namely dust deposition and total suspended particulate matter (TSP).

Table 2 and **Table 3** summarise the air quality goals for dust that are relevant to this study. The air quality goals relate to the total dust burden in the air and not just the dust from the project. Therefore, some consideration of background levels needs to be made when using these goals to assess impacts.

Table 2: Air quality assessment criteria for particulate matter concentrations

POLLUTANT	STANDARD / GOAL	AVERAGING PERIOD	AGENCY
Total suspended particulate matter (TSP)	90 μg/m^3	Annual mean	NHMRC
Particulate matter < 10 μm (PM_{10})	50 μg/m^3	24-hour maximum	NSW DECC
	30 μg/m^3	Annual mean	NSW DECC long-term reporting goal
	50 μg/m^3	(24-hour average, 5 exceedances permitted per year)	NEPM

In addition to health impacts, airborne dust also has the potential to cause nuisance impacts by depositing on surfaces and possibly on vegetation/crops. **Table 3** shows the dust deposition criteria set out in the DEC procedures for modelling air pollutants from sources (**NSW DEC, 2005a**).

Table 3: NSW DECC criteria for dust[(a)] fallout

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

Notes:
[(a)] Dust in this context refers to the insoluble solids components of the deposited matter.

3.3 Other pollutants

In addition to the assessment criteria for particulate matter, ground-level concentration (glc) criteria are specified by NSW DECC for odorous and toxic air pollutants (**NSW DEC, 2005a**). The relevant pollutants are:

- products of combustion
  - Carbon dioxide (CO_2)
  - Nitrogen oxides (NO_x)
  - Sulfer oxides (SO_x)

- Carbon monoxide (CO)

- organic compounds, including volatile organic compounds (VOCs)
- air toxics

A full list of emissions is presented in **Section 6.2**. **Table 4** presents a summary of the emissions for which there are impact assessment criteria.

The impact assessment criteria are based on odour or toxicity whichever results in the more stringent goals.

Table 4: Relevant NSW impact assessment criteria

Pollutant	Assessment criteria	Averaging Period	Classification
Nitrogen dioxide (NO_2)	246 µg/m^3	1-hour maximum	Toxicity
	62 µg/m^3	Annual Mean	
Carbon monoxide (CO)	30 mg/m^3	1-hour maximum	Toxicity
	10 mg/m^3	8-hour maximum	
Sulfur dioxide	712 µg/m^3 570 µg/m^3 228 µg/m^3 60 µg/m^3	10-minute maximum 1-hour maximum 1 day Annual average	Toxicity
Arsenic	0.00009 mg/m^3	1-hour 99.9th percentile	Toxicity
Barium	0.009 mg/m^3	1-hour 99.9th percentile	Toxicity
Benzene	0.029 mg/m^3	1-hour 99.9th percentile	Toxicity
Beryllium	0.000004 mg/m^3	1-hour 99.9th percentile	Toxicity
Cadmium	0.000018 mg/m^3	1-hour 99.9th percentile	Toxicity
Chromium III	0.009 mg/m^3	1-hour 99.9th percentile	Toxicity
Chromium VI	0.00009 mg/m^3	1-hour 99.9th percentile	Toxicity
Copper (fumes)	0.0037 mg/m^3	1-hour 99.9th percentile	Toxicity
Ethylbenzene	8 mg/m^3	1-hour 99.9th percentile	Toxicity
Formaldehyde	0.02 mg/m^3	1-hour 99.9th percentile	Toxicity
Manganese	0.018 mg/m^3	1-hour 99.9th percentile	Toxicity
Mercury (organic)	0.00018 mg/m^3	1-hour 99.9th percentile	Toxicity
Zinc (oxide fumes)	0.09 mg/m^3	1-hour 99.9th percentile	Toxicity
Lead	0.5 mg/m^3	Annual Mean	Toxicity
Acetaldehyde	0.042 mg/m^3	1-hour 99.9th percentile	Odour
Toluene	0.36 mg/m^3	1-hour 99.9th percentile	Odour
Xylene	0.19 mg/m^3	1-hour 99.9th percentile	Odour

4. LOCAL DISPERSION CONDITIONS AND EXISTING CLIMATE

This section describes the dispersion meteorology and general climate in the study area. It provides information on prevailing wind patterns, historical data on temperature, humidity and rainfall, to give a more complete picture of the local climate.

4.1 Wind data

The closest meteorological station to the proposed development is located at the Tomago Aluminium Smelter. This is situated approximately 3 km east of the site (as shown on **Figure 1**). Annual and seasonal windroses for the period November 2005 to December 2006 are shown in **Figure 3**. Windspeed and wind direction data collected at 10 m.

The windroses show that in summer the winds are predominantly from the south, east-south-east, with some winds from the east and east-north-east. In winter, autumn and spring the predominant winds are from the north-west, although in spring, there are also some winds from the south, south-south-west, north-east and east. The patterns on an annual basis show that winds are predominately from the north-west with some winds from the south, south-south-west, north-east and east. The mean annual wind speed is 1.8 m/s.

The data from the Tomago Aluminium Smelter do not appear to show the sea-breezes from the north-east that are common to the area and the annual windspeed is much lower than other data from the area. Therefore, these data were compared with a meteorological dataset from the Bureau of Meteorology site located at Williamtown, (approximately 14 km east of the proposed development site). Annual and seasonal windroses prepared from this data file are shown in **Figure 4**.

The windroses show that in summer the winds are predominantly from the north-east, east-north-east, with some winds from the south and south-east. In winter, autumn and spring the predominant winds are from the west-north-west and north-west, though in spring, there are also reasonably frequent winds from the north-east and south-east. The patterns on an annual basis show that winds are predominately from the west-north-west and northwest. The mean annual wind speed is 4.5 m/s.

It is possible that some local influences are affecting the data from the Tomago Aluminium Smelter and therefore, as effects from the project are likely to be local in nature, these data were used as input for the air quality modelling conducted using the dispersion model AUSPLUME.

4.2 Atmospheric stability

Dispersion modelling requires information on atmospheric stability class[2] and mixing height[3]. **Table 5** presents a frequency of atmospheric stability classes at the site. These data are available from the AUSPLUME input meteorological data set. Stable conditions (E and F), under which emissions would disperse slowly are estimated to prevail for just over 48% of the time. **Appendix A** provides tables of joint wind speed, wind direction and atmospheric stability from the Aluminium Smelter data set.

Table 5: Frequency of atmospheric stability classes

Pasquill Gifford stability class	Frequency (%)
A	30.0
B	8.4
C	2.4
D	10.9
E	12.5
F	35.7
TOTAL	100.1

4.3 Temperature, humidity and rainfall

Table 6 presents the temperature, humidity and rainfall data for the closest Bureau of Meteorology site which is located at Raymond Terrace (**Bureau of Meteorology, 2007**). Humidity data consist of monthly averages of 9 am and 3 pm readings. Also presented are monthly averages of maximum and minimum temperatures. Rainfall data consist of mean monthly rainfall and the average number of raindays per month.

The annual average maximum and minimum temperatures experienced are 23.0°C and 10.3°C, respectively. The maximum monthly average temperature is recorded in January at 28.3°C. July is the coldest month, with an average minimum temperature of 3.6°C.

The annual average humidity collected at 9 am is 67%. The months with the highest 9 am humidity on average are May and June with 73%. At 3 pm the annual average humidity reading is 51%, with the highest average in February with 69% (there are missing data from March to June).

Rainfall data show that March is on average the wettest month, with a mean rainfall reading of 140.4 mm. March also has the highest average number of raindays with 10.9. September is the driest month with an average rainfall of 56.8 mm. The average annual rainfall is 1140.1 mm and the average number of raindays annually is 108.5.

[2] In dispersion modelling stability class is used to categorise the rate at which a plume will disperse. In the Pasquill-Gifford stability class assignment scheme, as used in this study, there are six stability classes A through to F. Class A relates to unstable conditions such as might be found on a sunny day with light winds. In such conditions plumes will spread rapidly. Class F relates to stable conditions, such as occur when the sky is clear, the winds are light and an inversion is present. Plume spreading is slow in these circumstances. The intermediate classes B, C, D and E relate to intermediate dispersion conditions.

[3] The term mixed-layer height refers the height of the turbulent layer of air near the earth's surface, into which ground-level emissions will be rapidly mixed. A plume emitted above the mixed-layer will remain isolated from the ground until such time as the mixed-layer reaches the height of the plume. The height of the mixed-layer is controlled mainly by convection (resulting from solar heating of the ground) and by mechanically generated turbulence as the wind blows over the rough ground.

Table 6: Temperature, humidity and rainfall data for Raymond Terrace (Wallaroo State Forest)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9 am Mean Dry-bulb and Wet-bulb Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	23.5	22.9	22.9	19.1	14.9	12.2	11.1	12.6	16.0	19.1	21.7	23.3	18.2
Wet-bulb	18.9	19.6	19.0	16.2	12.4	10.0	8.7	10.0	12.7	14.7	15.9	18.2	14.6
Humidity	63	72	68	72	73	73	71	71	66	59	52	59	67
3 pm Mean Dry-bulb and Wet-bulb Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	27.0	25.1	-	-	-	-	15.3	-	18.7	21.6	24.9	26.8	24.4
Wet-bulb	20.6	21.0	-	-	-	-	10.7	-	13.3	15.6	17.1	18.9	18.0
Humidity	54	69	-	-	-	-	53	43	51	51	42	45	51
Daily Maximum Temperature (°C)													
Mean	28.3	27.8	26.5	23.0	19.8	17.1	16.4	18.0	21.2	23.7	26.2	28.0	23.0
Daily Minimum Temperature (°C)													
Mean	16.3	16.4	14.8	11	7.4	5.8	3.6	4.8	6.7	10.2	12.4	14.6	10.3
Rainfall (mm)													
Mean	124.1	119.9	140.4	101.0	97.9	117.6	63.3	68.2	56.8	76.1	83.6	90.9	1140.1
Raindays (Number)													
Mean	9.5	10.3	10.9	9.1	9.3	9.3	7.9	7.6	7.6	9.2	9.3	8.5	108.5

Station Number: 061076 Commenced: 1938 Last record: 2004
Latitude:-32.6180 S Longitude: 151.8877 E Elevation: 75.0 m
Source: **Bureau of Meteorology (2007)**

5. EXISTING AIR QUALITY

Air quality standards and goals refer to pollutant levels which include the project and existing sources. To fully assess impacts against all the relevant air quality standards and goals (detailed in **Section 3**) it is necessary to have information or estimates on existing pollutant concentrations in the area in which the project is likely to contribute to these levels.

There has been no monitoring undertaken specifically for this project, but there are data available from the DECC monitoring network. The station that is expected to be most representative of the site is Beresfield. This monitoring station is approximately 7 km west of the proposed development site. The most recent years of data published by the DECC are 2004, 2005, and to June of 2006 (**NSW DEC, 2004a; 2005b, 2006**). The maximum 24-hour average PM_{10} concentrations are summarised in **Table 7**. These data consist of TEOM[4] measurements which are continuous recordings of PM_{10} concentrations.

Table 7: Maximum 24-hour average PM_{10} concentrations (TEOM) EPA monitoring data for Beresfield ($\mu g/m^3$)

Month	2004	2005	2006
January	33	35	34
February	44	53	52
March	40	30	41
April	48	46	35
May	44	40	37
June	34	38	45
July	38	27	-
August	33	38	-
September	30	36	-
October	49	46	-
November	38	29	-
December	56	45	-
Annual maximum	***56***	***53***	***41***

The maximum 24-hour concentrations are generally below the NEPM goal of 50 $\mu g/m^3$. There is one occasion in each year where the maximum measured 24-hour average concentration exceeds this. In December 2004 the maximum measured 24-hour average concentration was 56 $\mu g/m^3$ and in February 2005 the maximum measured 24-hour average concentration was 53 $\mu g/m^3$. The NEPM annual compliance report for 2004 (**NSW DEC, 2004b**) does not identify any events that can clearly be attributed to the cause of the exceedance in December 2004, however, the 2005 NEPM annual compliance report (**NSW DEC, 2005c**) notes bushfires and a total fire ban in the Hunter region as the cause of the February 2005 exceedance.

The monthly and annual averages of PM_{10} concentrations measured at Beresfield are presented in **Table 8**. The annual average concentrations are below the goal of 30 $\mu g/m^3$.

[4] Tapered Element Oscillating Microbalance (TEOM) are instruments used to measure PM_{10} concentrations

Table 8: Monthly average PM_{10} concentrations (TEOM) EPA monitoring data for Beresfield ($\mu g/m^3$)

Month	2004	2005	2006
January	20	20	19
February	25	25	23
March	22	16	22
April	22	20	19
May	28	20	23
June	19	20	19
July	19	36	-
August	17	61	-
September	16	37	-
October	18	20	-
November	22	17	-
December	22	28	-
Annual average	***21***	***27***	***21***

There are no dust deposition monitoring data available from which to determine background levels. However, as a rule of thumb, annual TSP concentrations of 90 $\mu g/m^3$, correspond to dust deposition rates of 4 g/m^2/month and PM_{10} concentrations are approximately 40% of TSP concentrations. Therefore an annual average of 27 $\mu g/m^3$ for PM_{10} (**Table 7**) would be approximately equal to 2 g/m^2/month ((27 / 50) x 4). This is likely to be typical of the residential area where the Beresfield monitor is located and similar to the levels at the proposed development site.

The monthly average and monthly maximum NO_2 concentrations are presented in **Table 9**. The maximum concentration measured was 90 $\mu g/m^3$ in 2004, which is significantly below the impact assessment criteria of 246 $\mu g/m^3$.

Table 9: NO_2 DEC monitoring data for Beresfield		
	NO_2 Monthly average (Maximum monthly 1-hour average)	
NSW Goal	*246 µg/m³*	
	2004	**2005**
Month	**µg/m³**	
January	12 (43)	12 (66)
February	14 (49)	16 (57)
March	16 (80)	16 (43)
April	21 (59)	18 (59)
May	27 (76)	25 (64)
June	25 (62)	23 (70)
July	21 (68)	No data
August	23 (64)	No data
September	23 (66)	No data
October	18 (90)	18 (59)
November	16 (57)	14 (55)
December	10 (64)	16 (78)
Annual average	**19**	**13**
Annual maximum 1-hour average	**90**	**78**

6. ESTIMATED EMISSIONS

6.1 Dust

The main emission from the plant is likely to be particulate matter with potential sources as listed below:

- unloading of aggregate upon delivery to site;
- movement of trucks when entering and leaving the site;
- fine particles from exhausts of diesel trucks; and
- from the plant exhaust stack.

Emission factors from the United States Environmental Protection Agency (**US EPA, 1995**) have been used to calculate emissions from all loading, dumping and wind erosion processes, taking into account the likely silt and moisture content of the materials. The details of the calculations are shown in **Appendix B**. **Table 10** summarises the surface emissions, and **Table 11** presents the stack parameters and emission rates.

Particulate emissions from the dryer stack have also been included in the dispersion modelling based on the emission rates given in the US EPA AP-42 document for Hot Mix Asphalt (**US EPA, 2004**).

Table 10: Estimated surface dust emissions at the proposed asphalt plant		
Operation / Activity	**Emission rate (kg/y)**	
	Typical busy day	**Maximum day[(a)]**
Unloading, conveying and loading emissions		
Trucks hauling raw materials on-site	938	2,344
Conveying aggregate to hopper	164	362
Trucks hauling product off-site	1,250	3,125

Note:
(a) Emissions for the busy day scenario will not prevail for a whole year, but the values are provided in kg/y for comparison to those for an average day.

Table 11: Stack parameters and TSP emission rate			
Stack parameters			
Stack height (m)		14.75	
Stack tip diameter (m)		1.44	
Exit velocity (m/s)		11.6	
Exit temperature (K)		413	
TSP emission rate			
Pollutant	**Emission factor (kg/t)[(a)]**	**Emission rate (g/s)**	
		Typical busy day	**Maximum day[(b)]**
TSP emission rate (g/s)	*2.15E-02*	0.12	0.37

Note:
(a) Source: **US EPA, 2004**
(b) Emissions for the busy day scenario will not prevail for a whole year, but the values are provided for comparison to those for an average day.

The way in which these emission data have been used for air dispersion modelling is discussed in **Section 7.1**.

6.2 Stack emissions

The National Pollutant Inventory (NPI) provides emission rates for Hot Mix Asphalt Plants in their Emission Estimation Technique Manual for Hot Mix Asphalt Manufacturing (**NPI, 1999**). The emission rates in the NPI document are taken from the US EPA AP-42 document for Hot Mix Asphalt (**US EPA, 2004**) which provides a list of the organic compounds associated with emissions from asphalt plants. The US EPA emissions data have been updated since the production of the NPI document, and therefore the US EPA data have been used in this assessment.

Table 12 provides a breakdown of the total organic emissions into individual chemical compounds listed in the US EPA documentation together with the emission factors for each of these compounds in kg/t for a batch mix dryer using LPG and fitted with a bag filter. Also presented are the emission rates used in the dispersion modelling.

Table 12: Emission factors for drum mix hot-mix asphalt plant			
Pollutant	Emission factor (kg/t)	Emission rate (g/s)	
		Typical day	Maximum day
CO	2.00E-01	1.16	3.47
NO_x	1.25E-02	0.07	0.22
SO_2	2.30E-03	0.01	0.04
Methane	3.70E-03	0.02	0.06
Acetaldehyde	1.60E-04	9.26E-04	2.78E-03
Benzene	1.40E-04	8.10E-04	2.43E-03
Ethylbenzene	1.10E-03	6.37E-03	1.91E-02
Formaldehyde	3.70E-04	2.14E-03	6.42E-03
Quinone	1.35E-04	7.81E-04	2.34E-03
Toluene	5.00E-04	2.89E-03	8.68E-03
Xylene	1.35E-03	7.81E-03	2.34E-02
2-methylnaphthalene	3.55E-05	2.05E-04	6.16E-04
Acenaphthene	4.50E-07	2.60E-06	7.81E-06
Acenaphthylene	2.90E-07	1.68E-06	5.03E-06
Anthracene	1.05E-07	6.08E-07	1.82E-06
Benzo(a)anthracene	2.30E-09	1.33E-08	3.99E-08
Benzo(a)pyrene	1.55E-10	8.97E-10	2.69E-09
Benzo(b)fluoranthene	4.70E-09	2.72E-08	8.16E-08
Benzo(g,h,i)perylene	2.50E-10	1.45E-09	4.34E-09
Benzo(k)fluoranthene	6.50E-09	3.76E-08	1.13E-07
Chrysene	1.90E-09	1.10E-08	3.30E-08
Dibenz(a,h)anthracene	4.75E-11	2.75E-10	8.25E-10
Fluoranthene	8.00E-08	4.63E-07	1.39E-06
Fluorene	8.00E-07	4.63E-06	1.39E-05
Indeno(1,2,3-cd)pyrene	1.50E-10	8.68E-10	2.60E-09
Naphthalene	1.80E-05	1.04E-04	3.13E-04
Phenanthrene	1.30E-06	7.52E-06	2.26E-05
Pyrene	3.10E-08	1.79E-07	5.38E-07
Benzaldehyde	6.50E-05	3.76E-04	1.13E-03
Butyraldehyde	1.50E-05	8.68E-05	2.60E-04
Crotonaldehyde	1.45E-05	8.39E-05	2.52E-04
Hexanal	1.20E-05	6.94E-05	2.08E-04
Arsenic	2.30E-07	1.331E-06	3.99306E-06
Barium	7.50E-07	4.34E-06	1.30208E-05
Beryllium	7.50E-07	4.34E-06	1.30208E-05
Cadmium	3.05E-07	1.765E-06	5.29514E-06
Chromium	2.85E-07	1.649E-06	4.94792E-06
Chromium VI	2.40E-08	1.389E-07	4.16667E-07
Copper	1.40E-06	8.102E-06	2.43056E-05
Lead	4.45E-07	2.575E-06	7.72569E-06
Manganese	3.45E-07	1.997E-06	5.98958E-06
Mercury	2.05E-07	1.186E-06	3.55903E-06
Nickel	1.50E-07	8.681E-07	2.60417E-06
Selenium	2.45E-07	1.418E-06	4.25347E-06
Zinc	3.40E-07	1.968E-06	5.90278E-06

7. APPROACH TO ASSESSMENT

The approach to the assessment has been to carry out an analysis of the impacts due to dust and other pollutant emissions from the proposed hot mix asphalt plant.

7.1 Dust

The DECC modelling and assessment guidelines (**NSW DEC, 2005a**) specify how assessments based on the use of air dispersion models should be undertaken. They include guidelines for the preparation of meteorological data to be used in dispersion models, the way in which emissions should be estimated and the relevant air quality criteria for assessing the significance of predicted concentration and deposition rates from the proposal. The approach taken in this assessment follows as close as possible to the approaches suggested by the guidelines.

This section is provided so that technical reviewers can appreciate how the modelling of different particle size categories was carried out.

The model used was a modified version of the US EPA ISCST3 model (ISCMOD). ISCST3 is fully described in the user manual and the accompanying technical description (**US EPA, 1995**). ISCMOD was developed to overcome the difficulty of ISCST3 overestimating the 24-hour average PM_{10} concentrations (see **Holmes Air Sciences, 2007** for further details)

The modelling has been based on the use of three particle-size categories (0 to 2.5 μm - referred to as $PM_{2.5}$, 2.5 to 10 μm - referred to as CM (coarse matter) and 10 to 30 μm - referred to as the Rest). Emission rates of TSP have been calculated using emission factors developed both within NSW and by the US EPA (see **Appendix B**).

The distribution of particles has been derived from measurements published by the SPCC **(SPCC, 1986)**. The distribution of particles in each particle size range is as follows:

- $PM_{2.5}$ (FP) is 4.7% of the TSP;
- $PM_{2.5\text{-}10}$ (CM) is 34.4% of TSP; and
- $PM_{10\text{-}30}$ (Rest) is 60.9% of TSP.

Modelling was done using three ISC source groups with each group corresponding to a particle size category. Each source in the group was assumed to emit at the full TSP emission rate and to deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mean of the limits of the particle size range, except for the $PM_{2.5}$ group, which was assumed to have a particle size of 1 μm. The predicted concentration in the three plot output files for each group were then combined according to the weightings in the dot points above to determine the concentration of PM_{10} and TSP.

The ISC model also has the capacity to take into account dust emissions that vary in time, or with meteorological conditions. This has proved particularly useful for simulating emissions on mining operations where wind speed is an important factor in determining the rate at which dust is generated.

Estimates of emissions for each source were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended upon the level of activity and the wind speed. It is important to do this in the ISC model to ensure that long-term average emission rates are not combined with worst-case dispersion conditions which are associated with light winds. Light winds at the site would correspond with periods of low dust generation because wind erosion and other wind dependent emissions rates would be low. Light winds also

correspond with periods of poor dispersion. If these measures are not taken into account, the model has the potential to significantly overstate impacts.

Operations were represented by a series of volume sources located according to the location of activities for the modelled scenario (as shown on **Figure 5**). It is noted that the proposed layout of the site has changed slightly since the dispersion modelling was completed, however, this would not change the location of the sources or the predicted impacts as the changes made to the layout are not sources of either gaseous or dust emissions.

Appendix B provides a summary of dust emissions, hours of emission and allocation of sources for each activity.

Dust concentrations and deposition rates have been predicted in the vicinity of the project site for the two scenarios of the proposed operations. The local terrain has been taken into consideration for the modelling.

The modelling has been performed using the meteorological data discussed in **Section 4** and the dust emission estimates from **Section 6.1**. As an example, an ISCMOD input file is provided in **Appendix C**.

To determine the worst-case 24-hour concentrations, it was necessary to model the emissions from a busy operational day. Obviously these emissions would not occur for long periods of time, but they need to be considered to assess worst-case conditions. If the maximum rate of production coincides with a day of worst-case dispersion conditions, then the 24-hour PM_{10} concentrations would be at their highest. Over a year, there would be days of maximum, average and below average production. Predictions for annual average concentrations and deposition rates have therefore been assessed using average values for truck movements and other processes. Both cases are considered in this assessment, and the different emissions are discussed in **Section 6.1** as typical busy and maximum days.

The average ground-level concentrations have been predicted at a set of receptors arranged in a grid approximately 5 km by 5 km, with 100 m spacing and the site at the approximate centre. Five additional receptors were also positioned at the residences close to the site, as shown in **Figure 1**.

7.2 Stack pollutants

Potential impacts of the emissions from the proposed facility on the surrounding area have been assessed using AUSPLUME Version 6. AUSPLUME is an advanced Gaussian dispersion model developed on behalf of the Victorian EPA (**VEPA, 1986**). It is widely used throughout Australia and is regarded as a "state-of-the-art" model. AUSPLUME is specified by the NSW DEC in the publication on approved methods for air quality assessments (**NSW DEC, 2005a**).

The average ground-level concentrations have been predicted at a set of receptors arranged in a grid approximately 5 km by 5km, with 100 m spacing and the site at the approximate centre. Five additional receptors were also positioned at the residences close to site, as shown in **Figure 1**.

8. ASSESSMENT OF IMPACTS

8.1 Dust

Table 13 presents the maximum predicted ground-level concentrations at the nearby residences due to dust related emissions, including emissions from the stack.

All the predicted concentrations are significantly below the relevant impact assessment criteria.

Table 13: Predicted ground-level particulate matter concentrations at receptors				
	PM_{10} ($\mu g/m^3$)		TSP ($\mu g/m^3$)	Dust deposition (g/m^2/month)
Averaging period	**24-hours**	**Annual**	**Annual**	**Annual**
Assessment criteria	*50 $\mu g/m^3$*	*30 $\mu g/m^3$*	*90 $\mu g/m^3$*	*2 g/m^2/month*
Residence ID	**Typical busy day**			
1	0.7	0.2	0.3	0.02
2	0.6	0.1	0.2	0.02
3	0.3	0.0	0.1	0.01
4	0.4	0.0	0.0	0.02
5	0.3	0.0	0.0	0.01
Residence ID	**Maximum day**			
1	5.3	1.0	1.32	0.05
2	4.4	0.7	0.92	0.04
3	2.3	0.3	0.30	0.01
4	3.9	0.4	0.47	0.05
5	2.0	0.1	0.00	0.00

The predicted maximum 24-hour PM_{10} concentrations due to operations at the proposed plant, are presented in **Figure 6**. The worst-case predicted concentrations at the nearest residences due to the maximum output and the worst-case meteorological conditions are of the order of 6 $\mu g/m^3$ or below, which is significantly below the DECC 24-hour impact assessment criteria of 50 $\mu g/m^3$. If the 24-hour average background concentrations were to exceed 45 $\mu g/m^3$ at the same time as the predicted maximum predicted impacts at Residence 1, the cumulative impact would exceed the NSW EPA 24-hour goal of 50 $\mu g/m^3$. However, as the existing air quality data presented in **Table 7** shows, the maximum measured 24-hour average concentrations are generally below 45 $\mu g/m^3$ and therefore an exceedance of the criteria is unlikely. Maximum 24-hour average concentrations due to the typical operations of plant at the nearest residential receptors are predicted to be less than 1 $\mu g/m^3$, significantly below NSW DECC assessment criteria and unlikely to result in a cumulative impact that exceeds the impact assessment criteria.

Annual average PM_{10} concentrations are predicted to be below 1 $\mu g/m^3$ at all residential areas (**Figure 7**). These concentrations are well below the DECC annual assessment criteria of 30 $\mu g/m^3$.

Predictions have also been made for annual average TSP, and these results are presented in **Figure 8**. Concentrations due to the asphalt plant at all residential areas are estimated to be less than 1.5 $\mu g/m^3$, well below the annual average TSP assessment criteria of 90 $\mu g/m^3$.

Figure 9 shows that predicted dust deposition concentrations are less than 0.1 g/m^2/month at the residential receptors, significantly below the assessment criteria of 2 g/m^2/month.

8.2 Stack emissions

Captured and ducted emissions are mostly aggregate dust, but they may contain gaseous VOCs, including smaller quantities of toxic and odorous air pollutants. It is likely that emissions from loading and unloading trucks, would be greater at ground-level than those emitted from the stack. The surface areas over which these fugitive emissions would be spread, would most probably be very small in comparison to asphalt being laid during roadway construction. However, the plant would be a continuous source compared with roadway construction/repair which is done intermittently.

The approach for assessing the impacts of the emissions from the stack was discussed in **Sections 7.2**.

As presented in **Table 14**, all predicted ground-level concentrations are significantly below the relevant impact assessment criteria for all pollutants.

Table 14: Predicted ground-level concentrations at residential receptors

Pollutant	Averaging period	Impact assessment criteria		Residence ID	R1	R2	Units
				x (m)	378962	379005	
				y (m)	6367986	6368038	
				Operating scenario	Predicted concentration		
CO[(a)]	1-hour	30	mg/m^3	Typical busy	5.58E-03	5.16E-03	mg/m^3
				Maximum	1.67E-02	1.55E-02	
	8-hour	10	mg/m^3	Typical busy	2.84E-03	2.73E-03	mg/m^3
				Maximum	8.52E-03	8.19E-03	
NO_2[(a)]	1-hour	246	µg/m^3	Typical busy	3.48E-01	3.22E-01	µg/m^3
				Maximum	1.05	9.67E-01	
	Annual	62	µg/m^3	Typical busy	2.71E-02	2.31E-02	µg/m^3
				Maximum	8.14E-02	6.94E-02	
SO_2[(a)]	1-hour	570	µg/m^3	Typical busy	6.41E-05	5.93E-05	µg/m^3
				Maximum	1.92E-04	1.78E-04	
	24-hour	228	µg/m^3	Typical busy	1.47E-05	1.33E-05	µg/m^3
				Maximum	4.40E-05	4.00E-05	
	Annual	60	µg/m^3	Typical busy	4.99E-06	4.26E-06	µg/m^3
				Maximum	1.50E-05	1.28E-05	
Lead[(a)]	Annual	0.5	mg/m^3	Typical busy	9.66E-10	8.24E-10	mg/m^3
				Maximum	2.90E-09	2.47E-09	
Acetaldehyde[(b)]	1-hour 99.9th percentile	0.042	mg/m^3	Typical busy	2.52E-06	2.38E-06	mg/m^3
				Maximum	7.56E-06	7.13E-06	
Benzene[(a)]	1-hour 99.9th percentile	0.029	mg/m^3	Typical busy	2.21E-06	2.08E-06	mg/m^3
				Maximum	6.62E-06	6.24E-06	
Ethylbenzene[(a)]	1-hour 99.9th percentile	8.0	mg/m^3	Typical busy	1.73E-05	1.63E-05	mg/m^3
				Maximum	5.20E-05	4.90E-05	
Formaldehyde[(a)]	1-hour 99.9th percentile	0.02	mg/m^3	Typical busy	5.83E-06	5.50E-06	mg/m^3
				Maximum	1.75E-05	1.65E-05	
Toluene[(b)]	1-hour 99.9th percentile	0.36	mg/m^3	Typical busy	7.88E-06	7.43E-06	mg/m^3
				Maximum	2.36E-05	2.23E-05	
Xylene[(b)]	1-hour 99.9th percentile	0.19	mg/m^3	Typical busy	2.13E-05	2.01E-05	mg/m^3
				Maximum	6.38E-05	6.02E-05	
Arsenic[(a)]	1-hour 99.9th percentile	9.00E-05	mg/m^3	Typical busy	3.62E-09	3.42E-09	mg/m^3
				Maximum	1.09E-08	1.03E-08	
Barium[(a)]	1-hour 99.9th percentile	9.00E-03	mg/m^3	Typical busy	1.18E-08	1.11E-08	mg/m^3
				Maximum	3.54E-08	3.34E-08	
Beryllium[(a)]	1-hour 99.9th percentile	4.00E-06	mg/m^3	Typical busy	1.18E-08	1.11E-08	mg/m^3
				Maximum	3.54E-08	3.34E-08	
Cadmium[(a)]	1-hour 99.9th percentile	1.80E-05	mg/m^3	Typical busy	4.80E-09	4.53E-09	mg/m^3
				Maximum	1.44E-08	1.36E-08	
Chromium[(a)]	1-hour 99.9th percentile	9.00E-03	mg/m^3	Typical busy	4.49E-09	4.24E-09	mg/m^3
				Maximum	1.35E-08	1.27E-08	
Chromium VI[(a)]	1-hour 99.9th percentile	9.00E-05	mg/m^3	Typical busy	3.78E-10	3.57E-10	mg/m^3
				Maximum	1.13E-09	1.07E-09	
Copper fumes	1-hour 99.9th percentile	3.70E-03	mg/m^3	Typical busy	2.21E-08	2.08E-08	mg/m^3
				Maximum	6.62E-08	6.24E-08	
Manganese[(a)]	1-hour 99.9th percentile	1.80E-02	mg/m^3	Typical busy	5.43E-09	5.13E-09	mg/m^3
				Maximum	1.63E-08	1.54E-08	
Mercury (organic) [(a)]	1-hour 99.9th percentile	1.80E-04	mg/m^3	Typical busy	3.23E-09	3.05E-09	mg/m^3
				Maximum	9.69E-09	9.14E-09	
Zinc (oxide fumes) [(a)]	1-hour 99.9th percentile	9.00E-02	mg/m^3	Typical busy	5.36E-09	5.05E-09	mg/m^3
				Maximum	1.61E-08	1.52E-08	

Notes:

(a) Impact assessment criteria based on toxicity of pollutant.

(b) Impact assessment criteria based on odour of pollutant.

9. CONTROLS AND SAFEGUARDS

The proposed site is located within an industrial area. There would however, be a requirement to control emissions using best practicable means. The assessment analysis has assumed that these have been implemented. They include the following:

- all roadway surfaces are sealed and would be kept free of dust producing material by sweeping;
- aggregate is dumped from the truck or train directly into a below ground hopper;
- a shielded conveyor would reclaim the aggregate immediately so there would be no on-site stockpiling of this material;
- the RAP stockpiles are enclosed on three-sides;
- there is a fabric filter on the outlet for the exhaust stack;
- the aggregate is dried and heated using LPG; and
- the lime silo would be fitted with a bag filter

10. GREENHOUSE GAS EMISSIONS

10.1 Introduction

10.2 Greenhouse gas inventories

Greenhouse gas inventories are calculated according to a number of different methods. The procedures specified under the Kyoto Protocol United Nations Framework Convention on Climate Change are the most common.

The protocol nominates the following greenhouse gases:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)

From the point of view of the proposed development, HFCs and PFCs are not relevant.

CO_2 would be formed and released during the combustion of gaseous, liquid and solid fuels. These would be the most significant gases for the project. They are liberated when fuels are burnt in diesel powered equipment and in the generation of the electrical energy that would be used by the project.

Inventories of greenhouse gas emissions[5] can be calculated using published emission factors. Different gases have different greenhouse warming effects (referred to as warming potentials) and emission factors take into account the global warming potentials of the gases created during combustion.

The estimated emissions are referred to in terms of CO_2-equivalent emission by applying a global warming potential of one for CO_2 (**AGO, 2006**)

[5] Note the estimates of emissions quoted in this report are quoted to an implied accuracy of 1 kg in some cases. This is not intended to be the accuracy of the estimate and is done to assist in checking the arithmetic of calculations.

10.3 Emission factors

The emission factors published by the Australian Greenhouse Office (**AGO, 2006**) have been used to convert fuel usage and electricity consumption into CO_2-equivalent emissions.

Three 'scopes' of emission categories are defined:

- Scope 1 covers direct emissions from sources within the project boundary such as fuel combustion and manufacturing processes
- Scope 2 covers indirect emissions from the consumption of purchased electricity, steam or heat produced by another organisation.
- Scope 3 includes all other indirect emissions that are a consequence of the organisations activities but are not from sources owned or controlled by the organisations, for example, production of diesel fuel, off-site transport of the product.

The relevant emission factors are:

- LPG usage – (see Table 1 of the AGO workbook **AGO (2006)**)
  - *Scope 1*: 59.8 kg CO_2-equivalent/GJ
  - *Scope 3*: 7.8 kg CO_2-equivalent/GJ

- Diesel usage – (see Table 3 of the AGO Workbook **AGO (2006)**)
  - *Scope 1*: 2.7 kg CO_2-equivalent/litre
  - *Scope 3*: 0.3 kg CO_2-equivalent/litre

- Electrical energy used in NSW – (see Table 5 of the AGO Workbook **AGO (2006)**).
  - *Scope 2*: 0.893 kg CO_2-equivalent/kWh
  - *Scope 3*: 0.176 kg CO_2-equivalent/kWh

10.4 Greenhouse emission calculations

CO_2 emissions from the project would result from the following sources:

1. The combustion of LPG fuel in the plant.
2. The transport of the raw material and final product.
3. The electricity usage at the site.

Based on information provided by the Proponent, **Table 15** presents a summary of fuel usage for a production rate of 150,000 t/y, and **Table 16** presents a summary of the CO_2-e emissions for each year and the lifetime of the project.

Table 15: Summary of energy usage

	Usage per tonne of production	Energy content (GJ / t)	Usage at 150,000 t/y
Fuel Combustion (LPG)	0.7 %	49.3	51,765 GJ
Transport Diesel	4.6 L	N/A	690 kL
Electricity	8.9 kWh	N/A	1,335 kWh

Source: **Lindsay & Dynan Pty Limited (2007)**

Table 16: Summary of estimated CO_2 emissions

	Emission category	Emission factor	Emissions per tonne of production (tCO_2-e/t product)	Annual CO_2-e (t/y)	Project Lifetime CO_2-e (t)
Fuel Combustion (LPG)		kg CO_2-e/GJ			
	Scope 1	59.8	0.021	3,096	92,866
	Scope 3	7.8	0.003	404	12,113
Diesel Usage		t CO_2-e/kL			
	Scope 1	2.7	0.012	1,863	55,890
	Scope 3	0.3	0.001	207	6,210
Electricity Usage		t CO_2-e/kWh			
	Scope 2	0.893	0.008	1,192	35,765
	Scope 3	0.176	0.002	235	7,049
			Total	**6,996**	**209,893**

On annual basis, it has been estimated that the proposed development would release less than 0.007 Mt/y CO_2-e. The annual greenhouse emissions in NSW for 2005 were 158.2 Mt (**AGO, 2007**). Therefore, the proposed development represents less than 0.005% of the total NSW greenhouse gas emissions.

The proposed equipment for the plant would be based on the current technology available and designed to minimise energy use.

11. CONCLUSIONS

This report has assessed the off-site impacts of dust and odorous and toxic air emissions due to the proposed hot mix asphalt plant at Tomago.

It has been predicted that there would be no off-site dust impacts due to operations on either a typical or busy day at the site. In regard to odorous and toxic emissions, the analysis has shown that all predicted concentrations are significantly below the impact assessment criteria for both operating scenarios.

It is important to note that the maximum production rate would not occur on a continuous basis. This scenario provides a worst-case estimate of impacts by ensuring the worst-case meteorological conditions are combined with the maximum operations. The predicted impacts at the residences with this worst-case scenario are significantly below the impact assessment criteria.

The cumulative impacts of the proposed development are predicted to be insignificant.

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Appendix A: Joint Wind Speed, Wind Direction and Stability Class Tables for Tomago Aluminium Smelter

STATISTICS FOR FILE: C:\Jobs\Tomago\Met\Tgo0506.aus
MONTHS: All
HOURS : All
OPTION: Frequency

PASQUILL STABILITY CLASS 'A'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.002976	0.003663	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.006754
NE	0.002175	0.007555	0.000916	0.000000	0.000000	0.000000	0.000000	0.000000	0.010646
ENE	0.001259	0.003777	0.000458	0.000000	0.000000	0.000000	0.000000	0.000000	0.005495
E	0.000572	0.004579	0.002518	0.000000	0.000000	0.000000	0.000000	0.000000	0.007669
ESE	0.001832	0.009730	0.012935	0.000229	0.000000	0.000000	0.000000	0.000000	0.024725
SE	0.002289	0.010188	0.009158	0.000114	0.000000	0.000000	0.000000	0.000000	0.021749
SSE	0.002976	0.005838	0.003892	0.000572	0.000000	0.000000	0.000000	0.000000	0.013278
S	0.003434	0.008471	0.001374	0.000000	0.000000	0.000000	0.000000	0.000000	0.013278
SSW	0.001946	0.008700	0.002289	0.000000	0.000000	0.000000	0.000000	0.000000	0.012935
SW	0.001603	0.004350	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.006067
WSW	0.002289	0.002289	0.000801	0.000000	0.000000	0.000000	0.000000	0.000000	0.005380
W	0.003091	0.005838	0.000801	0.000343	0.000000	0.000000	0.000000	0.000000	0.010073
WNW	0.009959	0.033539	0.003663	0.000343	0.000000	0.000000	0.000000	0.000000	0.047505
NW	0.024153	0.026328	0.002404	0.000114	0.000000	0.000000	0.000000	0.000000	0.052999
NNW	0.017972	0.009615	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.027587
N	0.008700	0.004121	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.012821
CALM									0.020833
TOTAL	0.087225	0.148581	0.041438	0.001717	0.000000	0.000000	0.000000	0.000000	0.299794

MEAN WIND SPEED (m/s) = 1.94
NUMBER OF OBSERVATIONS = 2619

PASQUILL STABILITY CLASS 'B'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NE	0.000000	0.001030	0.000916	0.000000	0.000000	0.000000	0.000000	0.000000	0.001946
ENE	0.000229	0.001145	0.001374	0.000000	0.000000	0.000000	0.000000	0.000000	0.002747
E	0.000572	0.002404	0.004350	0.000572	0.000000	0.000000	0.000000	0.000000	0.007898
ESE	0.000801	0.000114	0.000801	0.000572	0.000000	0.000000	0.000000	0.000000	0.002289
SE	0.000916	0.000458	0.000458	0.000114	0.000000	0.000000	0.000000	0.000000	0.001946
SSE	0.000916	0.001946	0.002862	0.001717	0.000000	0.000000	0.000000	0.000000	0.007440
S	0.002747	0.009730	0.007555	0.001259	0.000000	0.000000	0.000000	0.000000	0.021291
SSW	0.000458	0.009959	0.003777	0.000229	0.000000	0.000000	0.000000	0.000000	0.014423
SW	0.000114	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000229
WSW	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000114
W	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WNW	0.000458	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000687
NW	0.010875	0.004579	0.000000	0.000229	0.000000	0.000000	0.000000	0.000000	0.015682
NNW	0.002976	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002976
N	0.000458	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000458
CALM									0.003549
TOTAL	0.021635	0.031708	0.022092	0.004693	0.000000	0.000000	0.000000	0.000000	0.083677

MEAN WIND SPEED (m/s) = 2.44
NUMBER OF OBSERVATIONS = 731

PASQUILL STABILITY CLASS 'C'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NE	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000229
ENE	0.000572	0.001717	0.000343	0.000000	0.000000	0.000000	0.000000	0.000000	0.002633
E	0.000343	0.001603	0.000916	0.000000	0.000000	0.000000	0.000000	0.000000	0.002862
ESE	0.000572	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000687
SE	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000229
SSE	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000114
S	0.000572	0.000229	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000916
SSW	0.000458	0.000916	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.001374
SW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
W	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NW	0.008814	0.001603	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.010417
NNW	0.002289	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002289
N	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
CALM									0.002518
TOTAL	0.014194	0.006181	0.001374	0.000000	0.000000	0.000000	0.000000	0.000000	0.024267

MEAN WIND SPEED (m/s) = 1.38
NUMBER OF OBSERVATIONS = 212

PASQUILL STABILITY CLASS 'D'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.000114	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000229
NE	0.001030	0.001717	0.002518	0.000000	0.000000	0.000000	0.000000	0.000000	0.005266
ENE	0.001603	0.006181	0.007555	0.001259	0.000000	0.000000	0.000000	0.000000	0.016598
E	0.001374	0.005952	0.011447	0.001259	0.000000	0.000000	0.000000	0.000000	0.020032
ESE	0.000114	0.000114	0.005266	0.000916	0.000000	0.000000	0.000000	0.000000	0.006410
SE	0.000114	0.000000	0.002862	0.000229	0.000000	0.000000	0.000000	0.000000	0.003205
SSE	0.000343	0.000114	0.007212	0.000916	0.000343	0.000000	0.000000	0.000000	0.008929
S	0.001488	0.001030	0.009158	0.001374	0.000458	0.000000	0.000000	0.000000	0.013507
SSW	0.000343	0.001488	0.005723	0.000916	0.000000	0.000000	0.000000	0.000000	0.008471
SW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WSW	0.000114	0.000000	0.000114	0.000114	0.000000	0.000000	0.000000	0.000000	0.000343
W	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WNW	0.000000	0.000229	0.000458	0.000000	0.000000	0.000000	0.000000	0.000000	0.000687
NW	0.011447	0.000343	0.000343	0.000000	0.000000	0.000000	0.000000	0.000000	0.012134
NNW	0.003434	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003549
N	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000114
CALM									0.009959
TOTAL	0.021635	0.017399	0.052656	0.006983	0.000801	0.000000	0.000000	0.000000	0.109432

MEAN WIND SPEED (m/s) = 2.77
NUMBER OF OBSERVATIONS = 956

PASQUILL STABILITY CLASS 'E'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.002289	0.000458	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.002747
NE	0.002289	0.006754	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.009158
ENE	0.002747	0.008356	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.011332
E	0.002976	0.007669	0.000916	0.000000	0.000000	0.000000	0.000000	0.000000	0.011561
ESE	0.002404	0.003091	0.003892	0.000000	0.000000	0.000000	0.000000	0.000000	0.009386
SE	0.000801	0.002175	0.004235	0.000000	0.000000	0.000000	0.000000	0.000000	0.007212
SSE	0.001832	0.004693	0.001030	0.000000	0.000000	0.000000	0.000000	0.000000	0.007555
S	0.003892	0.007784	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.011790
SSW	0.002289	0.012477	0.001030	0.000000	0.000000	0.000000	0.000000	0.000000	0.015797
SW	0.000229	0.000343	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000572
WSW	0.000572	0.000458	0.000343	0.000000	0.000000	0.000000	0.000000	0.000000	0.001374
W	0.000343	0.000114	0.000229	0.000000	0.000000	0.000000	0.000000	0.000000	0.000687
WNW	0.000114	0.000916	0.000458	0.000000	0.000000	0.000000	0.000000	0.000000	0.001488
NW	0.013851	0.002976	0.000916	0.000000	0.000000	0.000000	0.000000	0.000000	0.017743
NNW	0.003434	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.003434
N	0.000801	0.000000	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.000916
CALM									0.012592
TOTAL	0.040865	0.058265	0.013622	0.000000	0.000000	0.000000	0.000000	0.000000	0.125343

MEAN WIND SPEED (m/s) = 1.88
NUMBER OF OBSERVATIONS = 1095

PASQUILL STABILITY CLASS 'F'

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.007326	0.005266	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.012592
NE	0.006067	0.009158	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.015224
ENE	0.005266	0.001717	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.006983
E	0.004808	0.003663	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.008471
ESE	0.007326	0.012019	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.019345
SE	0.009501	0.011905	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.021406
SSE	0.007326	0.007326	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.014652
S	0.009730	0.009844	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.019574
SSW	0.007784	0.014538	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.022321
SW	0.004693	0.004464	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.009158
WSW	0.003205	0.002633	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.005838
W	0.005380	0.002404	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.007784
WNW	0.016026	0.011218	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.027244
NW	0.039492	0.012706	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.052198
NNW	0.019803	0.001603	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.021406
N	0.011447	0.001717	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.013164
CALM									0.080128
TOTAL	0.165179	0.112179	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.357486

MEAN WIND SPEED (m/s) = 1.20
NUMBER OF OBSERVATIONS = 3123

ALL PASQUILL STABILITY CLASSES

Wind Speed Class (m/s)

WIND SECTOR	0.50 TO 1.50	1.50 TO 3.00	3.00 TO 4.50	4.50 TO 6.00	6.00 TO 7.50	7.50 TO 9.00	9.00 TO 10.50	GREATER THAN 10.50	TOTAL
NNE	0.012706	0.009501	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.022321
NE	0.011790	0.026213	0.004464	0.000000	0.000000	0.000000	0.000000	0.000000	0.042468
ENE	0.011676	0.022894	0.009959	0.001259	0.000000	0.000000	0.000000	0.000000	0.045788
E	0.010646	0.025870	0.020147	0.001832	0.000000	0.000000	0.000000	0.000000	0.058494
ESE	0.013049	0.025183	0.022894	0.001717	0.000000	0.000000	0.000000	0.000000	0.062843
SE	0.013851	0.024725	0.016712	0.000458	0.000000	0.000000	0.000000	0.000000	0.055746
SSE	0.013507	0.019918	0.014995	0.003205	0.000343	0.000000	0.000000	0.000000	0.051969
S	0.021864	0.037088	0.018315	0.002633	0.000458	0.000000	0.000000	0.000000	0.080357
SSW	0.013278	0.048077	0.012821	0.001145	0.000000	0.000000	0.000000	0.000000	0.075321
SW	0.006639	0.009272	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.016026
WSW	0.006296	0.005380	0.001259	0.000114	0.000000	0.000000	0.000000	0.000000	0.013049
W	0.008814	0.008356	0.001030	0.000343	0.000000	0.000000	0.000000	0.000000	0.018544
WNW	0.026557	0.046131	0.004579	0.000343	0.000000	0.000000	0.000000	0.000000	0.077610
NW	0.108631	0.048535	0.003663	0.000343	0.000000	0.000000	0.000000	0.000000	0.161172
NNW	0.049908	0.011332	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.061241
N	0.021520	0.005838	0.000114	0.000000	0.000000	0.000000	0.000000	0.000000	0.027473
CALM									0.129579
TOTAL	0.350733	0.374313	0.131181	0.013393	0.000801	0.000000	0.000000	0.000000	1.000000

MEAN WIND SPEED (m/s) = 1.79
NUMBER OF OBSERVATIONS = 8736

FREQUENCY OF OCCURENCE OF STABILITY CLASSES

A : 30.0%
B : 8.4%
C : 2.4%
D : 10.9%
E : 12.5%
F : 35.7%

STABILITY CLASS BY HOUR OF DAY

Hour	A	B	C	D	E	F
01	0000	0000	0000	0027	0071	0266
02	0000	0000	0000	0036	0061	0267
03	0000	0000	0000	0029	0079	0256
04	0000	0000	0000	0048	0064	0252
05	0000	0000	0000	0039	0063	0262
06	0023	0025	0012	0032	0055	0217
07	0098	0058	0027	0028	0029	0124
08	0179	0107	0051	0027	0000	0000
09	0195	0090	0059	0020	0000	0000
10	0220	0098	0041	0005	0000	0000
11	0279	0072	0010	0003	0000	0000
12	0317	0042	0004	0001	0000	0000
13	0317	0041	0002	0004	0000	0000
14	0321	0040	0001	0002	0000	0000
15	0302	0060	0000	0002	0000	0000
16	0242	0055	0003	0009	0010	0045
17	0126	0043	0002	0039	0038	0116
18	0000	0000	0000	0131	0080	0153
19	0000	0000	0000	0127	0083	0154
20	0000	0000	0000	0115	0105	0144
21	0000	0000	0000	0096	0096	0172
22	0000	0000	0000	0058	0102	0204
23	0000	0000	0000	0042	0081	0241
24	0000	0000	0000	0036	0078	0250

STABILITY CLASS BY MIXING HEIGHT

Mixing height	A	B	C	D	E	F
<=500 m	0360	0187	0101	0262	1022	2963
<=1000 m	0994	0275	0096	0150	0014	0064
<=1500 m	1265	0269	0015	0486	0059	0096
<=2000 m	0000	0000	0000	0056	0000	0000
<=3000 m	0000	0000	0000	0002	0000	0000
>3000 m	0000	0000	0000	0000	0000	0000

MIXING HEIGHT BY HOUR OF DAY

Hour	0000 to 0100	0100 to 0200	0200 to 0400	0400 to 0800	0800 to 1600	1600 to 3200	Greater than 3200
01	0248	0087	0016	0001	0012	0000	0000
02	0245	0084	0018	0005	0012	0000	0000
03	0243	0086	0020	0004	0009	0002	0000
04	0241	0082	0017	0008	0013	0003	0000
05	0281	0052	0014	0006	0010	0001	0000
06	0181	0099	0078	0003	0003	0000	0000
07	0120	0056	0114	0074	0000	0000	0000
08	0000	0058	0130	0176	0000	0000	0000
09	0000	0000	0091	0191	0082	0000	0000
10	0000	0000	0000	0234	0130	0000	0000
11	0000	0000	0000	0136	0228	0000	0000
12	0000	0000	0000	0092	0272	0000	0000
13	0000	0000	0000	0000	0364	0000	0000
14	0000	0000	0000	0000	0364	0000	0000
15	0000	0000	0000	0000	0364	0000	0000
16	0000	0000	0000	0000	0364	0000	0000
17	0023	0022	0007	0000	0311	0001	0000
18	0061	0059	0037	0000	0205	0002	0000
19	0079	0108	0050	0004	0108	0015	0000
20	0104	0107	0044	0014	0088	0007	0000
21	0134	0100	0041	0019	0069	0001	0000
22	0154	0144	0017	0006	0043	0000	0000
23	0205	0109	0016	0008	0025	0001	0000
24	0225	0098	0015	0004	0021	0001	0000

Appendix B: Dust emission calculations

DUST EMISSIONS INVENTORY

Haulage of raw materials on-site

Approximately 500 t of raw materials would be brought on-site during the course of a typical busy production day (These materials are listed in Table 1 of the report). Based on average truck capacity of 16 t, this would require a total of approximately 32 truck movements per day. Assuming an average return travel distance of 0.1 km and dust generation rate of 1.0 kg/VKT for a sealed road, the total dust generated would be 3.13 kg/day [(32 x 0.1 km x 1.0 kg/km]. Over the course of a year, the total emissions due to haulage of raw materials would therefore be approximately 938 kg/y [3.13 kg/day x 300 day/y].

On a maximum production day, the amount of raw material required would increase to 1500 t/day and the number of truck movements would increase to 94. This would cause an increase of dust generation to 9.38 kg/day.

Conveyer stacking aggregate to hopper

Approximately 500 t of aggregate and filler would be conveyed to the dryer hopper, on a typical busy production day. Each tonne of material stacked would generate a certain amount of dust, depending on the wind speed and the moisture content. Equation 1 (**US EPA, 1995, 13.2.4-3**) shows the relationship between these variables.

Equation 1

$$E_{TSP} = k \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \right) \quad \text{kg/t}$$

where,

$k = 0.74$

$U = \text{wind speed (m/s)}$

$M = \text{moisture content (\%)}$

[where $0.25 \leq M \leq 4.8$]

Assuming a moisture content of 2% for the aggregate, and an average wind speed of 0.816 m/s, the emission factor for the conveyer stacking the dryer, is therefore 0.00097 kg/t. The total emission for loading it to the dryer hopper is therefore approximately 0.483 kg/day, [0.00097 kg/t x 500 t/day]. Over the course of a year, this would be approximately 362 kg/y [0.483 kg/day x 300 day/y].

On a maximum day, approximately 1,500 t of material would be loaded via the conveyer. The total emissions from this operation on a maximum day would therefore be approximately 1.45 kg [0.00097 kg/t x 1,500 t/day].

Hauling product off-site

Approximately 500 t of material would be transported off-site during a typical busy day. Based on a truck capacity of 12 t, this would require approximately 42 truck movements per day. Assuming a travel distance of 0.1 km and dust generation rate of 1.0 kg/VKT for a sealed road, the total dust generated would be 4.17 kg/day [42 x 0.1 km x 1.0 kg/km]. Over the course of a year this would be approximately 1,250 kg/y [4.17 kg/day x 300 day/y].

On a maximum production day it is anticipated that approximately 125 truck movements would be required to haul the 1,500 t of product off-site. The total dust generated on such a day would be approximately 12.5 kg/day [125 x 0.1 km x 1.0 kg/km].

This section of the Appendix shows the estimated dust emission calculated using the emission factors discussed above and the quantities of material handled.

Apart from the first block of data, each successive block shows the estimated annual average emission in kg/y for each activity and nominates if the activity is (1) insensitive to wind speed (2) sensitive to wind speed or (3) is a wind erosion source. In addition the blocks specify how many sources the dust emission is assumed to be spread over and which sources have been used to specify the locations of the emissions.

Typical busy day

```
--------------------------------  14-May-2007 10:22
 DUST EMISSION CALCULATIONS V2
 --------------------------------

 Output emissions file  : C:\Jobs\Tomago\ISCMod\Typical\typical1.dat
 Meteorological file    : C:\Jobs\Tomago\Met\Tgo0506.isc
 Number of dust sources : 59
 Number of activities   : 3
 No-blast conditions    : None
 Wind sensitive factor  : 0.816 (0.925 adjusted for activity hours)
 Wind erosion factor    : 13.112

  -----ACTIVITY SUMMARY-----
 ACTIVITY NAME : Hauling raw  materials on-site
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 938 kg/y
 FROM SOURCES  : 24
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
 HOURS OF DAY  :
0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0

 ACTIVITY NAME : Conveying
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 164 kg/y
 FROM SOURCES  : 14
25 26 27 28 29 30 31 32 33 34 35 36 37 38
 HOURS OF DAY  :
0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0

 ACTIVITY NAME : Hauling raw materials off-site
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 1250 kg/y
 FROM SOURCES  : 21
39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59
 HOURS OF DAY  :
0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0
```

Maximum day

```
--------------------------------      14-May-2007 10:26
 DUST EMISSION CALCULATIONS V2
 --------------------------------

 Output emissions file  : C:\Jobs\Tomago\ISCMod\Maximum\maximum1.dat
 Meteorological file    : C:\Jobs\Tomago\Met\Tgo0506.isc
 Number of dust sources : 59
 Number of activities   : 3
 No-blast conditions    : None
 Wind sensitive factor  : 0.816 (0.816 adjusted for activity hours)
 Wind erosion factor    : 13.112

  -----ACTIVITY SUMMARY-----
 ACTIVITY NAME : Hauling raw  materials on-site
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 2344 kg/y
 FROM SOURCES  : 24
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Conveying
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 362 kg/y
 FROM SOURCES  : 14
25 26 27 28 29 30 31 32 33 34 35 36 37 38
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Hauling raw materials off-site
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 3125 kg/y
 FROM SOURCES  : 21
39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
```

Appendix C: ISCMOD input file

```
**  ISCST3 model input runstream : Dust
CO STARTING
   TITLEONE ISCST3 Dust Model Run
   MODELOPT RURAL CONC DDEP DRYDPLT
   AVERTIME 24 PERIOD
   POLLUTID TSP
   ERRORFIL error.log
   TERRHGTS ELEV
   RUNORNOT RUN
CO FINISHED

SO STARTING
   LOCATION  POINT1  VOLUME  378499 6368266 1.8
   LOCATION  POINT2  VOLUME  378498 6368263 1.8
   LOCATION  POINT3  VOLUME  378498 6368261 1.8
   LOCATION  POINT4  VOLUME  378498 6368258 1.8
   LOCATION  POINT5  VOLUME  378497 6368254 1.8
   LOCATION  POINT6  VOLUME  378497 6368251 1.8
   LOCATION  POINT7  VOLUME  378497 6368249 1.8
   LOCATION  POINT8  VOLUME  378498 6368247 1.8
   LOCATION  POINT9  VOLUME  378500 6368245 1.8
   LOCATION  POINT10  VOLUME  378504 6368244 1.8
   LOCATION  POINT11  VOLUME  378507 6368244 1.8
   LOCATION  POINT12  VOLUME  378511 6368243 1.8
   LOCATION  POINT13  VOLUME  378515 6368243 1.8
   LOCATION  POINT14  VOLUME  378519 6368242 1.9
   LOCATION  POINT15  VOLUME  378521 6368241 1.9
   LOCATION  POINT16  VOLUME  378522 6368239 1.9
   LOCATION  POINT17  VOLUME  378523 6368237 1.9
   LOCATION  POINT18  VOLUME  378496 6368246 1.8
   LOCATION  POINT19  VOLUME  378496 6368243 1.8
   LOCATION  POINT20  VOLUME  378495 6368240 1.8
   LOCATION  POINT21  VOLUME  378495 6368236 1.8
   LOCATION  POINT22  VOLUME  378494 6368233 1.8
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   LOCATION  POINT24  VOLUME  378500 6368237 1.8
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   LOCATION  POINT26  VOLUME  378512 6368230 1.9
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   LOCATION  POINT28  VOLUME  378511 6368223 1.9
   LOCATION  POINT29  VOLUME  378511 6368220 1.9
   LOCATION  POINT30  VOLUME  378510 6368217 1.9
   LOCATION  POINT31  VOLUME  378510 6368214 1.9
   LOCATION  POINT32  VOLUME  378526 6368209 1.9
   LOCATION  POINT33  VOLUME  378528 6368209 1.9
   LOCATION  POINT34  VOLUME  378531 6368208 1.9
   LOCATION  POINT35  VOLUME  378532 6368208 1.9
   LOCATION  POINT36  VOLUME  378532 6368210 1.9
   LOCATION  POINT37  VOLUME  378532 6368212 1.9
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   LOCATION  POINT39  VOLUME  378541 6368224 1.9
   LOCATION  POINT40  VOLUME  378541 6368226 1.9
   LOCATION  POINT41  VOLUME  378542 6368229 1.9
   LOCATION  POINT42  VOLUME  378542 6368233 1.9
   LOCATION  POINT43  VOLUME  378543 6368236 1.9
   LOCATION  POINT44  VOLUME  378546 6368239 1.9
   LOCATION  POINT45  VOLUME  378548 6368239 1.9
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   LOCATION  POINT52  VOLUME  378553 6368228 1.9
   LOCATION  POINT53  VOLUME  378553 6368233 1.9
   LOCATION  POINT54  VOLUME  378554 6368238 1.9
   LOCATION  POINT55  VOLUME  378556 6368225 1.9
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   LOCATION  POINT57  VOLUME  378557 6368233 1.9
   LOCATION  POINT58  VOLUME  378558 6368237 1.9
   LOCATION  POINT59  VOLUME  378558 6368245 1.9
   LOCATION  POINT60  VOLUME  378499 6368266 1.8
   LOCATION  POINT61  VOLUME  378498 6368263 1.8
   LOCATION  POINT62  VOLUME  378498 6368261 1.8
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   LOCATION  POINT64  VOLUME  378497 6368254 1.8
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LOCATION  POINT67  VOLUME  378498 6368247 1.8
LOCATION  POINT68  VOLUME  378500 6368245 1.8
LOCATION  POINT69  VOLUME  378504 6368244 1.8
LOCATION  POINT70  VOLUME  378507 6368244 1.8
LOCATION  POINT71  VOLUME  378511 6368243 1.8
LOCATION  POINT72  VOLUME  378515 6368243 1.8
LOCATION  POINT73  VOLUME  378519 6368242 1.9
LOCATION  POINT74  VOLUME  378521 6368241 1.9
LOCATION  POINT75  VOLUME  378522 6368239 1.9
LOCATION  POINT76  VOLUME  378523 6368237 1.9
LOCATION  POINT77  VOLUME  378496 6368246 1.8
LOCATION  POINT78  VOLUME  378496 6368243 1.8
LOCATION  POINT79  VOLUME  378495 6368240 1.8
LOCATION  POINT80  VOLUME  378495 6368236 1.8
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LOCATION  POINT82  VOLUME  378497 6368237 1.8
LOCATION  POINT83  VOLUME  378500 6368237 1.8
LOCATION  POINT84  VOLUME  378512 6368233 1.9
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LOCATION  POINT86  VOLUME  378511 6368227 1.9
LOCATION  POINT87  VOLUME  378511 6368223 1.9
LOCATION  POINT88  VOLUME  378511 6368220 1.9
LOCATION  POINT89  VOLUME  378510 6368217 1.9
LOCATION  POINT90  VOLUME  378510 6368214 1.9
LOCATION  POINT91  VOLUME  378526 6368209 1.9
LOCATION  POINT92  VOLUME  378528 6368209 1.9
LOCATION  POINT93  VOLUME  378531 6368208 1.9
LOCATION  POINT94  VOLUME  378532 6368208 1.9
LOCATION  POINT95  VOLUME  378532 6368210 1.9
LOCATION  POINT96  VOLUME  378532 6368212 1.9
LOCATION  POINT97  VOLUME  378532 6368213 1.9
LOCATION  POINT98  VOLUME  378541 6368224 1.9
LOCATION  POINT99  VOLUME  378541 6368226 1.9
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LOCATION  POINT101  VOLUME  378542 6368233 1.9
LOCATION  POINT102  VOLUME  378543 6368236 1.9
LOCATION  POINT103  VOLUME  378546 6368239 1.9
LOCATION  POINT104  VOLUME  378548 6368239 1.9
LOCATION  POINT105  VOLUME  378551 6368240 1.9
LOCATION  POINT106  VOLUME  378553 6368242 1.9
LOCATION  POINT107  VOLUME  378555 6368245 1.9
LOCATION  POINT108  VOLUME  378555 6368249 1.9
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LOCATION  POINT112  VOLUME  378553 6368233 1.9
LOCATION  POINT113  VOLUME  378554 6368238 1.9
LOCATION  POINT114  VOLUME  378556 6368225 1.9
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LOCATION  POINT116  VOLUME  378557 6368233 1.9
LOCATION  POINT117  VOLUME  378558 6368237 1.9
LOCATION  POINT118  VOLUME  378558 6368245 1.9
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LOCATION  POINT135  VOLUME  378523 6368237 1.9
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LOCATION  POINT137  VOLUME  378496 6368243 1.8
LOCATION  POINT138  VOLUME  378495 6368240 1.8
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LOCATION  POINT140  VOLUME  378494 6368233 1.8
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   SRCPARAM  STACK2  0.37 14.75 413 11.6 1.44
   SRCPARAM  STACK3  0.37 14.75 413 11.6 1.44
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   PARTDIAM  STACK2 5.0
   PARTDIAM  STACK3 17.3
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   PARTDIAM  POINT60-POINT118 5.0
   PARTDIAM  POINT119-POINT177 17.3
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   MASSFRAX  POINT1-POINT177 1.0
   PARTDENS  STACK1-STACK3 2.5
   PARTDENS  POINT1-POINT177 2.5
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   SRCGROUP  CM  POINT60-POINT118 STACK2
   SRCGROUP  REST  POINT119-POINT177 STACK3
SO FINISHED

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RE DISCCART 378512 6368229 1.86
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RE DISCCART 378697 6368180 2.22
RE DISCCART 378721 6368279 2.14
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RE DISCCART 378230 6367811 1.78
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RE DISCCART 378463 6367971 2.08
RE DISCCART 379029 6367824 2.95
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RE DISCCART 379053 6368635 2.29
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FIGURES

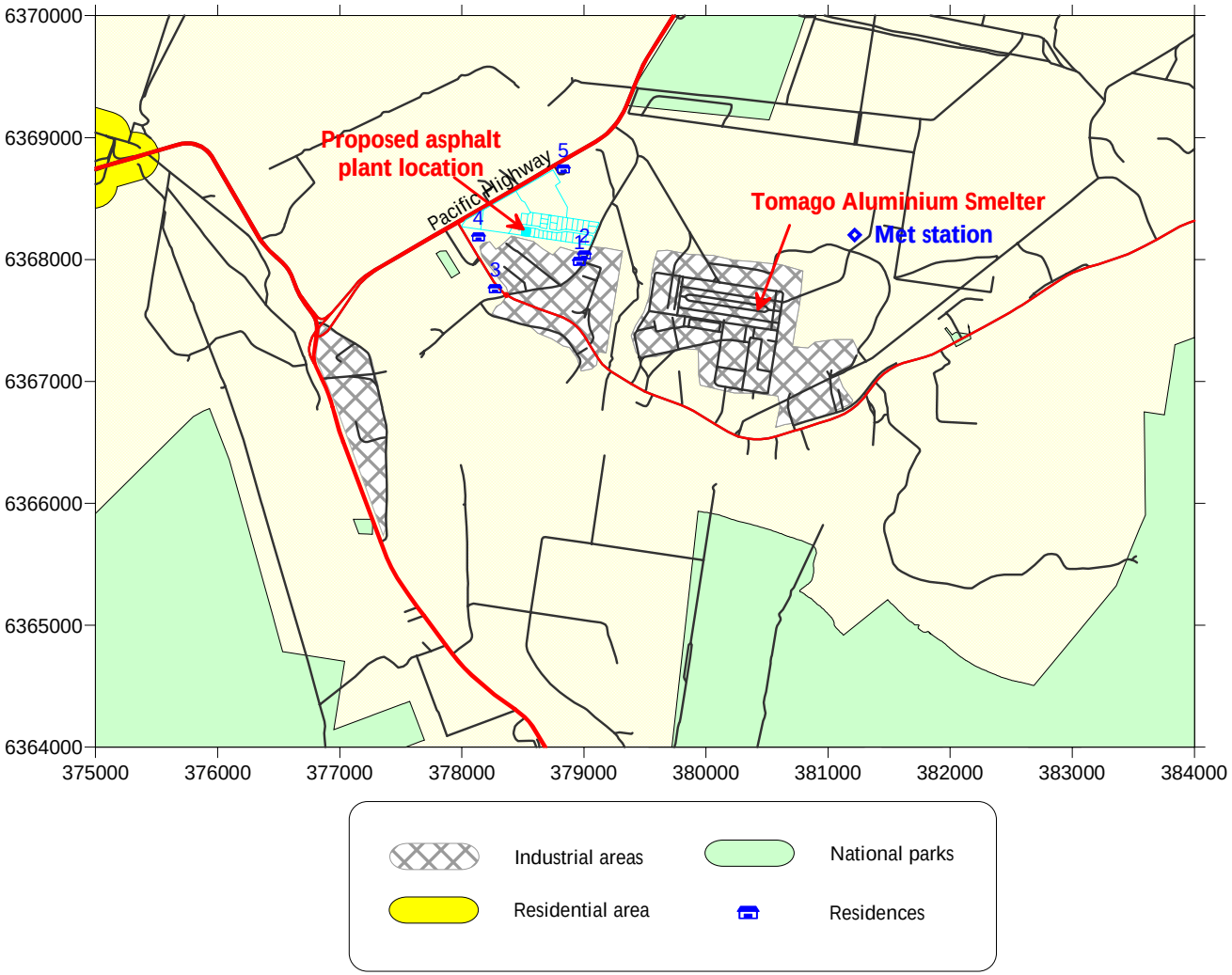


Figure 1: Location map with project site

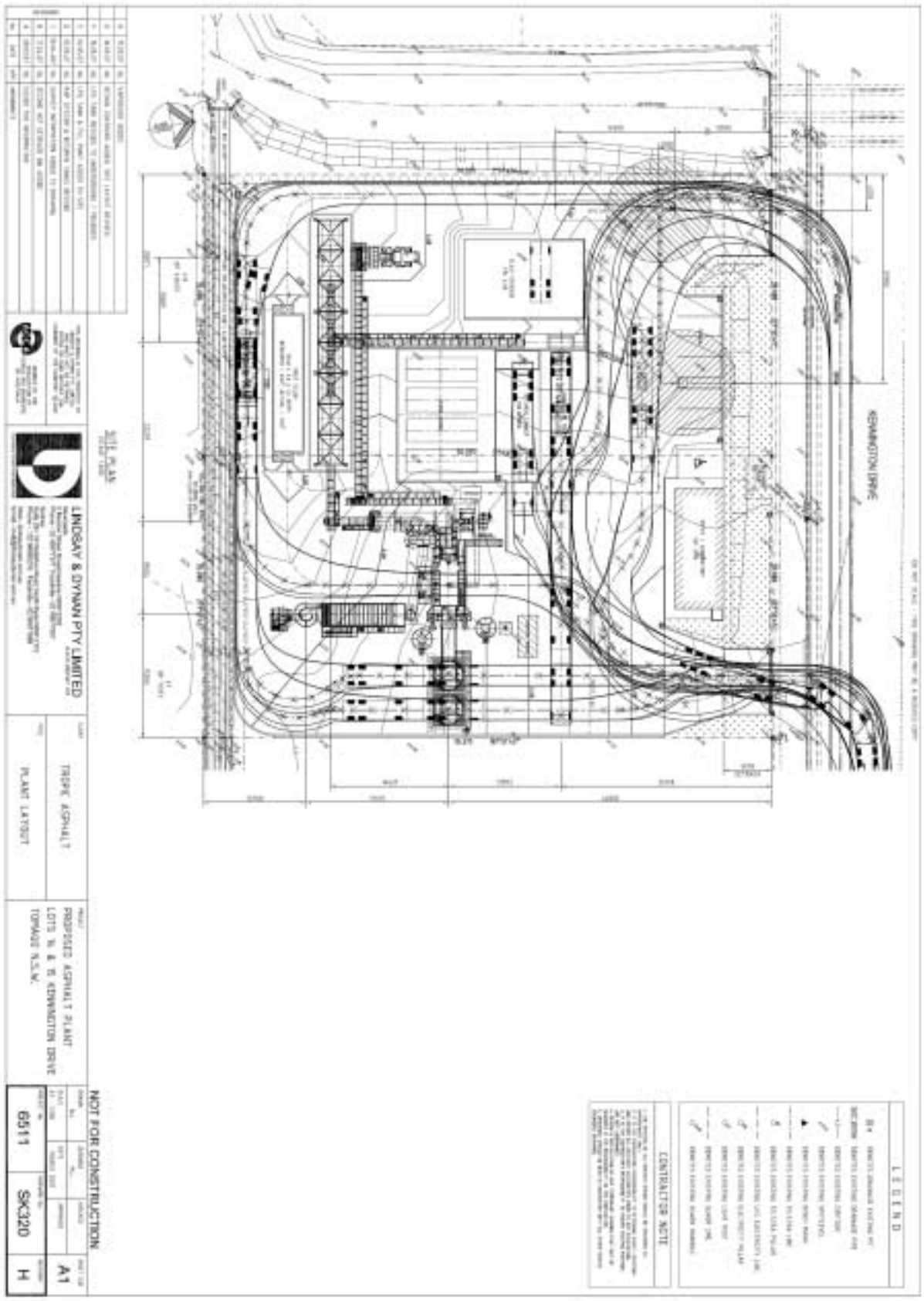


Figure 2: Proposed site layout

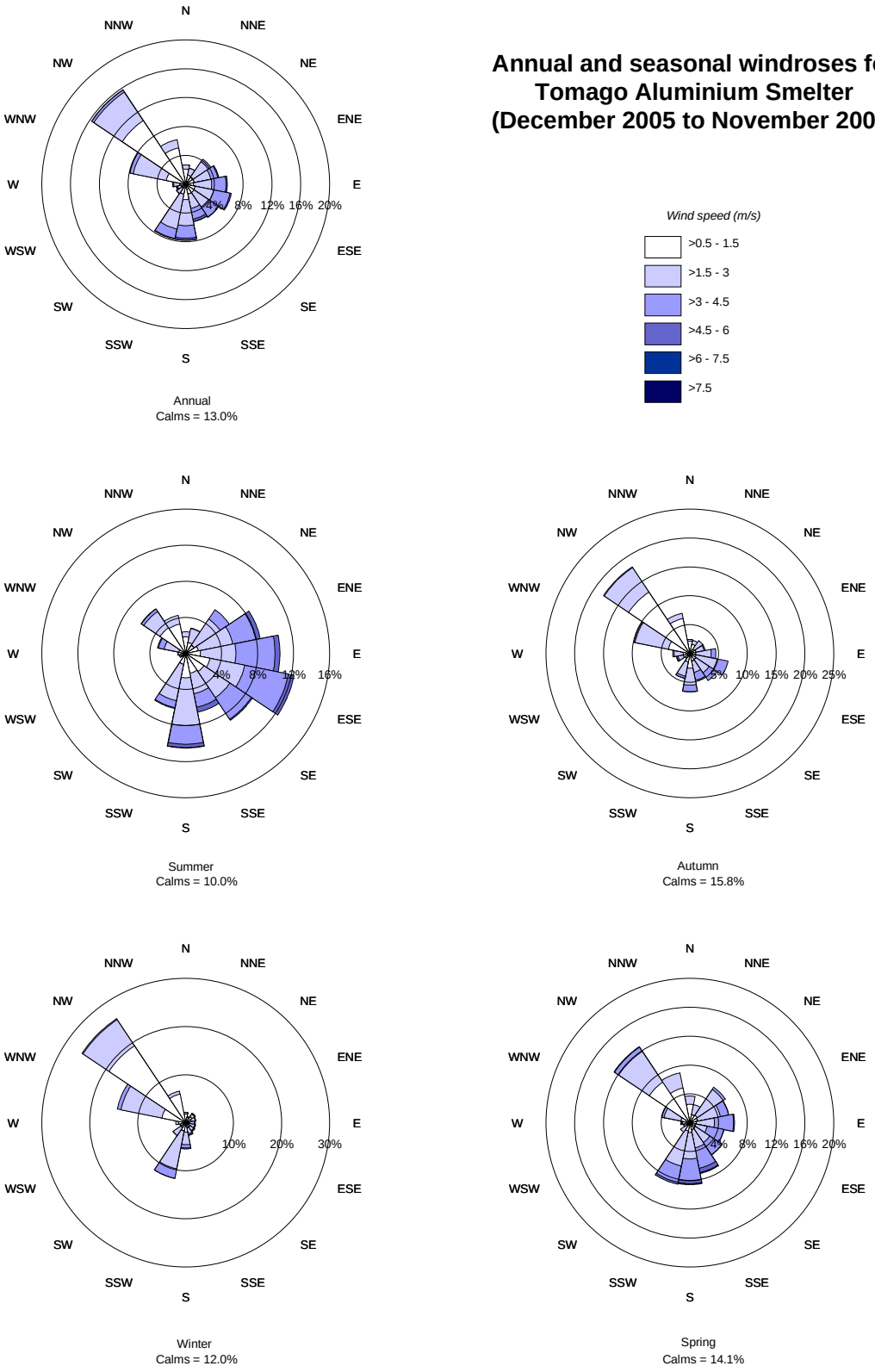


Figure 3: Annual and seasonal windroses for Tomago Aluminium Smelter – December 2005 to November 2006

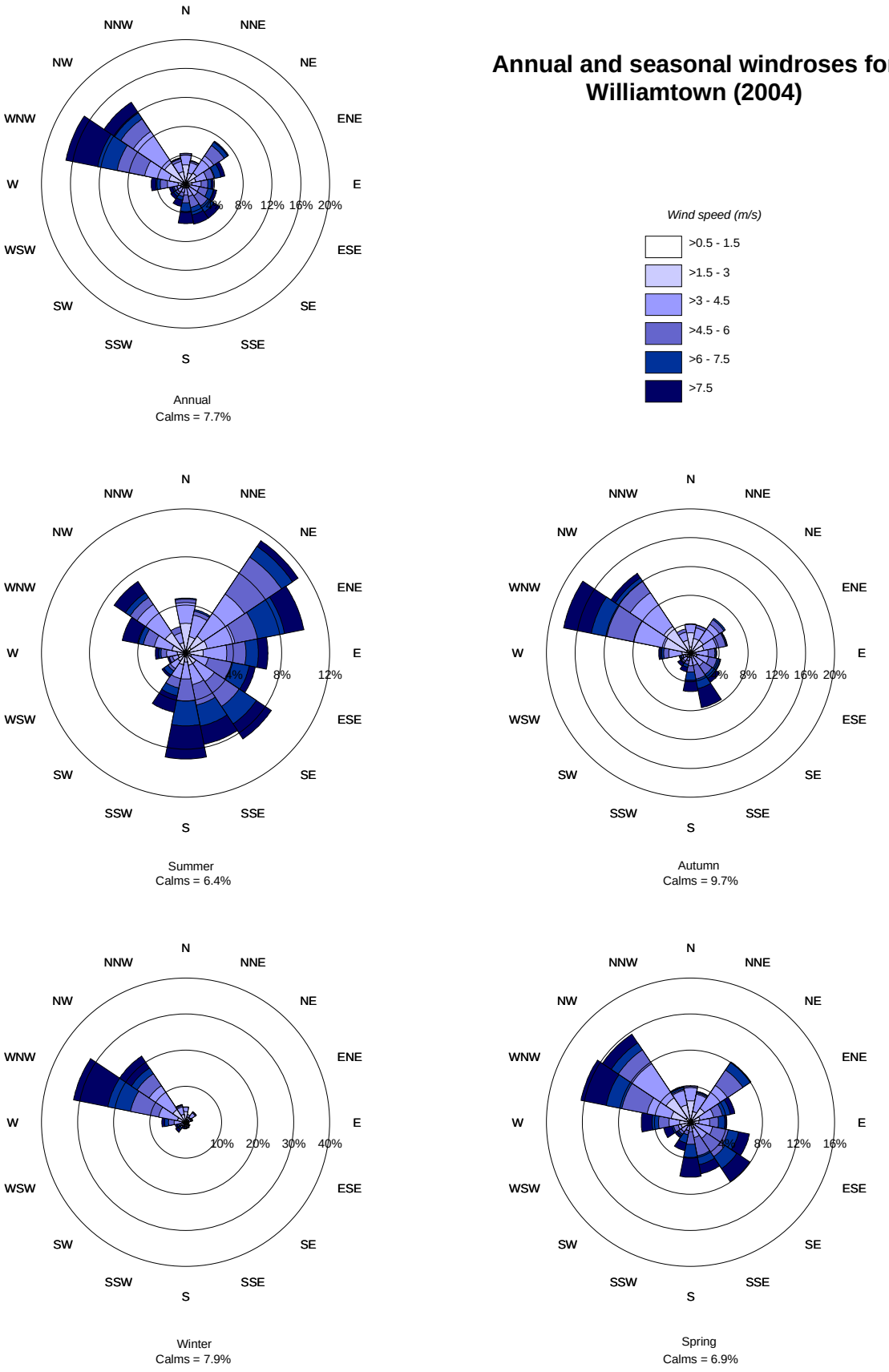
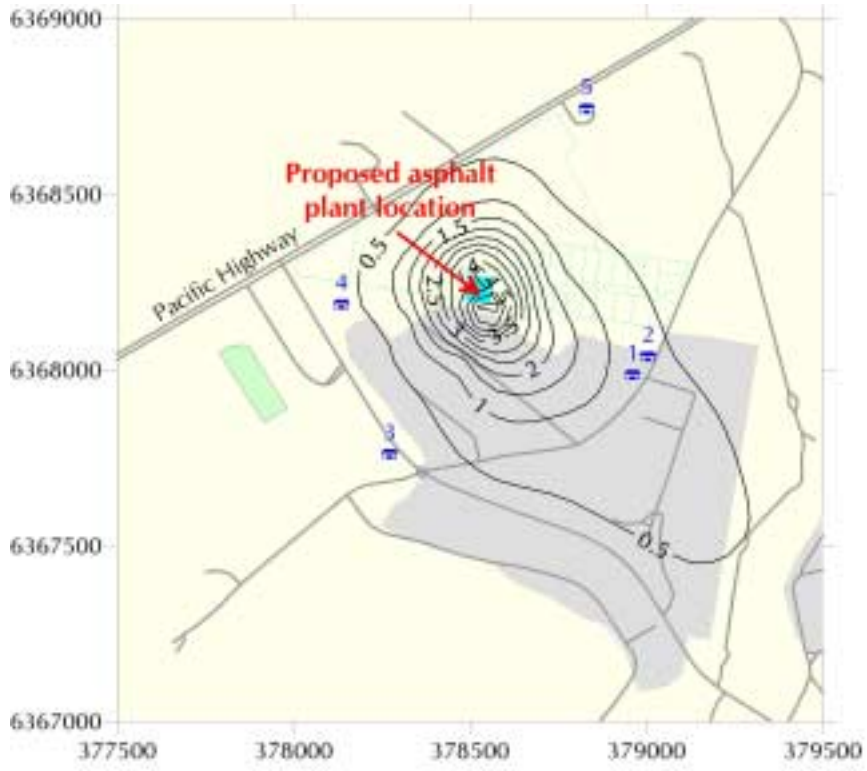
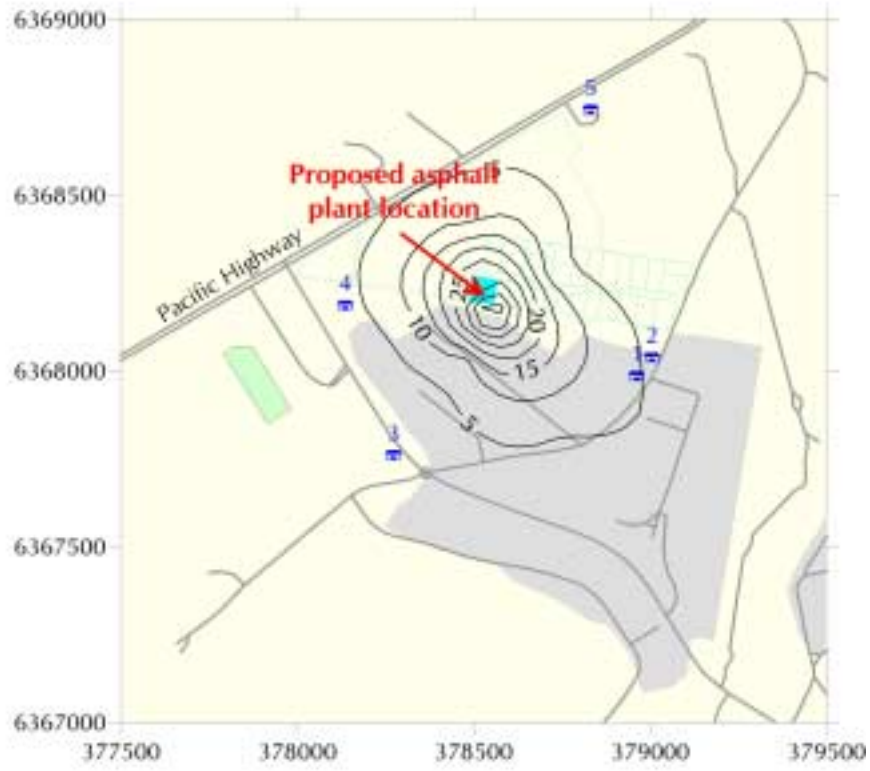


Figure 4: Annual and seasonal windroses for Williamtown (2004)

Figure 5: Location of volume sources

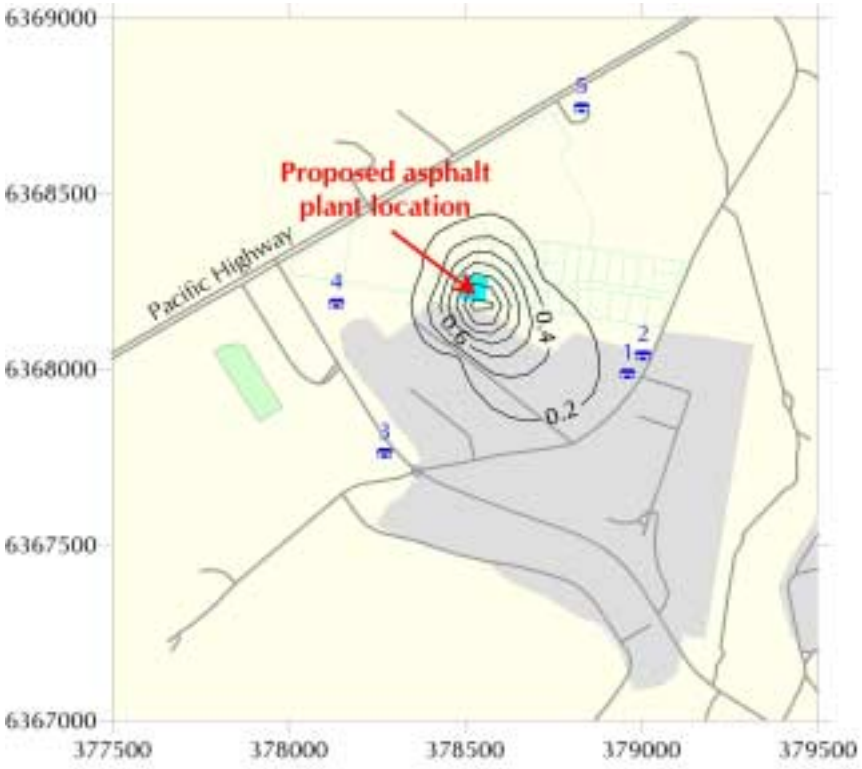


Typical busy day



Maximum day

Figure 6: Predicted maximum 24-hour average PM_{10} concentration (µg/m³)



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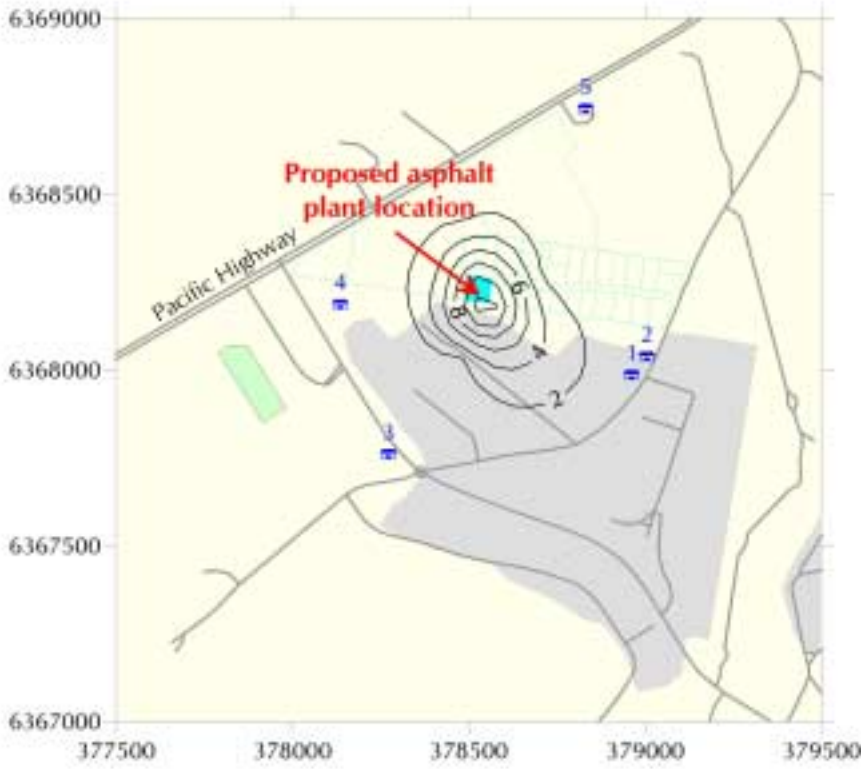


Maximum day

Figure 7: Predicted annual average PM_{10} concentration (µg/m³)

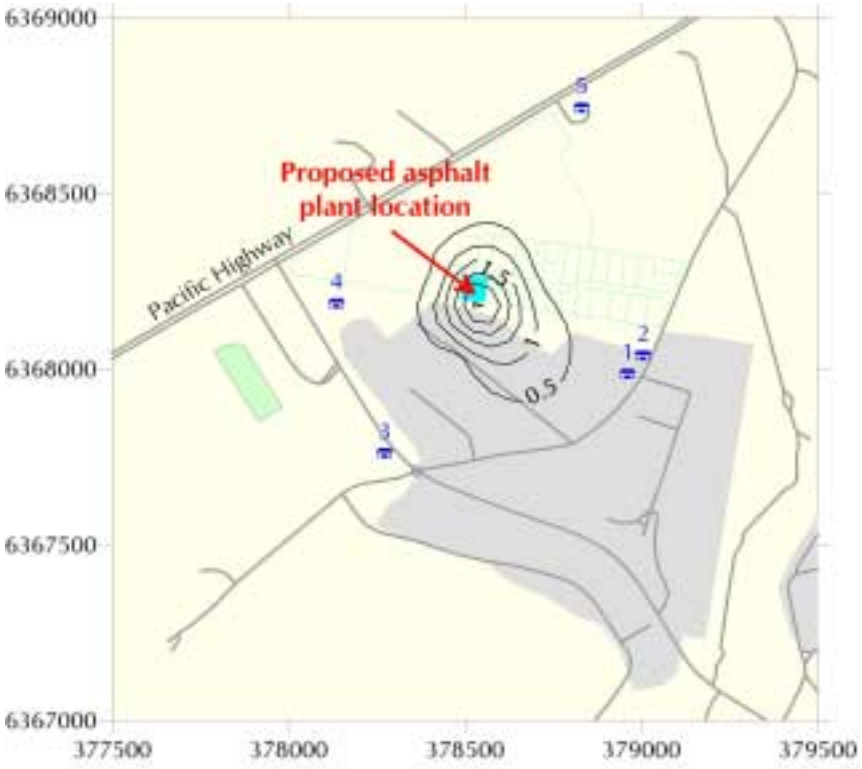


Figure 8: Predicted annual average TSP concentration (µg/m³)

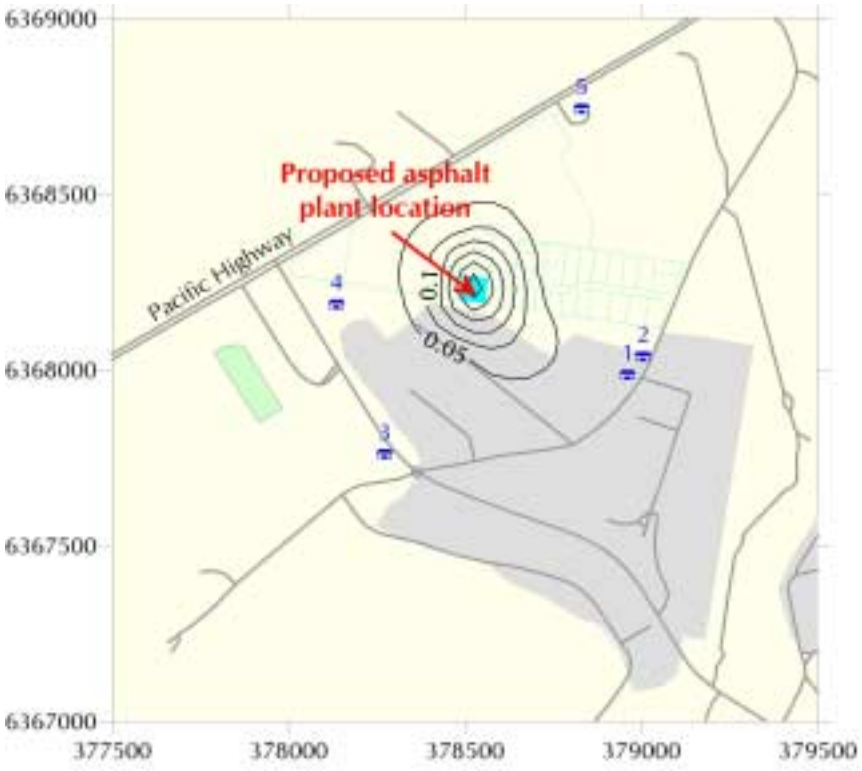


Figure 9: Predicted annual average dust deposition (g/m^2/month)

APPENDIX I

Water Management Plan Report

Lindsay and Dynan Pty Limited

WATER MANAGEMENT PLAN PROPOSED TROPHIC ASPHALT PLANT AT TOMAGO NSW

Advisory Report

Ref: J06-034 Final 2

ONSITE ENVIRONMENTAL MANAGEMENT PTY LTD
20 Andrew Road, Valentine, NSW, 2280
ACN 107 764 312

Phone: (02) 4946 1066
Fax: (02) 4946 1077
Email: david.bone@osem.com.au

June 2007

ONSITE ENVIRONMENTAL MANAGEMENT PTY LTD
20 Andrew Road, Valentine, NSW, 2280
ACN 107 764 312

Phone: (02) 4946 1066
Fax: (02) 4946 1077
Email: david.bone@osem.com.au

June 2007
Reference: J06-0034 Final 2

Authorised:

David Bone

Director

CONTENTS

1 INTRODUCTION

1.1 SCOPE OF REPORT

This report has been prepared by Onsite Environmental Management Pty Ltd (OSEM) to address the design requirements and management of potentially contaminated stormwater contained within first flush systems to be installed at a proposed bitumen batch plant at Tomago, NSW.

General water management principles relevant to this industry are also addressed in this document, along with potential for water recycling and reuse options.

1.2 BACKGROUND

This is located at Tomago, north of Newcastle within a newly constructed industrial estate within the buffer zone of the Tomago Aluminium Smelter. The site is located on Lots 14 and 15, Kennington Drive Tomago. The estate is access from Tomago Road via Old Punt Road. The site location is shown in *Figure 1* of the Environmental Assessment.

1.3 SITE DESCRIPTION AND OPERATION

Plant layout

The proposed layout of the plant is shown in Appendix B of the Environmental Assessment. The water management features discussed in this plan are located in the Southern side of the site below the plant, raw material storage and product loading areas (First Flush basin 65m^3). Disposal areas are limited to the landscaping areas to the north, west and along the southern edge of the plant, these areas are proposed to be constructed as a grass area (around the office and laboratory with wetland type vegetation (reeds and tree screening) along the western and southern edges of the site and along the road edge to the site entry.

Plant Capacity

Data supplied by Lindsay and Dynan engineers shows that the plant has a maximum hourly capacity of 150 tonnes per hour, a typical daily output of 200 – 500 tonnes, with a peak capacity of 1000 tonnes (over an 8 hour shift) and 1500tonnes over a 24 hour period.

Overall, average production capacity per annum is estimated at 75,000 tonnes with a range of between 50,000 to 150,000 tonnes dependent on demand.

Delivery and handling of raw materials

Raw materials are proposed to be sourced from various local sources. All deliveries to the plant will be via the North-western gate along fully sealed roadways and hardstand areas. Deliveries will be via Truck and dog (aggregates and recycled asphalt products) or tanker (bitumen compounds). Raw material storage will be stored within covered bins (aggregates etc) and bunded storage tanks (bitumen products). Transfer conveyors from the storage areas will be covered will be essentially fully closed, with dust suppression sprays fitted at transfer points. Dust suppression sprays are also proposed to be fitted to raw material truck dump areas to reduce dust during delivery and handling of some materials during dry and /or windy conditions.

Apart from bitumen compounds, no other chemicals are proposed to be stored in bulk at the site. The laboratory on site will have small quantities of chemicals to allow quality and process control checks and sampling to be conducted. The plant will also be fed by LPG from an underground Storage tank located on the north-western edge of the site.

Disposal of all chemicals and chemical wastes will be via contractors approved to handle the relevant wastes.

Water usage in process operations

No water is used in the process. Potable water will be connected to the administration and laboratory buildings. Water is also used in the soap down area.

Stormwater controls

All stormwater drainage from the plant is to be directed via the first flush tank by adjusting levels and the use of ripple strip kerb bunds where required. The catchment areas are described below as:

- Clean water (office, laboratory area to north of access road boundary)
- Dirty water catchment (Bitumen storage tanks, asphalt plant, product load out area, aggregate storage and delivery area)

Stormwater is collected from various points within these catchments in open road drains and directed to the first flush basin. Following the initial 15mm of rainfall across the site, the remainder of the water will bypass the first flush basin and be discharged to the existing open drain along the southern boundary of the site via an under/over flow weir and floating oil boom located at the discharge point of the basin.

2 LEGAL REQUIREMENTS

2.1 PROTECTION OF THE ENVIRONMENT OPERATIONS ACT 1999

The management of pollutants disposed of to air, water or land in NSW is predominately governed by the *Protection of the Environment Operations Act 1999* (POEO Act). This act and its regulations is administered by the NSW Department of Environment and Conservation (DEC, the former Environment Protection Agency, EPA, is a department within DEC under current arrangements). The POEO Act repealed several other acts governing pollution of the environment, including the Pollution Control Act, Clean Air Act, Clean Waters Act and Noise Control Act. Local Councils also administer the POEO Act for activities which are not deemed to be Scheduled Activities or Scheduled Development Work under the POEO Act.

Scheduled activities are described in Schedules to the POEO Act. The proposed bitumen plant's capacity of 150 tonnes per hour and between 50,000 to 150,000 tonnes per annum will require an Environment Protection Licence to be obtained for scheduled development work (construction phase) and operation of the plant as a scheduled activity.

The construction phase of the project is deemed to be scheduled development work under the definition in the POEO Act as the construction is designed to enable a scheduled activity to occur at the premises.

If the development of the plant is to be staged, such that the construction phase is for a plant which has an initial production rate did not exceed 150t/hour or 30,000 tonnes per annum, then a license may not be required for construction or operation, until these rates are exceeded.

The matters required to be addressed for application to DEC for an EPL under the POEO Act is contained in Appendix A.

2.2 DEC GUIDELINES

2.2.1 *Stormwater First Flush Pollution*

DEC guidelines on the control of first flush pollutants from industrial sites where a high proportion of the surface area is impervious require that systems are installed in these areas to control the pollutant load to the receiving environment. In these situations first flush tanks or basins are required to be installed and also double as spill containment sumps.

The principles required to be incorporated into systems are described below:

- Minimise availability of pollutants which can be entrained by rainfall events
- Install systems to capture most of a sites polluted portion of runoff
- Re-use or dispose of first flush water quickly and properly

Systems should consider incorporating the following measures into systems:

- Isolate clean and dirty catchments
- A bypass flow arrangement to separate flows from the first flush holding area when it is full if the rainfall event exceeds first flush design capacity
- Adequately separate bypass flows from the collection area to avoid entrainment of potentially contaminated materials in the collection area
- The volume of the collection area should be sized to capture the expected pollutant load from the catchment
- A marker should be placed in the collection area to indicate the design capacity which the area should be maintained at to allow for capture of the next rainfall event. Where sediment is likely to be captured in the pit, an additional 30% of the required capacity should be allowed for.

2.3 LOCAL GOVERNMENT AND AUTHORITIES

2.3.1 Port Stephens Council and Hunter Water

The site is located within the Tomago Aluminium smelter buffer zone and in close proximity (approximately 2 kilometres to the north) to the Tomago Sandbeds. The area is within an industrial land zoning (4a) within Port Stephens Local Government Area (LGA), indicating that it is a permissible development.

The close proximity of a water supply area and the swampy nature of the surrounding area, indicate that control of contaminants at the site will be a priority.

3.1.1 Catchment and Collection areas

The site is divided into 2 catchment areas:

- Dirty water catchment 1, (Bitumen storage tanks, asphalt plant, product load out area, generally the south-western section of the site)
- Clean water catchment 2 (office, laboratory area to north of access road boundary)

Catchment 1 (approximately 3,350m^2) reports to the first flush basin and catchment 2 (approximately 1,575m^2) flows offsite to Kennington Drive via landscaped areas and driveways.

The location of the first flush basin is shown in the figures in Appendix B of the Environmental Assessment.

A design storm collection event of 15mm has been adopted for this site as recommended by Table 2 of the DEC guideline, "Stormwater first flush pollution" September 2005. The tank has a capacity of approximately 65m^3, which is in excess of 15mm times the catchment area of 3350m^2. That is 3350m^2 x 0.015mm x 1.3 = 65m^3. The 1.3 multiplication factor allows for a 30% settlement zone in that tank as required by the Soils and Construction Handbook Vol 1 Ed. 4 2004.

The design of the basin is similar to the reference drawing contained in the DEC publication "Stormwater first flush pollution" September 2005. The overland flows from the catchment enter the basin via an under/overflow weir arrangement with baffling and a kerb inlet located at the required height of sediment containment for the first flush collection. Once this level is reached, the water overflows into another pit via a 90 degree bend, to reduce sediment re-entrainment, and overflows via a spillway wall which discharges to the offsite drains. The first flush pit also has a floating boom fitted to absorb any oily materials which may enter the pits from bitumen product contamination.

A schematic of the first flush pit is provided in Appendix B.

3.1.2 Treatment and disposal options

The basin collects all water from the bitumen plant and product delivery areas and has a potential to contain a small amount of hydrocarbons from rainwater contact with product at the plant. The outlet to this basin is fitted with an underflow arrangement to trap the majority of oily materials which may to be

present in bypass flows, after the first flush contaminated material has already been collected.

Due to the possible presence of hydrocarbon material in this basin and the nil water input into production, the only reuse option is for stockpile dust suppression and some landscape watering. Following laboratory testing, if hydrocarbon levels (measured as Oil and Grease content) are below 10mg/L, and other parameters (Total Suspended Solids and pH) are within specified limits as defined by in the POEO Act (former Clean Waters Act Schedule 2 limits) of TSS <50mg/L, pH 6.5-8.5 then the majority of this water will be discharged to stormwater drains via the landscaping areas around the site.

Where elevated levels of Oil and Grease (>10mg/L) are present and the water cannot be recycled within the plant processes the water will be classified in accordance with the NSW DECC waste guidelines, and disposed of as a liquid waste by a licensed contractor.

Potential water reuse options are:

- Truck wash area, aggregate dust suppression, irrigation water (secondary plant supply)

Landscaping

To ensure that water from basin can be used on landscaping, careful attention is required to the plant selection and landform design. Plants which are tolerant of higher than normal salt loads and which can survive in waterlogged conditions are best suited to this site. Species which would be most suitable include:

- Casuarina and Allocasuarina spp (*glauca, littoralis)*
- Melaleuca sp (*quinquinervia, styphelioides*)
- Reeds (Carex sp, Juncus sp, Gahnia sp.)

To allow for irrigation of these species, a swale or depression is required, so that the taller tree and shrub species can be planted at the higher sections of the swale and the reed species in the central areas. Free draining sandy type topsoils are ideal for this construction with the lower clayey and silty layers retaining the water in the upper layers and allowing additional filtering before discharge to the surrounding drains. This type of construction (above natural ground level) benefits in disturbing less of the ASS materials which may be present at the site and retaining these soils below water table level which prevents the oxidation of the sulphate materials and therefore the generation of acids.

To ensure no flooding of the site occurs, the swales must also include high level overflow grass lined or reinforced spillways to the perimeter drains.

3.1.3 Monitoring and maintenance

The operation of the basin will require a regular (weekly) testing and maintenance regime to be established. The effectiveness of the basin will be dependent on the rapid reuse or discharge of collected waters prior to the next rainfall event.

Monitoring

Discharges from the basin may be licensed by DECC and the parameters for monitoring would then be defined in the EPL. In general, the following regime of monitoring will be undertaken.

Weather conditions: The Bureau of Meteorology Website (http://www.bom.gov.au) will be used to track potential storm events in the region and for information on upcoming weather systems. Weekly weather forecasts can also be obtained from other sources, including Australian weather news (http://australianweathernews.com/OCF), these websites provide site operators with warnings as to the speed in which the first flush basin will need to be tested and emptied. Generally, the basin should always be fully operational within 7 days of rainfall events.

Sediment Build-up

To ensure basin capacity is not reduced due to sediment build-up, markers on the walls of the basin are installed which show when 30% and 70% of the basin capacity has been reached, this is also useful to know how much water is in the basin at any time. As a minimum, the basin should be cleaned of sediment when the 30% mark is reached. Water levels should always remain at or below this mark for effective functioning of the basin. When the forecast indicates rainfall likely to produce 15mm in total (either in one event or incrementally over a few days), the basin should be inspected and be available for that event.

To aid the reduction of sediment ion water entering the basin, flocculants will be added to the inlets of the first flush pit. These will ensure that water entering the basins has received an initial treatment prior to entering the basin. Following the rainfall event, the basin will be inspected and laboratory tests undertaken to determine the levels of flocculants required for adequate treatment of the water to reduce sediment levels below the 50mg/L level and allow discharge (provided other parameters are within specified ranges (Oil and grease <10mg/L, ph 6.5 – 8.5, TSS <50mg/L).

Suitable flocculants for placement in inlet drains include:

- Gypsum – Available in pellet, rock and crushed forms the product is relatively safe to use without detailed chemical testing. Extreme dosing can cause sometimes cause pH levels to change, depending on the incoming water.

- Polyelectrolytes – These commercially available products have a greater capacity to treat water than gypsum and are available in block and liquid forms. The block forms provide a simple and relatively risk free method of flocculation when used in areas which are not permanently submerged. The liquid form is best used via a dosing pump and requires regular chemical testing to ensure overdosing is not occurring. The products are suitable for use in farm dam situations and are reportedly not toxic to aquatic life when used correctly.

- Aluminium Sulphate (Alum) – A very effective method of flocculation reportedly 1000 times faster than gypsum. The product should only be used in commercial dosing arrangements as overdosing can occur easily and can result in pH changes and Aluminium toxicity as the salt rapidly dissolves. Aluminium is an acute toxin for most aquatic life and extreme care is required when using this product.

The gypsum and polyelectrolyte blocks are easily incorporated into inlet channels using cages, baskets or bags placed in the flow lines which ensures that water must flow through the flocculant prior to entering the basin. The final testing and treatment of basins is still required prior to discharge, however this method provides for an early treatment of waters and commences the flocculation process during rainfall events, reducing the time required for settlement.

Water Testing

Testing arrangements for general operation of the basins are as follows:

- Monthly grab sampling (1L glass and 1L plastic) Up stream and downstream of the discharge point to establish the quality of water surrounding the site

- Following a rainfall event, a grab sample (1L glass and 1L plastic) is taken from the discharge point of the first flush pit

- Water samples are tested at a laboratory (possibly onsite laboratory) for Oil and grease, pH and TSS

- Results are compared with licence limits or guidelines and recorded on the monitoring spreadsheet for annual reporting

- Where exceedances are noted, treatment can be initiated (eg. Flocculation to remove sediment, pH dosing, hydrocarbon removal)

- Where exceedances of oil and grease or the presence of hydrocarbons are noted, the water is to be directed to process usage, where possible, or disposed of via a licensed contractor for liquid wastes.

To enable rapid testing of basins in the event of frequent storm activity, an initial set of 10 samples will be tested for pH, TSS and Turbidity in the laboratory and concurrently in the field with an electronic meter (pH, and Turbidity only). Given that the catchments are likely to receive sediments from the same materials over time, a relationship between TSS and Turbidity can be developed so that a meter can be used to test the basins daily, or as required. Once the calibration between TSS and turbidity is established, a laboratory testing regime of 1 test in 10 will be undertaken to ensure calibration factors are constant. Where the factors differ by more than ± 10 % re-calibration testing will occur. Field test meters will be calibrated as required by registered laboratories to ensure accuracy.

Reference sheets for sampling are included as Appendix D.

4 *WATER MANAGEMENT PRINCIPLES*

During an audit of Bitumen manufacturing plants in NSW by DEC officers in 2001, several aspects of general site operation were found to require attention, these were:

- Bunding of chemicals and fuels
- Oil water interceptor weirs
- Ripple strip bunding, drainage links
- Covered hoppers
- Wet scrubbers (water reuse)
- Dust suppression sprays

All of these aspects are planned for incorporation into the design of this plant, with the exception of wet scrubbers on stacks. Other water reuse options proposed for this plant include landscaping irrigation.

REFERENCES

DEC, April 2001, Compliance performance report – Asphalt Manufacturing Industry

DEC , September 2005, Stormwater first flush pollution

DEC, Guide to Licensing under the POEO Act 1997, Parts A and B

APPENDICIES

APPENDIX A

POEO ACT REQUIREMENTS FOR LICENSE APPLICATIONS

4 Supporting documentation required when applying for an environment protection licence

The following is a checklist (referred to in section 3.3 of Part A of this guide) to help applicants for environment protection licences ensure they have included all the documentation required by the EPA to process their applications.

4.1 Premises-based activities

You must supply the following information, where applicable, with your licence application for scheduled development work, scheduled activity and/or non-scheduled activity likely to cause water pollution.

The activity – general information

- ❑ Environmental Impact Statement or statement of environmental effects
- ❑ Species impact statement
- ❑ Waste strategy in force under the Waste Avoidance and Resource Recovery Act 2001
- ❑ Development consent
- ❑ A detailed description of:
    - the current and/or proposed activity (including commencement and completion dates of all stages of development work)
    - the production process (if any), including the types of materials used (that is, all solid, liquid and gas inputs), any reuse of recycled materials, and the nature of the finished product and all intermediates. Include a flow diagram of the process, showing all emission and/or discharge points for pollutants, raw material stockpiles and raw material input points; add a piping and instrument diagram where appropriate.
    - the finished product (if any) (tonnes/year), and capacity (tonnes/year)
    - all pollutants (air, water, noise) and waste products that will be generated, discharged and/or emitted
    - the proposed treatment, mitigation, and/or disposal methods for pollutants, including any discharges after treatment and/or mitigation and disposal
    - all pollution control equipment.

Discharge of pollutants to air

- ❑ For pollutants to be emitted or discharged, both before and after treatment:
    - composition of flue gases on a dry basis
    - moisture content in flue gases
    - volumetric flow rate (cubic metres per hour) corrected to 0oC and 101.3 kilopascals
    - temperature of flue gases
    - pollutant concentrations (parts per million) and mass emission rate (grams per second)
    - exit velocity of flue gases from each discharge point
    - concentrations and size ranges of particulate matter
    - dispersion modelling for pollutants (including odours) used in determining chimney heights. Include all assumptions, air quality criteria and background ambient levels used.
- ❑ A detailed assessment of fugitive emissions from the activity on the premises, including location of fugitive emissions, source of emissions, and mitigation measures for these emissions.

Discharge of pollutants to water

- ❑ A full justification for any proposed discharges. This must include a description of best management practices and cleaner production techniques to be used, and an assessment of what wastewater can be beneficially reused in preference to being discharged to waters.

- ❑ Plans and cross-sectional drawings of proposed works, including inlet and outlet points, baffles or other works to be installed at the discharge point.
- ❑ A longitudinal-section drawing along the outfall drainpipe or diffuser for the disposal of effluent to waters.
- ❑ A schematic flow diagram of the treatment and disposal process proposed, including a piping and instrument diagram where appropriate.
- ❑ The average flow rate (kilolitres per day) of liquid to be discharged/irrigated from the proposed discharge point.
- ❑ The maximum flow rate (kilolitres per day) of liquid to be discharged/irrigated from the proposed discharge point.
- ❑ Proposed methods for measuring flow rates to be discharged/irrigated, and details of major items of equipment (for example, aerators, diffusers, sprinkler types, pumps).
- ❑ The location of proposed monitoring points.
- ❑ A detailed description of the concentration of pollutants both before and after treatment, in terms of the following characteristics:
  - temperature
  - pH
  - biological oxygen demand (BOD)
  - total suspended solids
  - faecal coliforms
  - metals
  - radioactivity
  - oil, grease and floating solids
  - infectious or contagious materials
  - nutrient content
  - salinity
  - any prescribed matter for the definition of water pollution.

The description must take into consideration the characteristics and hydrology of the receiving waters. Consideration must also be given to the cumulative effects of a number of pollutants.

Discharge of pollutants to land

- ❑ Soil and land characteristics:
  - type and description
  - permeability, infiltration and percolation potential
  - soil profile: strata type at each depth
  - types of vegetation or crops
  - subsoil nutrient and salinity status.
- ❑ Topography:
  - ground slope
  - description of adjacent land
  - erosion potential
  - flood potential.

- ❑ Climate:
  - precipitation analysis (monthly distribution)
  - storm intensities
  - evapotranspiration (monthly distribution)
  - prevailing wind.

- ❑ Ground water:
  - depth to ground water
  - location of existing wells:
  - on site, and/or
  - adjacent to site
  - current use of ground water
  - whether the site is a groundwater recharge area
  - groundwater chemistry and hydrology.

- ❑ Surface waters:
  - proximity
  - current use
  - flow characteristics.

- ❑ Proximity to dwellings and roads.

- ❑ Irrigation system:
  - a schematic diagram of the system controls, including pipes, pumps, valves, timers and alarms
  - description of the type of irrigation system: flood, spray, trickle or furrow.

- ❑ A hydraulic water balance, including calculations.

See the *Draft guidelines for the use of treated effluent by irrigation* available from DEC's Environment Line on 131 555.)

Generation, treatment, processing, reprocessing, storage and/or disposal of waste

- ❑ For licence applications relating to landfilling activities:
  - provide details of how environmental goals will be met through the benchmark techniques specified in the Environmental guidelines: solid waste landfills (EPA 1996), or provide a comprehensive environmental management plan.
  - identify whether the facility is located in an environmentally sensitive area. (See Appendix 8 of this guide.)

See the publications *Environmental guidelines: solid waste landfills* (EPA 1996) and *Draft environmental guidelines for industrial waste landfilling* (EPA 1999). Copies are available from DEC's Environment Line on 131 555.

- ❑ For putrescible landfills where the application is for a supervisory licence, the applicant must specify the arrangements under which they have the capacity to exercise control over the waste facility with respect to:
  - the types and volumes of waste received at the waste facility
  - the design of the waste facility
  - the separation, reuse, reprocessing and recycling of waste received at the facility.

- ❑ In all cases, a detailed assessment of the types and quantities of waste generated, received, treated, processed, reprocessed and/or stored at the facility and exported from the facility

See the publication *Environmental guidelines: assessment, classification and management of liquid and non-liquid wastes* (EPA 1999). Copies are available from DEC's Environment Line on 131 555.

The environmental outcomes

- ❑ A detailed assessment of the expected environmental goals or outcomes to be achieved in conducting the activity. This should include, at a minimum, the following:
  - reuse options for the wastewater
  - pollutant emission loads on a yearly basis
  - potential impacts on regional air quality, including odour modelling
  - noise levels at the nearest receptors, and any mitigation measures required to ensure noise levels are within acceptable limits
  - a 'cradle to grave' flow diagram for all waste generated by the development works and/or activity.

The assessment must refer to any relevant standard, guideline or policy that formed the basis of any environmental goal or outcome to be achieved (for example, World Health Organisation goals, Australian and New Zealand Environment and Conservation Council guidelines, the adoption of best-management technology or the demonstration that it is being used).

Site contamination

- ❑ Details of any contamination present on the premises, including:
  - the nature and extent of any contamination
  - any actual or proposed remediation to be carried out
  - any actual or proposed validation of the remediation carried out.

Locality and site plan

- ❑ Locality and site plan drawn to scale showing:
  - contours
  - existing and proposed facilities, site boundaries, adjacent residential areas (existing and proposed development), and other noise-sensitive areas such as schools, hospitals and aged-care centres
  - nearest affected or isolated residences within the area likely to be affected by the activity
  - other adjoining premises (commercial and/or industrial)
  - all sensitive ecological receivers, including nearby creeks and wetlands.

Auditing compliance

- ❑ Proposed means of auditing compliance with licence conditions.

4.2 Non-premises-based activities – mobile plant

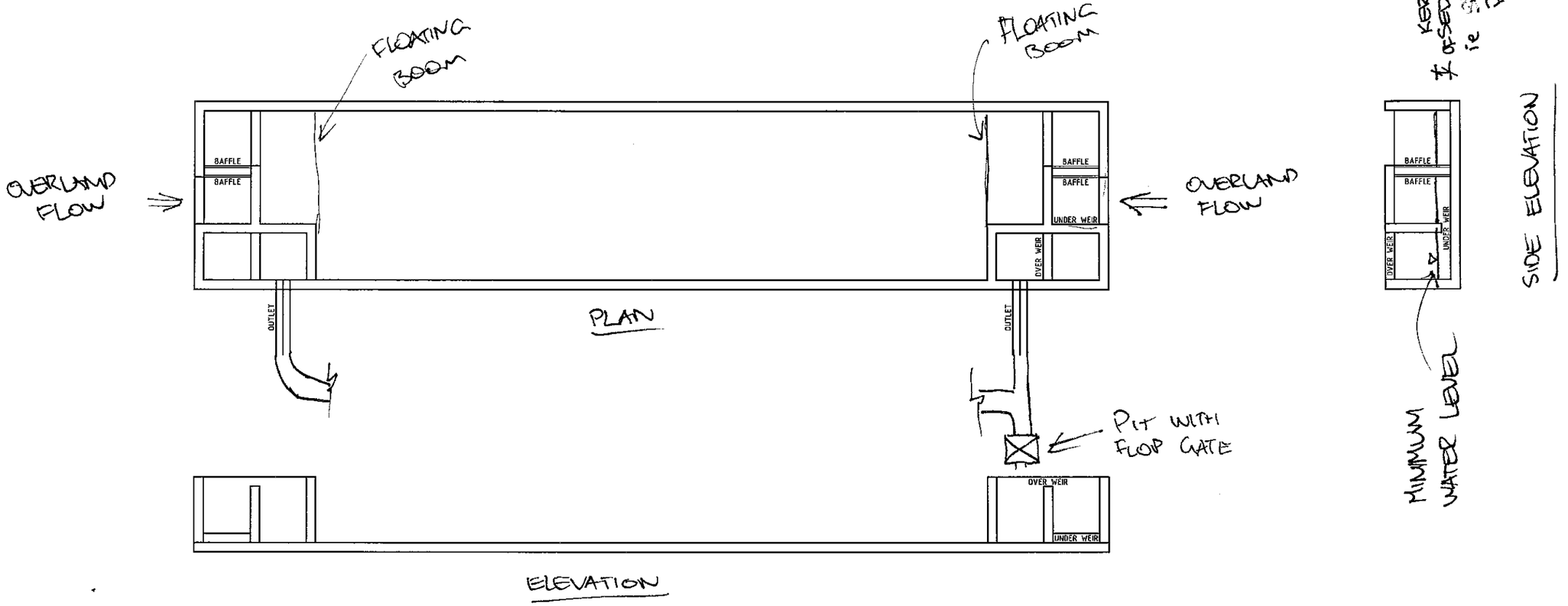
You must supply the following information, **where applicable**, with your licence application for scheduled development work, scheduled activity and/or non-scheduled activity likely to cause water pollution. You must supply the following information with your licence application for a mobile plant activities or mobile waste processing.

- ❑ A detailed assessment of the expected environmental goals or outcomes to be achieved in conducting the activity. This should include at a minimum, where applicable, the following:
  - details of potential discharges and the reuse options for the waste water
  - pollutant emission loads on a yearly basis
  - potential impacts on regional air quality, including odour modelling
  - noise levels at the nearest receptors, and any mitigation measures required to ensure noise levels are within acceptable limits
  - a 'cradle to grave' flow diagram for all waste products resulting from the development works and/or activity.

The assessment must refer to any relevant standard, guideline or policy that formed the basis of any environmental goal or outcome to be achieved (for example, World Health Organisation goals, Australian and New Zealand Environment and Conservation Council guidelines, the adoption of best- management technology or the demonstration that it is being used).

APPENDIX B

FIRST FLUSH PIT DESIGNS



KERB DEPTH EQUAL TO DEPTH OF SEDIMENT IN TANK.
i.e 30% OF VOLUME IS PROPOSED

SIDE ELEVATION

MINIMUM WATER LEVEL

FIRST FLUSH TANK

APPENDIX C

FLOCCULANT INFORMATION

P.O. Box 48, Swansea, NSW 2281 Australia
Ph 61 2 4920 8566 Fax 61 2 4920 8966
Email: sales@envirowarehouse.com
Web site: www.envirowarehouse.com
ABN 30 074 812 758

Environmental Warehouse

DamClear Flocculant Blocks
Grades AN1 & AN2

DamClear Flocculant Blocks are water soluble blocks of anionic polyacrylamide flocculant powder dispersed in a solid but readily water soluble polymer. The Flocculant Blocks are intended for clarification of dirty water.

1.0 Product Identification

Identifier	*Classification*
U.N. No.	Not assigned
Hazchem:	Not assigned
Packaging Group:	Not assigned
D.G. Class:	Not assigned
Poisons Schedule:	Not assigned
CAS No.	Commercially confidential
Product Identification:	DamClear Flocculant Blocks grades AN1 & AN2

NON HAZARDOUS ACCORDING TO WORKSAFE AUSTRALIA CRITERIA [NOHSC:1008(1994)]

2.0 Chemical & Physical Data

Characteristic	*Technical Data*
Chemical type:	Formulation containing anionic polyacrylamide
Physical Form :	Solid rectangular block
Colour:	White
pH (1% solution):	Approx 6.5
Boiling Point:	Not applicable
Water Solubility:	Infinite
Odour:	Faint characteristic odour
Flash Point:	Not exhibited
Bulk Density:	1.0 - 1.2 g/cm3

3.0 Health Hazard & First Aid Information

Exposure Type	*Risk*	*First Aid*
Inhalation:	Minimal, not an inhalation hazard under normal conditions of use.	Remove affected person to fresh air. Clear any blocked airways. If recovery is delayed seek medical advice.
Skin Contact:	Not a skin irritant or sensitiser. Prolonged or repeated skin contact may lead to slight skin irritation.	Remove contaminated clothing and wash skin thoroughly with soap and water.
Skin Absorption:	Low.	Unlikely to be absorbed through skin.

Eye Contact:	May cause some irritation which should cease on removal of product.	If eye contact occurs, irrigate with water for 15 minutes. If there is any irritation seek medical attention.
Ingestion:	Low toxicity product.	Do not induce vomiting. **If unconscious** do not give anything by mouth. Check for breathing and pulse, if present place in the recovery position and obtain medical attention. **If conscious** rinse out the mouth with water. Give 400 mL of water to drink immediately and repeated drinks of water at a rate of a cupful every 10 minutes. Obtain medical attention immediately.

4.0 Product Handling Information

Exposure Type	*Precautions*
Respiratory Protection:	Not normally required.
Hand Protection:	Suitable skin protection should be worn when using this product, i.e. rubber or plastic gloves.
Eye Protection:	Suitable eye protection should be worn when using this product, i.e. safety glasses or goggles.
Skin and Body Protection:	Light weight protective clothing.
Exposure Standards:	None allocated.
Engineering Controls:	Ensure adequate ventilation, especially in confined areas.

5.0 Reactivity Data and Fire & Explosion Hazard Data

Characteristic	*Risk Data*
Incompatibility:	Avoid contact with reactive chemicals.
Hazardous Decomposition Products:	No decomposition if stored and applied as directed. Burning may produce carbon monoxide and/or carbon dioxide.
Fire & Explosion Data:	Non flammable. Non explosive.
Extinguishing Media:	Foam, dry powder or carbon dioxide, in preference to water spray as product becomes very slippery when wet.

6.0 Spills & Waste Disposal

Parameter	*Risk Data*
Personal Precautions:	Use personal protective equipment.
Environmental Precautions:	Do not let product enter drains or sewer system.

Waste Disposal:	Wastes should be disposed of in accordance with requirements of local, state or federal government authorities.
Procedures For Clean Up	Sweep and shovel into containers suitable for disposal. Residues or small spillage may be hosed away with large quantities of water. Product becomes very slippery when wet. Either contain wet product with sand or soil or apply Flocculant Solvent (available from Environmental Warehouse) to neutralise product.

7.0 Contact Point

Telephone: 61 2 4920 8566 (Australia)

Document Reference: PDS #19 - DamClear FB MSDS

APPENDIX D

MONITORING AND SAMPLING PROFORMA SHEETS

Water Quality Monitoring, Inspection and Test Plan

Date: **Sampled by:**

Rainfall preceding sample? Y / N _____mm Source of data ? BOM / Rain gauge / Estimate

Site Location:	**Discharge**	**Sample taken**	**pH (field)**	**pH (lab)**	**TSS (lab)**	**Turbidity (field)**	**Oil and Grease* (lab)**	**Sediment level (m)**	**Comments:** **ie: (flow rate, colour of drain water, colour of discharge, operations active at time of discharge)**
Outlet Basin 1									
Outlet Basin 2									
Upstream									
Downstream									

* = Visual only. If present, sample is required to be taken.

APPENDIX J

Preliminary Risk Screening

PRELIMINARY RISK SCREENING

Undertaken in accordance with "Applying SEPP 33" produced by Dept of Planning

HAZARDOUS MATERIALS

Bitumen

Volume stored	4 x 50,000L tanks = 200,000L
UN number	3257
Proper Shipping Name	Elevated Temperature Liquid N.O.S.
Class	9
Subsidiary Risk	-
Packaging Group	III
Storage	Tank within bund
Minimum distance from boundary	22m (to bund wall)
Number of road movements to facility	5 tankers/week 170 tanker/annum

LPG

Volume Stored	$62m^3$
UN number	1075
Proper Shipping Name	Petroleum Gases, Liquefied
Class	2.1
Subsidiary Risk	-
Packaging Group	-
Storage	Underground Tank
Number of road movements to facility	3/week 38/ annum

Toluene

Volume Stored	20L
UN number	1294
Proper Shipping Name	Toluene
Class	3
Subsidiary Risk	-
Packaging Group	II

Storage	Steel Drum
Minimum distance from boundary	6m
Number of road movements to facility	6 / annum

Methylated Spirits

Volume Stored	20L
UN number	1170
Proper Shipping Name	Ethanol
Class	3
Subsidiary Risk	-
Packaging Group	II
Storage	Steel Drum
Minimum distance from boundary	6m
Number of road movements to facility	8 / annum

ANALYSIS

Hot asphalt (below 240°C) is not classed as a dangerous good. The temperature of asphalt stored and delivered from this plant will be approximately 160°C and will not reach the 240°C threshold. Therefore hot asphalt from this plant will not be classified as a dangerous good.

Lime (Calcium Oxide) is only classified a dangerous good when transported by air. This is not applicable for this development.

RISK SCREENING

Hot bitumen is class 9. Class 9 materials are excluded from the risk screening as per "Applying SEPP 33", Table 1 – Screening method to be used. Therefore NOT POTENTIALLY HAZARDOUS.

Threshold for LPG stored in an underground tank is 64m^3 as per "Applying SEPP 33", Table 3 – Screening threshold quantities. This plant will store 62m^3 and is therefore NOT POTENTIALLY HAZARDOUS

Threshold for toluene (Class 3 PGII) stored on site is 2m^3 as per "Applying SEPP 33", Table 1 – Screening method to be used. This plant will store 0.2m^3 and is therefore NOT POTENTIALLY HAZARDOUS

Threshold for methylated spirits (Class 3 PGII) stored on site is 2m^3 as per "Applying SEPP 33", Table 1 – Screening method to be used. This plant will store 0.2m^3 and is therefore NOT POTENTIALLY HAZARDOUS

TRANSPORTATION SCREENING
Refers to “Applying SEPP 33”, Table 2 – Transportation Screening Thresholds

Hot bitumen is class 9. The transportation vehicular movement threshold for class 9 materials is >60/week or >1000/annum as per Table 2. This plant will require 5/week and 170/annum. Therefore NOT POTENTIALLY HAZARDOUS.

Transportation vehicular movement threshold for LPG (Class 2.1) is >30/week or >500/annum as per Table 2. This plant will require 3/week and 38/annum. Therefore NOT POTENTIALLY HAZARDOUS.

Transportation vehicular movement threshold for Toluene (Class 3 PGII) is >45/week or >750/annum as per Table 2. This plant will require 6/annum. Therefore NOT POTENTIALLY HAZARDOUS.

Transportation vehicular movement threshold for Methylated Spirits (Class 3 PGII) is >45/week or >750/annum as per Table 2. This plant will require 8/annum. Therefore NOT POTENTIALLY HAZARDOUS.

CONCLUSION

No dangerous goods stored at, transported to or from the plant are classified as ‘potentially hazardous’ as per the risk screening process outlined in “Applying SEPP 33”. Therefore there is no need for a “preliminary hazard analysis” to be undertaken.

APPENDIX K

Acid Sulphate Management Plan

ACID SULFATE SOIL ASSESSMENT AND MANAGEMENT PLAN

14-15 KENNINGTON DRIVE HUNTER INDUSTRIAL PARK TOMAGO

Prepared for

Lindsay & Dynan Pty Ltd

On behalf of

Tropic Asphalt

Prepared by

RCA AUSTRALIA

RCA ref 6292-002/1
CLIENT ref 00006511

JULY 2007

RCA AUSTRALIA
ABN 53 063 515 711

92 Hill Street, CARRINGTON NSW 2294

Telephone: +61 2 4902 9200
Facsimile: +61 2 4902 9299
Email: newcastle@rca.com.au
Internet: www.rca.com.au

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/1	1	Electronic	RCA – Job archive	30.07.07
/1	1	Bound Report	RCA – Job archive	30.07.07

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RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

Geotechnical Engineering

Engineering Geology

Environmental Engineering

Hydrogeology

Construction Materials Testing

RCA ref 6292-002/1
Client ref 00006511

30 July 2007

Tropic Asphalt
c/- Lindsay & Dynan Pty LTD
2 Newton Street
BROADMEADOW NSW 2292

Attention: Mark Spencer

ACID SULFATE SOIL ASSESSMENT & MANAGEMENT PLAN
14-15 KENNINGTON DRIVE, HUNTER INDUSTRIAL PARK, TOMAGO

1 INTRODUCTION

This report describes an acid sulfate assessment carried out on the proposed project located at 14-15 Kennington Drive, Hunter Industrial Park, Tomago.

This work was commissioned by Mark Spencer of Lindsay & Dynan Pty LTD in response to the requirement of the Director-General of the Department of Planning.

For the purpose of the investigation, Lindsay and Dynan Pty Ltd provided a site plan showing the proposed development at the site and location.

2 FIELDWORK

Field work was conducted on 9 May 2007, and consisted of the following:

- Drilling of three (3) bores to depths of 1.2-1.5m. Bores were drilled using a hand auger.
- Acid sulfate samples were taken at 0.5m, and 1.2-1.5m.

All fieldwork was carried out by and in the presence of RCA Australia (RCA) personnel. Approximate test locations are shown on the attached site plan (Drawing 1).

Borehole locations are only to be considered as approximate. Bore depths have been recorded relative to the existing ground surface at the time of investigation.

All bores were backfilled on completion.

Engineering logs of bores are presented in Appendix B, together with explanation sheets.

Laboratory testing of samples recovered during fieldwork comprised the following:

- Acid sulfate screening on six (6) soil samples.
- Acid sulfate soil analysis (pH, chromium reduction technique and total potential acidity) on five (5) soil samples.

Soil samples were stored in airtight plastic bags at below 4°C and sent to the ALS Environmental laboratory for acid sulfate soil analysis.

The results of the laboratory testing are detailed on the laboratory test reports, which are attached in Appendix C.

3 ACID SULFATE SOIL ASSESSMENT

3.1 ACID SULFATE SOIL BACKGROUND

The soil pH has the potential to become much lower when the soil is exposed to oxygen as a result of activities such as excavation and drainage and this can lead to the generation of sulphuric acid. Acidic leachate can lead to the release of toxic concentrations of aluminium and iron into water bodies which can affect water quality and cause ecological damage.

Acid sulfate soils can be a major constraint on land use and development, however once identified and quantified, successful management of these areas is possible.

Acid Sulfate Soils (ASS) are soils which contain significant concentrations of pyrite. Where pyrite is exposed to oxygen (in the presence of sufficient moisture), it oxidises, resulting in the generation of sulfuric acid. Unoxidised pyritic soils are referred to as potential ASS. When the soils are exposed, the oxidation of pyrite occurs and sulfuric acids are generated, the soils are said to be actual ASS.

Pyritic soils typically form in waterlogged, saline sediments rich in iron and sulfate. Typical environments for the formation of these soils include tidal flats, salt marshes and mangrove swamps below about RL 5m AHD. They can also form as bottom sediments in coastal rivers and creeks.

Pyritic soils of concern on low lying NSW and coastal lands have mostly formed in the Holocene period, (10,000 years ago to present day) predominantly in the 7,000 years since the last rise in sea level. It is generally considered that pyritic soils which formed prior to the Holocene period (>10,000 years ago) would already have oxidised and leached during ice age periods of low sea level which exposed pyritic coastal sediments to oxygen.

Disturbance or poorly managed development and use of acid sulfate soils can generate significant amounts of sulphuric acid, which can lower soil and water pH to extreme levels (generally <4) and produce acid and salts, resulting in high salinity.

The low pH, high salinity soils can reduce or altogether preclude vegetation growth and can produce aggressive soil conditions which may be detrimental to concrete and steel components of structures, foundations, pipelines and other engineering works.

Generation of the acid conditions often releases aluminium, iron and other naturally occurring elements from the otherwise stable soil matrices. High concentrations of some such elements, coupled with low pH and alterations to salinity can be detrimental to aquatic life. In severe cases, affected waters flowing off site can have detrimental effect on aquatic ecosystems.

3.2 ACID SULFATE SOILS RISK MAP AND SOIL LANDSCAPES

The Beresfield Acid Sulfate Soil Risk Map indicates that the site is in an area of alluvial sand plain at RL 2-4m with a high probability of the presence of ASS between 1-3m depth.

3.3 RESULTS

The ASSMAC guidelines (1998) indicate that potential acid sulfate soil conditions are present where the pH of soil in peroxide is less than 3 and/or the pH change during the test is greater than 1. The screening test results indicated that none of the samples tested had a pH in water of less than 4 and, as such, the soils would not be classified as actual ASS. However, based on the ASSMAC guidelines (1998) and the results of the screening tests there was an indication of potential for acid forming conditions upon oxidation for all samples tested. All samples but one on which screening was undertaken exhibited a pH change of more than 1 and three of the samples exhibited a pH in peroxide of less than 3. The results of the screening are shown below in Table 1.

Table 1 *Summary Acid Sulfate Screening Results- 14-15 Kennington Drive Tomago*

Test Pit	Depth (m)	Soil Type	Initial pH (in water)	pH in peroxide	pH change
HA 1	0.5	Silty SAND	6.0	2.5	3.5
HA 1	1.3	CLAY	5.9	2.4	3.2
HA 2	0.5	Silty SAND	5.6	2.6	3.0
HA 2	1.3	CLAY	4.7	3.8	0.9
HA 3	0.5	Silty SAND	6.9	3.0	3.9
HA 3	1.3	Silty SAND	7.3	3.8	3.5

Note: Shaded results exceed ASSMAC action criteria (Ref [1]).

As a result of the preliminary screening test results further analysis was undertaken on all samples except for the HA2 sample from 1.3m. Further testing involved Chromium Reducible Sulphur (CRS) and Titratable Peroxide Acidity (TPA) analysis, the results of which are shown below in Table 2.

Table 2 *Summary of CRS & TPA analysis- 14-15 Kennington Drive Tomago*

Test Pit	Depth (m)	Soil Type	CRS (%Scr)	Oxidisable pH	TPA mole H^+/t	Potential Acidity Neutralising Calculation Kg Lime/m^3 (based on %Scr)	Potential Acidity Neutralising Calculation Kg Lime/m^3 (based on TPA)
HA 1	0.5	Silty SAND	<0.02	3.8	177	-	19.5
HA 1	1.3	CLAY	<0.02	3.9	33	-	3.6
HA 2	0.5	Silty SAND	0.02	3.9	31	1.4	3.4
HA 3	0.5	CLAY	<0.02	3.8	115	-	12.7
HA 3	1.3	Silty SAND	0.04	8.4	<2	2.8	-

Note: Shaded results exceed ASSMAC action criteria (Ref 1).

3.4 INTERPRETATION OF RESULTS

The results of the acid sulfate soil analysis summarised on Table 2 indicate:

- The percent chromium reducible sulphur (%Scr) of the samples was under the threshold values for the representative soil types (ASSMAC, 1998). Consequently this soil would not be classified as potential acid sulfate soil.

- The Titratable Peroxide Acidity (TPA) acidity trail results do indicate some acid generation for all samples, however given the low chromium reducible sulphur for that sample this is thought likely to be due to sources other than sulphur, eg, presence of organics and/or manganese oxide.

- The observed variation between oxidised pH shown in Table 1 and Table 2 is thought to be due to sample preparation. The results presented in Table 1 are from testing of sample as received, whereas Table 2 results from samples that have been dried and crushed, with an apparent increase in the soil neutralising capacity.

Reference to the ASSMAC assessment guidelines indicate that test results discussed above exceed ASSMAC action criteria. ASSMAC guidelines indicate that a management plan is required where the action criteria are exceeded.

Owing to the presence of potential acid soils at the site, an acid soil management plan would be required for the treatment and management of acid soils during construction.

Neutralising requirements for each of the soil samples tested are shown on Table 2. The neutralising requirements shown on Table 2 include a factor of safety of 1.5, which is recommended for complete neutralisation.

It is noted these neutralising rates are conservative based on testing completed. If less conservative rates were required to reduce treatment costs then additional testing would be necessary. Assuming sufficient sample has been retained from the first suite of testing, additional testing would cost some $500 and take about a week to complete.

4 ACID SULFATE SOIL MANAGEMENT PLAN

4.1 PROPOSED DEVELOPMENT

The proposed development comprises an asphalt plant. Construction activities involve:

- excavations for the building foundations.

- possibly minor excavation to subgrade level for car park pavement.
- possibly an underground storage tank.

Some minor trimming of the existing ground surface is likely to be required for the car park and slab areas for geometric and construction reasons. It is expected that this will involve localised excavation of existing soils to a depth in the order of 0.5m. Excavation is expected for building foundations and the proposed tank. This may involve disturbance of potential acid sulfate soils.

All soils excavated or disturbed should be considered as acid sulfate soils and treated in accordance with the Acid Sulfate Soil Management Plan.

4.2 ACID SULFATE SOILS ISSUES

The construction raises the following ASS related issues that need to be addressed by the management plan:

- The oxidisation of potential ASS exposed in excavation spoil.
- The oxidisation of potential ASS exposed in excavation face.

4.3 GENERAL ASS MANAGEMENT RATIONALE

All soils excavated or disturbed should be considered as potential acid sulfate soils. Suitable management options for treatment of these materials may include the following:

- Avoidance of ASS Disturbance – construction without minor disturbance of the soils is not considered to be practical as this would involve importation of a significant volume of filling to the site and removal of soils is required for foundation and pavement support criteria.
- Liming of Exposed Material – for areas of excavation that are likely to impact on ASS, acid production could be controlled by the addition of lime. The locations of such excavations, as well as the method and procedures for neutralisation by lime including indicative liming rates, are presented in Section 4.4.2.
- Burial - ASS can be disposed of by burial below the water table after excavation. Not practical for this site.
- Disposal off site - not practical for this site.

The preferred method of ASS Management is to avoid disturbance. Where excavation of ASS is required, the preferred method of treatment would be neutralisation by lime, followed by re-use of the material on site.

4.4 ACID SULFATE SOIL MANAGEMENT

4.4.1 PREVENTING OXIDATION OF ASS

This method involves avoiding the excavation and disturbance of ASS on site and is the preferred method of management to be adopted over the majority of the site.

Minor disturbance of the natural soils is considered to be unavoidable in formation of the foundations for the building and car park subgrade. In these areas disturbed soils will need to be treated by neutralising with lime as detailed below.

4.4.2 NEUTRALISATION BY LIME

Neutralised by lime is the recommended treatment for ASS on the site that are disturbed as part of construction activities.

Options for lime treatment of ASS are:

- in situ treatment by addition of lime; or
- treatment in a bunded area.

As the excavated and disturbed materials are to be re-used on site, it is considered that treatment of excavated materials by lime can be undertaken at the point of excavation. This should involve:

- placing or reworking excavated material to form layers of maximum 300mm thickness;
- uniform spreading of lime based on the rate noted below;
- thorough and uniform mixing of the soil and lime using a rotary hoe or some similar mechanical process;
- monitoring to confirm neutralisation.

The liming rates for samples are presented in Table 2. Calculation of the liming rates has been based on a factor of safety of 1.5 above the theoretical requirement. This takes into account the rate of lime reactivity and the possibility of inhomogeneous mixing.

It is recommended that a liming rate of 20kg of lime per cubic metre of material disturbed be used. This is based on the worst case acid sulfate soil test result and a factor of safety of 1.5. Where disturbed material is spread in 300mm thick layers for mixing, this rate equates to 6kg of lime per square metre.

Good quality fine agricultural lime should be used.

Liming rates will need to be confirmed by testing and monitoring at the time of construction.

The exposed face of excavated surfaces should also be treated with lime.

The time required for applied lime to neutralise ASS is widely variable and depends on the specific properties of the neutralised soil, although the lime will begin to neutralise the acid soils from the time of application.

4.5 MONITORING PROGRAMME

Monitoring will be required to confirm that lime treatment has neutralised the ASS.

After lime treatment, soil should be assessed by testing for pH and total actual and potential acidity (TAA, TPA). The soil can be considered neutralised if the net acid generating potential assessed on the basis of TAA and TPA is less than 0.5kg H_2SO_4 / tonne or negative.

Testing of treated soil should be based on field monitoring of the pH based on one test per $50m^3$ of soil with TAA and TPA standard ASS laboratory test for every 5 field pH measurements.

Monitoring of soil pH in exposed excavation faces and treatment areas should be undertaken on a weekly basis during the construction works.

Monitoring of surface water pH should be undertaken upstream, within the area of works and downstream on a daily basis during the construction works.

On completion of earthworks or other disturbances, weekly pH measurements should be undertaken on all water bodies until three consecutive readings indicate neutral conditions ($6.5 < pH < 8.5$).

Post construction monitoring should comprise monthly assessment of drain water pH for a minimum of six months with an assessment of any continuing requirement to be made within that period.

4.6 CONTINGENCY MEASURES

Soil acidity in excavated and disturbed materials should be monitored. Should the field pH tests and the laboratory tests show that the soil acidity has not achieved the minimum required standard, then the material must be reworked and additional lime treatment carried out until it is verified that the soil meets the required standard.

In the event that pH measurement of exposed soils in excavations does not meet required levels, lime shall be spread over the affected area and the pH levels further monitored.

Sufficient lime is to be stored in a dry location on site to permit the immediate implementation of the above contingency measures

5 LIMITATIONS

This report has been prepared for Tropic Asphalt and Lindsay & Dynan Pty Ltd in accordance with the agreement with RCA. The services performed by RCA have been conducted in a manner consistent with that generally exercised by members of its profession and consulting practice.

This report has been prepared for the sole use of Tropic Asphalt and Lindsay & Dynan Pty Ltd. The report may not contain sufficient information for purposes of other uses or for parties other than Tropic Asphalt and Lindsay & Dynan Pty Ltd. This report shall only be presented in full and may not be used to support objectives other than those stated in the report without permission.

The information in this report is considered accurate at the date of issue with regard to the current conditions of the site. Conditions can vary across any site that cannot be explicitly defined by investigation.

Environmental conditions including contaminant concentrations can change in a limited period of time. This should be considered if the report is used following a significant period of time after the date of issue.

Yours faithfully

RCA AUSTRALIA

Mark Allman

REFERENCES

[1] NSW Acid Sulfate Soil Management Advisory Committee, Acid Sulfate Soil Manual, August 1998.

Appendix A

Drawings

LEGEND

⊕ Approximate bore hole location

KENNINGTON DRIVE

BOX CULVERTS UNDER ROAD

TWIN BOX CULVERTS 1.2m WIDE x 0.45m HIGH

EDGE OF BITUMEN

BACK OF KERB

COLLECTION TANK

TPIL

EPIL

SPIT SL.3.78 IL.2.98

SPIT SL.3.73

SPIT SL.3.63 IL.2.74

HEADWALL

SMH SL.3.87 IL.-0.19

BENCHMARK NAIL IN KERB RL: 3.97 A.H.D.

ELECTRICITY KIOSK

WATERCOURSE

TOP OF BANK

CENTRELINE

BOX CULVERT 1.2m WIDE x 0.45m HIGH

SPIT SL.3.76 IL.2.69

SPIT SL.3.88 IL.2.81

SPIT SL.3.63 IL.2.61

LINE PEG

0.2m WIDE CONC. BLOCK RETAINING WALL 0.11m CLEAR OF BOUNDARY

HA1

HA2

HA3

1

16

15 2463m²

14 2463m²

13

411 DP 612675

47 DP 71253

277° 35 51'

35 45"

7°51'45"

187°51'45"

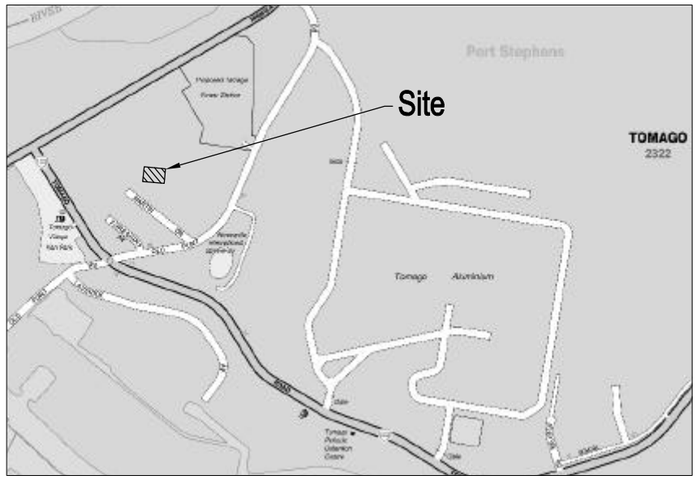
70.375

(B)

(C)

(E)

Locality Plan
N.T.S



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TEST LOCATION PLAN
ASPHALT PLANT
TOMAGO

CLIENT	Lindsay & Dynan			PROJECT No	6292
DRAWN BY	GB	SCALE	1 : 500 (A3)	DRAWING No 1	REV 0
APPROVED BY	MA	DATE	13/6/07	OFFICE	NEWCASTLE

CDT-DWG-A3H-001/1

Appendix B

Engineering Logs

Symbol Index Sheet

General Soil Description Sheets

General Rock Description Sheets

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

TEST BORE LOG
BORE No: HA1

CLIENT: Lindsay & Dynan
PROJECT: Geotechnical Investigation for Asphalt Plant
LOCATION: Tomago

PROJECT No: 6292
DATE: 9/5/07
SURFACE LEVEL: Existing
SHEET 1 of 1
METHOD OF ADVANCE: Hand Auger

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
				TOPSOIL, Silty SAND, moist, brown
		0.4		FILL, Silty SAND, moist, brown
	D @ 0.5m			
0.8 ▽		1.0		CLAY, soft, wet, brown
	D @ 1.3m			End Bore Hole HA1 at 1.3m

0.25
0.5
0.75
1.0
1.25
1.5
1.75
2.0
2.25

LOGGED: GB | CHECKED: MA | DATE: 13/6/07

CRS-TBL-A4V-001/1

RCA AUSTRALIA
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TEST BORE LOG
BORE No: HA2

CLIENT: Lindsay & Dynan
PROJECT: Geotechnical Investigation for Asphalt Plant
LOCATION: Tomago

PROJECT No: 6292
DATE: 9/5/07
SURFACE LEVEL: Existing
SHEET 1 of 1
METHOD OF ADVANCE: Hand Auger

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
		0.4		TOPSOIL, Silty SAND, moist, brown
	D @ 0.5m	1.0		FILL, Silty SAND, moist, brown
0.8 ▽				CLAY, soft, wet, brown
	D @ 1.3m			End Bore Hole HA2 at 1.3m

0.25, 0.5, 0.75, 1.0, 1.25, 1.5, 1.75, 2.0, 2.25

LOGGED: GB | CHECKED: MA | DATE: 13/6/07

CRS-TBL-A4V-001/1

RCA AUSTRALIA
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TEST BORE LOG
BORE No: HA3

CLIENT: Lindsay & Dynan
PROJECT: Geotechnical Investigation for Asphalt Plant
LOCATION: Tomago

PROJECT No: 6292
DATE: 9/5/07
SURFACE LEVEL: Existing
SHEET 1 of 1
METHOD OF ADVANCE: Hand Auger

GROUND WATER	SAMPLE TESTING AND DEPTH	DEPTH (m)	STRATA	DESCRIPTION (SOIL TYPE, STRENGTH, MOISTURE, COLOUR, ORIGIN)
		0.3		FILL, Silty SAND, moist, brown
	D @ 0.5m	0.6		FILL, Silty SAND, moist, brown, traces of gravel
0.7 ▽				FILL, Silty SAND, wet, brown
	D @ 1.3m			End Bore Hole HA3 at 1.3m

0.25
0.5
0.75
1.0
1.25
1.5
1.75
2.0
2.25

LOGGED: GB | CHECKED: MA | DATE: 13/6/07

CRS-TBL-A4V-001/1

SYMBOLS INDEX SHEET

This sheet should be read in conjunction with all test hole log sheets and any idealised geological sections.

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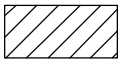
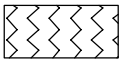
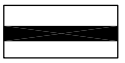
SOIL SYMBOLS

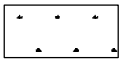
Primary Components


Clay

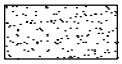

Topsoil

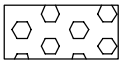

Bitumen

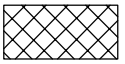

Silt

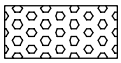

Peat/Organic Soil

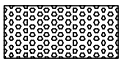

Concrete/ road pavement


Sand

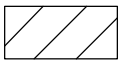

Cobbles/boulders (>60mm in size)

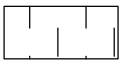

Fill


Gravel

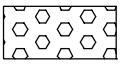

Ironstone gravel, laterite

Secondary Components


Clayey


Silty

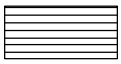

Sandy

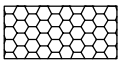

Gravelly

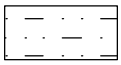
NOTE: Primary soil component shown in capitals and preceded by secondary components. Minor components noted in description. For example Sandy CLAY, with some gravel. The main component is clay with secondary sand and minor gravel. Laboratory classification testing should be undertaken where quantitative soil description is required.

ROCK SYMBOLS

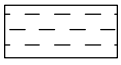
Sedimentary

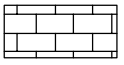

Claystone

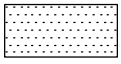

Conglomerate


Siltstone

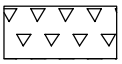

Coal

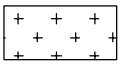

Shale/Laminite


Limestone

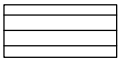

Sandstone

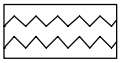
Igneous


Volcanic (fine grained–basalt)


Plutonic (coarse grained–granite)

Metamorphic


Low grade (slate, schist)


High grade (gneiss, quartzite)

SYMBOLS

Testing and Sampling

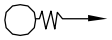
D	Disturbed sample	PP	Pocket penetrometer value (kPa)
B	Bulk sample	Sv	Shear vane, peak undrained shear strength (kPa)
U50	Undisturbed tube sample (50mm diameter)	○	Point load test (axial)
SPT	Standard penetration test	●	Point load test (diametrical)
N	SPT blows per 300mm	PID	Photoionisation detector reading (ppm) (note: comments regarding odour are based on olfactory evidence)
R	SPT refusal		

Groundwater


Groundwater level at time of measurement


Water outflow (loss)


Water inflow (make)


Seepage

Groundwater levels unless otherwise indicated refer to the level of free water encountered in the bores or test holes at the time of measurement. The actual groundwater level may differ depending on material permeability, climate, tides etc.

Well Construction


Screened interval


Filter zone


Hole collapse


Bentonite seal


Lockable cover

GENERAL SOIL DESCRIPTION SHEET

This sheet should be read in conjunction with all test hole log sheets and any idealised geological sections.

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SOIL DESCRIPTION

Descriptive Terms

Cohesive	–	Soils that exhibit cohesion or bonding between particles (ie clay, silt).
Granular	–	Soils that have little cohesion or bonding between particles (ie sand, gravel).
Dry	–	Looks and feels dry. Dry cohesive soils are hard, friable or powdery and dry granular soils are cohesionless and free running.
Moist	–	Soil feels cool and looks dark in colour. Moist cohesive soils can be moulded and moist granular soils tend to cohere.
Wet	–	Free water present.
Cemented	–	Secondary bonding between soil particles. Weakly cemented soils are easily broken up by hand.

SOIL GRAIN SIZE

CLAY	SILT	SAND			GRAVEL			COBBLES	BOULDERS
		Fine	Medium	Coarse	Fine	Medium	Coarse		
0.002mm	0.06mm	0.2mm	0.6mm	2mm	6mm	20mm	60mm	200mm	

SOIL STRENGTH

Consistency of Cohesive Soils[1]

Term	Pocket Penetrometer Value (kPa)	Field Guide
Very soft	<25	Surface Penetrated by fist
Soft	25-50	Easily penetrated by thumb
Firm	50-100	Penetrated by thumb with effort
Stiff	100-200	Indented by thumb
Very stiff	200-400	Surface only marked by thumbnail
Hard	>400	

Density of Granular Soils[2]

Term	Density Index (%)
Very loose	<15
Loose	15-35
Medium dense	35-65
Dense	65-85
Very dense	85-100

NOTE: 1. Consistency can be assessed based on insitu testing or laboratory testing on undisturbed samples. Undrained shear strengths can be estimated from field pocket penetrometer values by dividing by 2. Quantification of undrained shear strength should be based on insitu or laboratory testing.

2. Density can only be assessed on the basis of insitu testing

SOIL ORIGIN

Weathered in Place Soils

Residual soil	–	Rock completely broken down to soil, no rock structure visible.
Extremely weathered material	–	Rock predominantly broken down to soil with some relict rock structure present.

Transported Soils

Alluvial soil	–	Deposited by streams and rivers.
Slopewash soils	–	Deposited on slopes by gravity and sheet flow.
Aeolian soils	–	Deposited by wind.
Lacustrine soils	–	Deposited in lakes.
Marine soils	–	Deposited in bays, beaches and estuaries.
Slide debris	–	Deposited by mass movement (colluvium).
Fill	–	Deposited by man.

GENERAL ROCK DESCRIPTION SHEET

This sheet should be read in conjunction with all test hole log sheets and any idealised geological sections.

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The following rock description is intended for the geotechnical logging of diamond drill core and is also applicable for the mapping of natural exposures and cuttings.

In most rocks the presence of defects and the effects of weathering have a significant influence on the engineering behaviour of the rock mass.

The term **rock substance** refers to the description of material characteristics such as rock type, grain size, colour, strength and weathering.

The term **rock mass** refers to the properties of the overall rock mass/body and involves description of defects (discontinuities or fractures in the rock substance such as joints, faults bedding partings etc), weathering and structure.

ROCK SUBSTANCE – DESCRIPTIVE TERMS

Rock name : Simple rock names are used rather than precise geological classifications.

$I_s(50)$: Point load strength index.

Grain size/ type : The grains of a rock can be described in terms of size (mm) and shape on the basis of appropriate terms used in the General Soil Description Sheet. Where identified, individual minerals should be described.

Strength : Strength is estimated on the basis of tactile appraisal and confirmed by point load strength testing where shown. The rock strength description refers to the strength of the rock material and not to the strength of the rock mass which may be considerably weaker due to the effect of rock defects. Unconfined compressive strength testing should be undertaken where rock strengths need to be quantified.

Term	Symbol	$I_s(50)$ MPa	Field Guide (The core refers to 150mm long x 50mm dia. sample)
Extremely Low	EL	<0.03	Soil strength property description appropriate
Very Low	VL	0.03-0.1	May be crumbled in the hand. Sandstone is 'sugary' and friable.
Low	L	0.1-0.3	The core may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
Medium	M	0.3-1.0	The core may be broken by hand with considerable difficulty. Readily scored with knife
High	H	1.0-3.0	The core cannot be broken by unaided hands, can be slightly scratched or scored with knife.
Very High	VH	3.0-10.0	The core may be broken with hand held hammer. Cannot be scratched with knife.
Extremely High	EH	>10.0	The core is difficult to break with hand held hammer. Rings when struck with hammer.

*I_s (50) = Point load strength index

Weathering :

Term	Symbol	Definition
Extremely Weathered	EW	The rock exhibits soil-like properties though the texture of the original rock is still evident.
Highly Weathered	HW	Limonite staining or colour change affects the whole of the rock mass. Signs of chemical or physical decomposition is evident throughout the whole of the rock mass.
Moderately Weathered	MW	Staining extends throughout the whole of the rock mass and the original colour is no longer recognisable.
Slightly Weathered	SW	Partial staining or decolouration of the rock mass, usually by limonite, has taken place.
Fresh	F	Rock mass unaffected by weathering.

The assignment of rock weathering terms is subjective and is used for identification purposes only

GENERAL ROCK DESCRIPTION SHEET

This sheet should be read in conjunction with all test hole log sheets and any idealised geological sections.

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ROCK MASS – DESCRIPTIVE TERMS

Defects : **Defects** are fractures in the rock mass and include joints, faults, shear planes, cleavages and bedding partings. Description of defects is important as defects generally control the overall engineering behaviour of the rock mass.

Defect spacing refers to the degree of fracturing or spacing of all natural fractures. Artificial fractures induced by drilling, boxing or transport of rock core are not included in the defect spacing log. The delineation of artificial fractures is subjective.

Defect Description

Type	:	Parting	(along rock layering/bedding)
		Joint	(across rock layering/bedding)
		Shear	(zone or seam of rock movement resulting in crushing/fracturing)
		Clayey seam	(infilled or extremely weathered layer)
		Vein	(secondary mineralisation along a fracture)
Shape	:	Planar	
		Curved	
		Undulose/Stepped	
		Irregular	
Roughness	:	Rough	
		Smooth	
		Striated	(slickenside, indicative of shear movement)
Infill	:	Clean	(defect surfaces clean)
		Stained	(surfaces stained by limonite (iron–oxide) or similar)
		Veneer	(thin surface coating $\leq$1mm thick)
		Coating	(surface coating 1mm–5mm thick)
		Seam	(5mm–100mm thick)
		Zone	(>100mm thick)

Orientation of defects is described relative to the horizontal.

Dip = the maximum angle of a defect plane relative to the horizontal surface

Strike = orientation relative to magnetic north of the line of intersection of a defect plane and the horizontal surface

Structure : Structure refers to larger scale rock mass features such as bedding, folding, lineation and flow banding etc. Where no structure is discernible the term massive is used.
In sedimentary rocks the following terms can be used to describe the spacing of bedding/stratification.

Term	Spacing of Bedding (mm)
Laminated	<20
Thinly bedded	20–200
Medium bedded	200–600
Thickly bedded	600–2000
Very thickly bedded	>2000

Appendix C

Laboratory Results

ALS Environmental

CERTIFICATE OF ANALYSIS

Client	: **ROBERT CARR & ASSOCIATES P/L**	*Laboratory*	: **Environmental Division Brisbane**	*Page*	: **1 of 5**
Contact	: **MR MARK ALLMAN**	*Contact*	: **Tim Kilmister**	*Work Order*	: **EB0705118**
Address	: **P O BOX 175 CARRINGTON NSW AUSTRALIA 2294**	*Address*	: **32 Shand Street Stafford QLD Australia 4053**		
E-mail	: **marka@rca.com.au**	*E-mail*	: **Services.Brisbane@alsenviro.com**		
Telephone	: **49029200**	*Telephone*	: **61-7-3243 7222**		
Facsimile	: **49029299**	*Facsimile*	: **61-7-3243 7259**		
Project	: **6292**	*Quote number*	: **----**	*Date received*	: **11 May 2007**
Order number	: **- Not provided -**			*Date issued*	: **16 May 2007**
C-O-C number	: **- Not provided -**			*No. of samples*	- *Received* : **6**
Site	: **- Not provided -**				*Analysed* : **6**

ALSE - Excellence in Analytical Testing

NATA Accredited Laboratory 825

This document is issued in accordance with NATA's accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatory	*Position*	*Department*
Kim McCabe	**Senior Inorganic Chemist**	**Inorganics - NATA 825 (818 - Brisbane)**

ALS Environmental

Comments

This report for the ALSE reference EB0705118 supersedes any previous reports with this reference. Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- **Analytical Results for Samples Submitted**
- **Surrogate Recovery Data**

The analytical procedures used by ALS Environmental have been developed from established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

When moisture determination has been performed, results are reported on a dry weight basis. When a reported 'less than' result is higher than the LOR, this may be due to primary sample extracts/digestion dilution and/or insuffient sample amount for analysis. Surrogate Recovery Limits are static and based on USEPA SW846 or ALS-QWI/EN38 (in the absence of specified USEPA limits). Where LOR of reported result differ from standard LOR, this may be due to high moisture, reduced sample amount or matrix interference. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number, LOR = Limit of Reporting. * Indicates failed Surrogate Recoveries.

Specific comments for Work Order **EB0705118**

Samples were frozen upon receipt and remained frozen until analysis was performed.
pH FOX Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Vigorous; 4 - Very Vigorous

ALS Environmental

Analytical Results

Client Sample ID				HA1 0.5m	HA1 1.3m	HA2 0.5m	HA2 1.3m	HA3 0.5m
Sample Matrix Type / Description				SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time				9 May 2007 15:00	9 May 2007 15:00	9 May 2007 15:00	9 May 2007 15:00	9 May 2007 15:00
Laboratory Sample ID				EB0705118-001	EB0705118-002	EB0705118-003	EB0705118-004	EB0705118-005
Analyte	***CAS number***	***LOR***	***Units***					
EA003 :pH (field/fox)								
pH (F)		0.1	pH Unit	6.0	5.9	5.6	4.7	6.9
pH (Fox)		0.1	pH Unit	2.5	2.4	2.6	3.8	3.0
Reaction Rate		1	--	2	1	2	2	1

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Analytical Results

			Client Sample ID :	HA3 1.3m			
			Sample Matrix Type / Description :	SOIL			
			Sample Date / Time :	9 May 2007 15:00			
			Laboratory Sample ID :	EB0705118-006			
Analyte	*CAS number*	*LOR*	*Units*				
EA003 :pH (field/fox)							
pH (F)		0.1	pH Unit	7.3			
pH (Fox)		0.1	pH Unit	3.8			
Reaction Rate		1	--	2			

ALS Environmental

Surrogate Control Limits

- **No surrogates present on this report.**

CHAIN OF CUSTODY DOCUMENTATION

[redacted]

ALS Environmental

CLIENT:	RCA Australia
POSTAL ADDRESS:	PO Box 175 Carrington
SEND REPORT TO:	MARK ALLMAN SEND INVOICE TO:
DATA NEEDED BY:	REPORT NEEDED BY:
PROJECT ID:	6292
P.O. NO.:	
FOR LAB USE ONLY	
COOLER SEAL	Yes ..... No .....
	Broken ..... Intact ✓
COOLER TEMP	3.5 deg. C
QUOTE NO.:	SY/S 25/03
COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:	Preserve remaining samples for further acid sulphate soil analysis. (If required)

LABORATORY BATCH NO.:

SAMPLERS:

PHONE: FAX: EMAIL:

REPORT FORMAT: HARD: ☐ FAX: ☐ E-MAIL: ☐

QC LEVEL: QCS1: ☐ QCS2: ☐ QCS3: ☐ QCS4: ☐

ANALYSIS REQUIRED

	SAMPLE ID	MATRIX	DATE	TIME	*CONTAINER DATA TYPE & PRESERVATIVE	NO.	pH	Perform pH Screen ✓	NOTES
1	HA1 0.5m	Soil	9/05		B			X	
2	HA1 1.3m	Soil	-		B			X	
3	HA2 0.5	Soil	-		B			X	
4	HA2 1.5m	Soil	-		B			X	
5	HA3 0.5	Soil	-		B			X	
6	HA3 1.3m	Soil	-		B			X	

Environmental Division
Brisbane
Work Order
EB0705118

Telephone : 61-7-3243 7222

RELINQUISHED BY

NAME: GLEN BURTON
OF:
DATE: 9/05
TIME: 1/05

NAME: Hayley McNaughton
OF: ALS Newcastle
DATE: 10/5/07
TIME: 4pm

RECEIVED BY

NAME: Kate Kelly
OF: ALS Newcastle
DATE: 9/5/07
TIME: 2.10pm

NAME:
OF: ALS Brisbane
DATE: 11/5/07
TIME: 1350

METHOD OF SHIPMENT

CONSIGNMENT NOTE NO. 739724635

TRANSPORT CO. NAME TNT

*Container Type and Preservative Codes: **P** = Natural Plastic; **N** = Nitric Acid Preserved; **C** = Sodium Hydroxide Preserved; **J** = Solvent Washed Acid Rinsed Jar; **S** = Solvent Washed Acid Rinsed Glass Bottle; **V** = Vial; **VC** = Hydrochloric Acid Preserved Vial; **VS** = Sulphuric Acid Preservative Vial; **BS** = Sulphuric Acid Preserved Glass Bottle; **PS** = Sulphuric Acid Preserved Plastic Bottle; **Z** = Zinc Acetate Preserved Bottle; **E** = EDTA Preserved Bottle; **H** = Hydrochloric Acid Preserved Plastic Bottle; **F** = Formaldehyde Preserved; **ST** = Sterile Bottle; **B** = Plastic Bag; **O** = Other

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ALS Environmental

QUALITY CONTROL REPORT

Client	:	**ROBERT CARR & ASSOCIATES P/L**	**Laboratory**	:	Environmental Division Brisbane	**Page**	: **1 of 4**
Contact	:	MR MARK ALLMAN	**Contact**	:	Tim Kilmister		
Address	:	P O BOX 175 CARRINGTON NSW AUSTRALIA 2294	**Address**	:	32 Shand Street Stafford QLD Australia 4053	**Work order**	: **EB0705118**
						Amendment No.	:
Project	:	6292	**Quote number**	:	----	**Date received**	: **11 May 2007**
Order number	:	- Not provided -				**Date issued**	: **16 May 2007**
C-O-C number	:	- Not provided -					
Site	:	- Not provided -					
E-mail	:	marka@rca.com.au	**E-mail**	:	Services.Brisbane@alsenviro.com	**No. of samples**	
Telephone	:	49029200	**Telephone**	:	61-7-3243 7222	**Received**	: 6
Facsimile	:	49029299	**Facsimile**	:	61-7-3243 7259	**Analysed**	: 6

This final report for the ALSE work order reference EB0705118 supersedes any previous reports with this reference.

Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

- Laboratory Duplicates (DUP); Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Samples (LCS); Recovery and Acceptance Limits
- Matrix Spikes (MS); Recovery and Acceptance Limits

Work order specific comments

Samples were frozen upon receipt and remained frozen until analysis was performed.

pH FOX Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Vigorous; 4 - Very Vigorous

ALSE - Excellence in Analytical Testing

NATA Accredited Laboratory - 825

This document is issued in accordance with NATA's accreditation requirements.

Accredited for compliance with ISO/IED 17025

This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatory	Department
Kim McCabe	Inorganics - NATA 825 (818 - Brisbane)

Quality Control Report - Laboratory Duplicates (DUP)

The quality control term **Laboratory Duplicate** refers to an intralaboratory split sample randomly selected from the sample batch. Laboratory duplicates provide information on method precision and sample heterogeneity.
- Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations:* ***LOR*** = *Limit of Reporting,* ***RPD*** = *Relative Percent Difference.*
* Indicates failed QC. The permitted ranges for the RPD of Laboratory Duplicates (relative percent deviation) are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting:- Result < 10 times LOR, no limit - Result between 10 and 20 times LOR, 0% - 50% - Result > 20 times LOR, 0% - 20%

Matrix Type: SOIL ***Laboratory Duplicates (DUP) Report***

Laboratory Sample ID	*Client Sample ID*	*Analyte name*	*LOR*	*Original Result*	*Duplicate Result*	*RPD*
EA003 :pH (field/fox)						
EA003 :pH (field/fox) - (QC Lot: 408221)				**pH Unit**	**pH Unit**	**%**
EB0705118-001	HA1 - 0.5m	pH (F)	0.1 pH Unit	6.0	6.0	0.0
		pH (Fox)	0.1 pH Unit	2.5	2.3	8.3
		Reaction Rate	1 --	2	2	0.0

Quality Control Report - Method Blank (MB) and Laboratory Control Samples (LCS)

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC type is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a known, interference free matrix spiked with target analytes or certified reference material. The purpose of this QC type is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of actual laboratory data. Flagged outliers on control limits for inorganics tests may be within the NEPM specified data quality objective of recoveries in the range of 70 to 130%. Where this occurs, no corrective action is taken. Abbreviations: LOR = Limit of reporting.

Method Blank (MB) and Laboratory Control Samples (LCS) Report

		Method blank result	*Actual Results*		*Recovery Limits*	
			Spike concentration	*Spike Recovery*	*Dynamic Recovery Limits*	
Analyte name	*LOR*			*LCS*	*Low*	*High*
- (QC Lot:)				**%**	**%**	**%**
			----	----	----	----

l **No Method Blank (MB) or Laboratory Control Samples (LCS) carried out on this Work Order.**

Quality Control Report - Matrix Spikes (MS)

The quality control term **Matrix Spike (MS)** refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC type is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQO's). 'Ideal' recovery ranges stated may be waived in the event of sample matrix interferences. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot. *Abbreviations:* ***LOR*** *= Limit of Reporting,* ***RPD*** *= Relative Percent Difference.*

* Indicates failed QC

Matrix Spike (MS) Report

					Actual Results		*Recovery Limits*	
					Sample Result	*Spike Recovery*	*Static Limits*	
Analyte name	*Laboratory Sample ID*	*Client Sample ID*	*LOR*	*Spike Concentration*		*MS*	*Low*	*High*
- (QC Lot:)						%	%	%
					----			

l **No Matrix Spike (MS) carried out on this Work Order.**

ALS Environmental

INTERPRETIVE QUALITY CONTROL REPORT

Client	:	**ROBERT CARR & ASSOCIATES P/L**	**Laboratory**	:	Environmental Division Brisbane	**Page**	: **1 of 5**
Contact	:	MR MARK ALLMAN	**Contact**	:	Tim Kilmister		
Address	:	P O BOX 175 CARRINGTON NSW AUSTRALIA 2294	**Address**	:	32 Shand Street Stafford QLD Australia 4053	**Work order**	: **EB0705118**
						Amendment No.	:
Project	:	6292	**Quote number**	:	----	**Date received**	: 11 May 2007
Order number	:	- Not provided -				**Date issued**	: 16 May 2007
C-O-C number	:	- Not provided -					
Site	:	- Not provided -					
E-mail	:	marka@rca.com.au	**E-mail**	:	Services.Brisbane@alsenviro.com	**No. of samples**	
Telephone	:	49029200	**Telephone**	:	61-7-3243 7222	**Received**	: 6
Facsimile	:	49029299	**Facsimile**	:	61-7-3243 7259	**Analysed**	: 6

This Interpretive Quality Control Report was issued on 16 May 2007 for the ALS work order reference EB0705118 and supersedes any previous reports with this reference.
This report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Type Frequency Compliance
- Summary of all Quality Control Outliers
- Brief Method Summaries

Interpretive Quality Control Report - Analysis Holding Time

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the sample aliquot was taken. Elapsed time to analysis represents time from sampling where no extraction / digestion is involved or time from extraction / digestion where this is present. For composite samples, sampling date/time is taken as that of the oldest sample contributing to that composite. Sample date/time for laboratory produced leaches are taken from the completion date/time of the leaching process. Outliers for holding time are based on USEPA SW846, APHA, AS and NEPM (1999). Failed outliers, refer to the 'Summary of Outliers'.

Matrix Type: SOIL ***Analysis Holding Time and Preservation***

Method / **Container /** Client Sample ID(s)	**Date Sampled**	**Extraction / Preparation**			**Analysis**		
		Date extracted	Due for extraction	Pass?	Date analysed	Due for analysis	Pass?
EA003: pH field/fox							
Snap Lock Bag - frozen							
HA1 - 0.5m, HA1 - 1.3m, HA2 - 0.5m, HA2 - 1.3m, HA3 - 0.5m, HA3 - 1.3m	**9 May 2007**	----	----	----	**14 May 2007**	8 May 2008	Pass

Interpretive Quality Control Report - Frequency of Quality Control Samples

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which this work order was processed. Actual rate should be greater than or equal to the expected rate.

Matrix Type: SOIL

Frequency of Quality Control Samples

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	**Actual**	**Expected**	
Laboratory Duplicates (DUP)					
EA003: pH field/fox	1	6	**16.7**	**10.0**	NEPM 1999 Schedule B(3) and ALSE QCS3 requirement

Interpretive Quality Control Report - Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged on the 'Quality Control Report'. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). Flagged outliers on control limits for inorganics tests may be within the NEPM specified data quality objective of recoveries in the range of 70 to 130%. Where this occurs, no corrective action is taken. - Anonymous - Client Sample IDs refer to samples which are not specifically part of this work order but formed part of the QC process lot.

Non-surrogates

- **For all matrices, no RPD recovery outliers occur for the duplicate analysis.**
- **For all matrices, no method blank result outliers occur.**
- **For all matrices, no laboratory spike recoveries breaches occur.**
- **For all matrices, no matrix spike recoveries breaches occur.**

Surrogates

- **For all matrices, no surrogate recovery outliers occur.**

Outliers : Analysis Holding Time

The following report highlights outliers within this 'Interpretive Quality Control Report - Analysis Holding Time'.

- **No holding time outliers occur.**

Outliers : Frequency of Quality Control Samples

The following report highlights outliers within this 'Interpretive Quality Control Report - Frequency of Quality Control Samples'.

- **No frequency outliers occur.**

Method Reference Summary

The analytical procedures used by ALS Environmental are based on established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house procedure are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

Matrix Type: SOIL ***Method Reference Summary***

Analytical Methods

EA003 : pH field/fox - Ahern et al 1998 - determined on a 1:5 soil/water extract designed to simulate field measured pH and pH after the extract has been oxidised with peroxide.

Maggie Kahi

From: Shaun Crabb on behalf of Services Brisbane
Sent: Thursday, 17 May 2007 4:51 PM
To: Samples Brisbane
Cc: Tim Kilmister
Subject: Rebatch: EB0705118. Our Job No 6292

Rebatch please.

From: Glen Burton [mailto:glenb@rca.com.au]
Sent: Thursday, 17 May 2007 12:35 PM
To: Services Brisbane
Subject: FW: Your Reference : EB0705118. Our Job No 6292

Tim,

Could you alos please undertake further analysis comprising CRS and TPA on the following samples from our project No. 6292

1 HA1 0.5
2 HA1 1.3
3 HA2 0.5
4 HA3 0.5
5 HA3 1.5

Environmental Division
Brisbane
Work Order
EB0705399

Regards,

Glen Burton

RCA Australia

92 Hill Street
Carrington NSW 2294

Mobile: 0405 513 895
Fax: (02) 49 029 299
Email: glenb@rca.com.au
Web: www.rca.com.au

Telephone : 61-7-3243 7222

From: Mark Allman
Sent: Wednesday, 16 May 2007 6:05 PM
To: Glen Burton
Subject: FW: Your Reference : 6292. Deliverables for ALSE Workorder : EB0705118

FYI

Mark Allman
B.E. (Hons 1), PhD, MIEAust

Manager of Geotechnical Services

RCA Australia
92 Hill Street
Carrington NSW 2294

CHAIN OF CUSTODY DOCUMENTATION

[redacted]

ALS Environmental

CLIENT: RCA Australia	LABORATORY BATCH NO:
POSTAL ADDRESS: PO Box 175 Carrington	SAMPLERS:
SEND REPORT TO: MARK ALLMAN SEND INVOICE TO:	PHONE: FAX: EMAIL:
DATA NEEDED BY: REPORT NEEDED BY:	REPORT FORMAT: HARD: ☐ FAX: ☐ E-MAIL: ☐
PROJECT ID: 6292 QUOTE NO.: SY/S 25/03	QC LEVEL: QCS1: ☐ QCS2: ☐ QCS3: ☐ QCS4: ☐
P.O. NO.: COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:	
FOR LAB USE ONLY: Preserve remaining samples for further acid sulphate soil analysis (if required)	
COOLER SEAL: Yes ... No ... Broken ... Intact ✓	
COOLER TEMP: 3°C deg. C	

	SAMPLE DATA				*CONTAINER DATA			ANALYSIS REQUIRED	
	SAMPLE ID		MATRIX	DATE	TIME	TYPE & PRESERVATIVE	NO.	pH	Perform pH screen
1 1	HA1	0.5m	Soil	9/05		B			X
2 2	HA1	1.3m	Soil	"		B			X
3 3	HA2	0.5	Soil	"		B			X
4	HA2	1.5m	Soil	"		B			X
4 5	HA3	0.5	Soil	"		B			X
5 6	HA3	1.2m	Soil	"		B			X

NOTES

Environmental Division Brisbane
Work Order
EB0705118
[redacted]
Telephone : 61-7-3243 7222

Environmental Division Brisbane
Work Order
EB0705399
Telephone : 61-7-3243 7222

RELINQUISHED BY		RECEIVED BY		METHOD OF SHIPMENT
NAME: GLEN BURTON	DATE: 9/05	NAME: Kate Kelly	DATE: 9/5/07	
OF:	TIME: 1/05	OF: ALS Newcastle	TIME: 2.10pm	CONSIGNMENT NOTE NO. 739724635
NAME: Hayley McNaughton	DATE: 10/5/07	NAME:	DATE: 11/5/07	
OF: ALS Newcastle	TIME: 4pm	OF: ALS Brisbane	TIME: 1350	TRANSPORT CO. NAME TNT

*Container Type and Preservative Codes: **P** = Natural Plastic; **N** = Nitric Acid Preserved; **C** = Sodium Hydroxide Preserved; **J** = Solvent Washed Acid Rinsed Jar; **S** = Solvent Washed Acid Rinsed Glass Bottle; **V** = Vial; **VC** = Hydrochloric Acid Preserved Vial; **VS** = Sulphuric Acid Preservative Vial; **BS** = Sulphuric Acid Preserved Glass Bottle; **PS** = Sulphuric Acid Preserved Plastic Bottle; **Z** = Zinc Acetate Preserved Bottle; **E** = EDTA Preserved Bottle; **H** = Hydrochloric Acid Preserved Plastic Bottle; **F** = Formaldehyde Preserved; **ST** = Sterile Bottle; **B** = Plastic Bag; **O** = Other

AUSTRALIAN LABORATORY SERVICES P/L

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AUSTRALIAN LABORATORY SERVICES PTY LTD ABN 84 009 936 029
32 Shand Street Stafford QLD 4053 Australia
Telephone: 61-7-3243 7222 Facsimile: 61-7-3243 7259 http://www.alsenviro.com/

ALS Environmental

SAMPLE RECEIPT NOTIFICATION (SRN)

Comprehensive report

Client Details

Client	:	**ROBERT CARR & ASSOCIATES P/L**
Contact	:	**MR GLEN BURTON**
Address	:	P O BOX 175 CARRINGTON NSW AUSTRALIA 2294
Project	:	**6292**
Order number	:	**- Not provided -**
C-O-C Number	:	**- Not provided -**
Site	:	**- Not provided -**
Sampler	:	**- Not provided -**
E-mail	:	glenb@rca.com.au
Telephone	:	49029299
Facsimile	:	49029299

Laboratory Details

Laboratory	:	**Environmental Division Brisbane**
Manager	:	**Tim Kilmister**
Address	:	32 Shand Street Stafford QLD Australia 4053
Quote number	:	ES20070076
Work order	:	**EB0705399**
E-mail	:	Services.Brisbane@alsenviro.com
Telephone	:	61-7-3243 7222
Facsimile	:	61-7-3243 7259

Dates

Date Samples Received	:	18 May 2007	**SRA Issue Date**	:	18 May 2007
Scheduled Reporting Date	:	**5 Jun 2007**	**Client Requested Date**	:	5 Jun 2007

Delivery Details

Mode of Delivery	:	Samples on hand.	**Temperature**	:	AMBIENT
No. of coolers/boxes	:	REBATCH	**No. of samples** - **Received**		5
Security Seal	:	Not intact.	- **Analysed**		5

Comments

- **Samples received in appropriately pretreated and preserved containers.**
- **Sample(s) have been received within recommended holding times.**

- Please direct any turn around / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (14 days), Solid (90 days) from date of completion of work order.
- Please direct any queries related to sample condition / numbering / breakages to Janine Hew.
- Analytical work for this work order will be conducted at ALSE Brisbane.
- When the sampling time is not supplied on the COC documentation, ALSE defaults the sampling time to that of the COC 'relinquishment' time (if supplied). If this also is not supplied, ALSE defaults the sampling time to the 'time of receipt at Laboratory'.

Client	: ROBERT CARR & ASSOCIATES P/L	**Work Order**	: EB0705399
Project	: 6292	**ALS Quote Reference**	: ES20070076

Summary of Sample(s) / Container(s) and Requested Analysis

Some items described below may be part of a laboratory process neccessary for the execution of client requested tasks. Packages may contain additional analyses, such as moisture and preparation tasks, that form an implicit part of that package.

ALS Sample ID.	Client Sample ID - Sample Date	**Requested Analysis**									
		EA026 - SOIL Chromium Reducible Sulphur	**EA029b TPA - SOIL** TPA								
EB0705399-001	**HA1 0.5m - 9 May 2007**	]	]								
EB0705399-002	**HA1 1.3m - 9 May 2007**	]	]								
EB0705399-003	**HA2 0.5m - 9 May 2007**	]	]								
EB0705399-004	**HA3 0.5m - 9 May 2007**	]	]								
EB0705399-005	**HA3 1.5m - 9 May 2007**	]	]								
	Total(s) :	**5**	**5**								

Client	: ROBERT CARR & ASSOCIATES P/L	**Work Order**	: EB0705399
Project	: 6292	**ALS Quote Reference**	: ES20070076

Requested Reports

l **MR GLEN BURTON**

- A4 - AU Certificate of Analysis - NEPM format	Email	glenb@rca.com.au
- A4 - AU Quality Control Report - NEPM format	Email	glenb@rca.com.au
- A4 - AU Interpretive Quality Control Report - NEPM format	Email	glenb@rca.com.au
- EDI Format - ENMRG	Email	glenb@rca.com.au
- EDI Format - XTab	Email	glenb@rca.com.au
- Default - Chain of Custody	Email	glenb@rca.com.au
- A4 - AU Sample Receipt Notification - Comprehensive format	Email	glenb@rca.com.au

l **MR MARK ALLMAN**

- A4 - AU Certificate of Analysis - NEPM format	Email	marka@rca.com.au
- A4 - AU Quality Control Report - NEPM format	Email	marka@rca.com.au
- A4 - AU Interpretive Quality Control Report - NEPM format	Email	marka@rca.com.au
- EDI Format - ENMRG	Email	marka@rca.com.au
- EDI Format - XTab	Email	marka@rca.com.au
- Default - Chain of Custody	Email	marka@rca.com.au
- A4 - AU Sample Receipt Notification - Comprehensive format	Email	marka@rca.com.au
- A4 - AU Tax Invoice	Email	marka@rca.com.au

Sample Container(s) / Preservation Non-Compliance Log

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

l **No sample container / preservation non-compliance exist.**

APPENDIX L

Threatened Species Assessment

THREATENED SPECIES ASSESSMENT

FOR

THE PROPOSED ASPHALT PLANT AT LOTS 14 AND 15 KENNINGTON DRIVE, TOMAGO

Prepared for
Lindsay & Dynan Pty Ltd
And
Tropic Asphalt Pty Ltd

ECOTONE ECOLOGICAL CONSULTANTS Pty Ltd
39 Platt Street, Waratah NSW 2298
phone: (02) 4968 4901 fax: (02) 4968 4960
e-mail: info@ecotoneconsultants.com.au

EEC PROJECT No. 0570TA

6 June 2007

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1.0 INTRODUCTION

1.1 Background and Scope

This Threatened Species Assessment has been prepared at the request of Mr Mark Spencer of Lindsay & Dynan Pty Ltd, on behalf of Tropic Asphalt Pty Ltd to support a Development Application for the construction of an asphalt plant at lots 14 and 15 Kennington Drive, Tomago.

The construction of the asphalt plant is hereafter referred to as *the proposal*.

The general aims of this assessment are to:

- describe the existing biological environment of the study area in relation to flora and fauna;
- discuss the potential impacts of the proposal for any threatened species, populations or ecological communities that occur or may occur in the subject site;
- provide discussion on measures to mitigate any perceived impacts.

Within this report, reference is given to the relevant sections of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); NSW *Threatened Species Conservation Act 1995* (TSC Act); *National Parks and Wildlife Act 1974* (NP&W Act); *Environmental Planning and Assessment Act 1979* (EP&A Act); *Native Vegetation Act 2003* (NV Act) and subsequent amendments to these. Specific consideration is given to Section 5A of the *EP&A Act*.

For this report,

- the *subject site* is defined as the land area to be directly affected by the construction and running of the asphalt plant (including landscaped and managed areas);

- the *study area* consists of the subject site plus the immediately surrounding land potentially indirectly affected by the proposal; and

- the *study locality* is the area of land within a ten (10) kilometre radius of the centre of the subject site.

A plan of the location of the study area is provided as **Figure 1.**

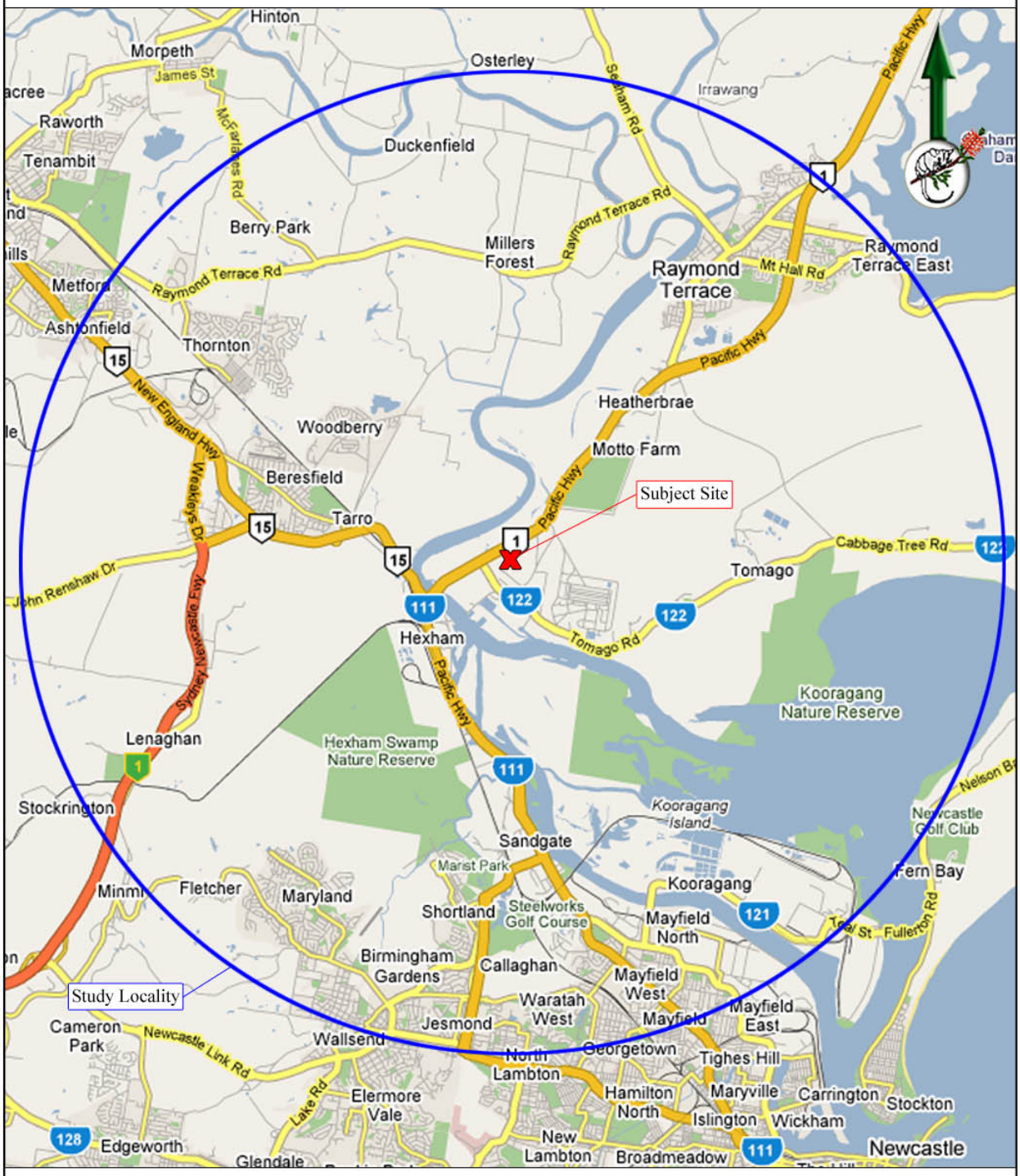


Figure 1. Study Locality

Threatened Species Assessment for the Proposed Asphalt Plant at Lots 14 & 15 Kensington Drive, Tomago — June 2007

1.2 General Description of the Subject Site, Study Area and Locality

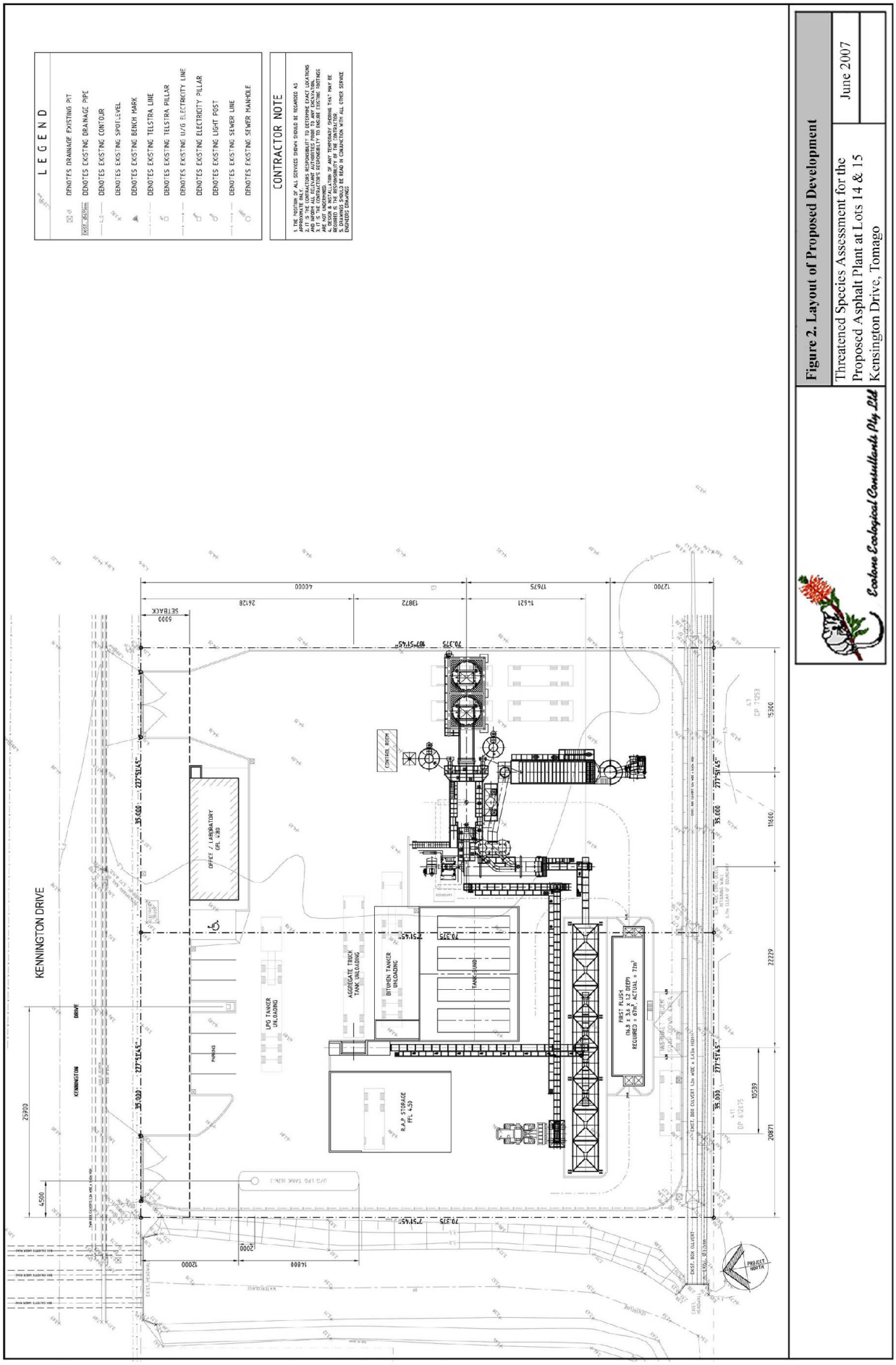
Client	Lindsay & Dynan Pty Ltd and Tropic Asphalt Pty Ltd
Subject Site	
Location	Lots 14 and 15 Kennington Drive, Tomago. Grid Reference: 379000E 6369000N (AGD66)
Elevation	<10m asl
Land Size	Approx. 1ha in area
Current landuse and general condition	Vacant cleared and levelled land. A few heaps of road base.
Significant features	There is a row of native vegetation along the southern boundary and drains with reedy vegetation along the western and southern boundaries.
Study area	
Surrounding landuse	There is existing industrial development to the South of the site. All other adjacent land is cleared and vacant in the same condition as the subject site. The Pacific Highway is a few hundred metres to the west.
Bioregion	Sydney Basin
LGA	Port Stephens
Study Locality	
Study Locality Description	The study locality includes a range of land use, including industrial, rural, rural residential and urban residential development including the suburbs of Newcastle, Tracts of bushland are also present including Nature Reserves (Hexham Swamp NR, Kooragang NR and Panbalong NR) and Water board land. The Hunter River also passes through the locality.

1.3 Description of the Proposal

The proposal involves the construction of an asphalt plant with a maximum throughput of 150t/hr and an estimated annual production of 75000-150000t. The final product is made by mixing bitumen with aggregates and some filler. The plant will also have the ability to utilise recycled asphaltic product (RAP) into the process.

The development will consist of cold aggregate storage bins, a RAP storage shed, a tank farm, the asphalt plant itself, hot product storage bins and associated office and laboratory.

A plan of the proposal has been included as **Figure 2.**


LEGEND
DENOTES DRAINAGE EXISTING PIT
DENOTES EXISTING DRAINAGE PIPE
DENOTES EXISTING CONTOUR
DENOTES EXISTING SPOT LEVEL
DENOTES EXISTING BENCH MARK
DENOTES EXISTING TELSTRA LINE
DENOTES EXISTING TELSTRA PILLAR
DENOTES EXISTING U/G ELECTRICITY LINE
DENOTES EXISTING ELECTRICITY PILLAR
DENOTES EXISTING LIGHT POST
DENOTES EXISTING SEWER LINE
DENOTES EXISTING SEWER MANHOLE
CONTRACTOR NOTE
KENNINGTON DRIVE
OFFICE / LABORATORY
CONTROL ROOM
AGGREGATE TRUCK TANK UNLOADING
BITUMEN TANKER UNLOADING
LPG TANKER UNLOADING
R.A.P. STORAGE
FIRST FLUSH
PROJECT NORTH
Figure 2. Layout of Proposed Development
Threatened Species Assessment for the Proposed Asphalt Plant at Lots 14 & 15 Kensington Drive, Tomago
June 2007
Ecotone Ecological Consultants Pty Ltd

2.0 FIRST STAGE ECOLOGICAL INVESTIGATION – PRELIMINARY ASSESSMENT

2.1 Review of Local Threatened Species and Other Records

In order to determine those threatened flora and fauna species that are known to occur within the study locality, a review of available data has been undertaken. From the review, a list of threatened species known to occur in the locality was generated. This review has been utilised in the assessment of those threatened species that are potential subject species (based on known habitat requirements of each local threatened species in relation to the habitat of the subject site). Potential subject species are defined as those threatened species considered likely to occur in the habitats present within the study area (NPWS 1996). Therefore, such species would be potentially impacted by the proposal.

A review of the documented records of the locations of threatened flora and fauna species within the study locality has been undertaken. Threatened species records were principally accessed from the NPWS Atlas of NSW Wildlife Database (as at May, 2007) for the Newcastle 9232 1: 100 000 map sheet).

2.1.1 Flora

Threatened Species

From the review, a total of six (6) threatened flora species are known to occur within the study locality. These are listed in **Table 1** below. Two (2) of these species are classified as Endangered on Schedule 1, Part 1 (*Rulingia prostrata* and *Zannichellia palustris*) and four (4) species are classified as Vulnerable on Schedule 2 of the *TSC Act*. In terms of national listings, three (3) of the species are listed as Vulnerable under the schedules of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*

ROTAP Species

A further two species listed under ROTAP exclusively are also known to occur in the locality. All of the eight threatened flora species are also listed under the national database known as ROTAP (Briggs & Leigh 1996).

Table 1. Threatened & ROTAP Flora Species previously recorded within the Study Locality

Scientific Name	Status (TSC)	Status (EPBC)	Rotap Risk Code	Earliest / latest record	Number of records within 10km of site	Number of records within 2.5km of site
Callistemon linearifolius	V	-	2RCi	2004-2005	3	0
Eucalyptus camfieldii	V	V	2VCi	2001	1	0
Eucalyptus parramattensis subsp. decadens	V	V	2V	1996-2006	12	0
Rulingia prostrata	E1	-	2ECi	1996-2000	2	0
Tetratheca juncea	V	V	3VCi	1997-2004	2	0
Zannichellia palustris	E1	-	3R	1971-2006	4	0
Rotap Only Species						
Grevillea granulifera	U	-	3KCa	1998	1	0
Macrozamia flexuosa	P13	-	2K	1998-2004	3	0

Notes:
379000 E 6369000 N are the co-ordinates of the centre of the subject site.
Nomenclature follows Harden (1990-1993) and Harden & Murray (2000).

Status (TSC): refers to the NSW *Threatened Species Conservation Act* 1995 (TSC) or the National Parks & Wildlife Act 1974 (NP&W)
E1 – Schedule 1, Part 1: Endangered Species
V – Schedule 2: Vulnerable Species
P13 - Schedule 13 of the National Parks & Wildlife Act - Protected Plant Species

Status (EPBC): refers to the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC)
E - Endangered Species
V - Vulnerable Species

ROTAP coding (Briggs and Leigh 1996)
2 Geographic range in Australia less than 100km
3 Geographic range in Australia greater than 100km
E Endangered Species: at risk of disappearing from the wild within 10-20 years if present land use and other threats continue to operate
V Vulnerable Species: not presently endangered, but possibly at risk in future due to continuing depletion or land-use change
R Rare Species: rare in Australia, but currently without any identifiable threat
C Reserved: indicates taxon has at least one population within a national park, or other proclaimed conservation reserve or in an area otherwise dedicated for the protection of flora
a indicates that 1000 plants or more are known to occur within a conservation reserve(s)
i indicates that less than 1000 plants are known to occur within a conservation reserve(s)
- indicates that the reserved population size is not accurately known

Please note: These records are based on information supplied by the NSW Department of Environment and Conservation and other sources, and may contain errors or omissions.

Endangered Populations of Flora

No endangered populations of flora as listed under the *TSC Act 1995* are known to occur within the locality, as at May 2007.

Endangered Ecological Communities

There is one Critically Endangered Ecological Community and 35 Endangered Ecological Communities as listed on Schedule 1, Part 3 of the *TSC Act 1995* that may occur within the area covered by the 9232 mapsheet. None of these currently occur in the study area.

2.1.2 Fauna

Threatened Species

A total of thirty-six (36) threatened terrestrial fauna species have previously been recorded within the study locality, including twelve (12) mammal, twenty-two (22) bird and two (2) frog. Of these, four species are currently regarded as Endangered on Schedule 1, Part 1 of the *TSC Act 1995*, including the Bush Stone-curlew, Black-necked Stork, Swift Parrot and Green and Golden Bell Frog. Those remaining are currently regarded as Vulnerable on Schedule 2 of the Act. Nationally, The Swift Parrot is also listed as Endangered and the Large-eared Pied Bat, Grey-headed Flying-fox and Green and Golden Bell Frog as Vulnerable, with the Osprey as Migratory under the Commonwealth *EPBC Act 1999*. The locally recorded threatened fauna species are listed below in **Table 2.**

The following species were removed from Table 2 due to the obvious lack of marine habitat: Humpback Whale, Greater Sand-plover, Lesser Sand-plover, Sooty Oystercatcher, Pied Oystercatcher, Broad-billed Sandpiper, Black-tailed Godwit, Painted Snipe (Australian subspecies), Little Tern and Terek Sandpiper.

Table 2. Threatened Fauna previously recorded within the Study Locality

Scientific Name	Common Name	Status (TSC)	Status (EPBC)	Earliest / latest record	Number of records within 10km of site	Number of records within 2.5km of site
BIRDS						
Anseranas semipalmata	Magpie Goose	V	-	1980-2004	36	1
Botaurus poiciloptilus	Australasian Bittern	V	-	1982-2002	12	0
Burhinus grallarius	Bush Stone-curlew	E1	-	1998-1999	7	0
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	1998-2004	3	0
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	1989-2004	4	1
Ephippiorhynchus asiaticus	Black-necked Stork	E1	-	1972-2005	145	0
Hamirostra melanosternon	Black-breasted Buzzard	V	-	1990	1	0
Irediparra gallinacea	Comb-crested Jacana	V	-	1984-1990	6	0
Ixobrychus flavicollis	Black Bittern	V	-	1999	1	0
Lathamus discolor	Swift Parrot	E1	E	1999-2003	5	0
Lophoictinia isura	Square-tailed Kite	V	-	1985-1993	2	0
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	1998-2004	3	0
Neophema pulchella	Turquoise Parrot	V	-	1982-2004	4	0
Ninox connivens	Barking Owl	V	-	1998	1	0
Ninox strenua	Powerful Owl	V	-	1986-2006	11	0
Oxyura australis	Blue-billed Duck	V	-	1983-1987	4	0
Pandion haliaetus	Osprey	V	Mi	1988-2005	7	0
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	1994-2006	7	0
Ptilinopus magnificus	Wompoo Fruit-Dove	V	-	1996	1	0
Ptilinopus superbus	Superb Fruit-Dove	V	-	1973	1	0
Stictonetta naevosa	Freckled Duck	V	-	1981-1986	20	0
Tyto novaehollandiae	Masked Owl	V	-	1998-2004	6	1
FLYING MAMMALS						
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	2004	1	0
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	1998-2000	2	0
Miniopterus australis	Little Bentwing-bat	V	-	1994-2005	27	1
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	1994-2005	22	0
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	1996-2004	12	1
Myotis adversus	Large-footed Myotis	V	-	1994-2004	9	0
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	1998-2006	21	1
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	1995-2003	3	0
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	1995-2005	9	1

Continued……

Table 2. continued.

Scientific Name	Common Name	Status (TSC)	Status (EPBC)	Earliest / latest record	Number of records within 10km of site	Number of records within 2.5km of site
FROGS						
Crinia tinnula	Wallum Froglet	V	-	2003	1	0
Litoria aurea	Green and Golden Bell Frog	E1	V	1973-2006	708	0
NON-FLYING MAMMALS						
Petaurus norfolcensis	Squirrel Glider	V	-	1979-2005	20	1
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	1969-1992	5	0
Phascolarctos cinereus	Koala	V	-	1892-2006	1305	68

Notes: 379000 E 6369000 N are the co-ordinates of the centre of the subject site.
Status (TSC): refers to the NSW *Threatened Species Conservation Act* 1995 (TSC)
E1 – Schedule 1, Part 1: Endangered Species V – Schedule 2: Vulnerable Species

Status (EPBC): refers to the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC)
E - Endangered Species V - Vulnerable Species Mi - Migratory Species

Please note: These records are based on information supplied by the National Parks and Wildlife Service and other sources, and may contain errors or omissions Records of Marine, Shoreline, Estuarine or Water-dependent species have not been listed due to there clearly being no such habitats on the site.

Endangered Populations of Fauna

Two endangered populations of fauna as listed under the *TSC Act 1995* are known to occur within or adjacent to the Port Stephens LGA, as at May 2007. These include the:

- Emu, *Dromaius novaehollandiae*, population in the NSW North Coast Bioregion and Port Stephens LGA.
- Koala Population, Hawks Nest and Tea Gardens.

The Koala population at Hawks Nest and Tea Gardens occurs to the north of Port Stephens and therefore, it is not relevant to the current proposal.

Critical Habitat

No areas of Critical Habitat are listed under the *TSC Act 1995* as occurring within the study locality as at May 2007.

2.2 EPBC Act Protected Matters Report

The EPBC Act Protected Matters Search Tool was accessed on the 20th of May 2007 to identify the Protected Matters under the Commonwealth EPBC Act that occur or may occur within the study locality. This review yielded a report (summarised in **Table 3**) listing the matters that could potentially be relevant under the EPBC Act for activities within the study area. Please note that species or other matters identified from the report as occurring, or having potential to occur within the study locality, may not be relevant to the study area or subject site itself.

Table 3. Summary of Potentially Relevant Matters under the Commonwealth EPBC Act 1999

Protected Matter	Potentially Relevant?	Details
Matters of National Environmental Significance		
World Heritage Properties	Yes	None
National Heritage Places	Yes	None
Wetlands of International Significance (Ramsar sites)	Yes	One: Hunter Estuary Wetlands
Commonwealth Marine Areas	No	-
Threatened Ecological Communities	Yes	One: White box – Yellow Box- Blakely's Red Gum Grassy Woodlandand derived native grassland (CE)
Threatened Species - Flora	Yes	Seven species: **Species or species habitat may occur within area according to EPBC modeling.** Leafless Tongue-orchid *Cryptostylis hunteriana* (**V**) **Species or species habitat likely to occur within area according to EPBC modeling.** Camfield's Stringybark *Eucalyptus camfieldii* (**V**) Earp's Gum *Eucalypyus parramattensis subsp. decadens* (**V**) *Grevillea parviflora subsp. parviflora* (**V**) Knotweed *Persicaria elatior* (**V**) Dwarf Kerrawang *Rulingia prostata* (**E**) *Tetratheca juncea* (**V**) The likelihood of any of these species occurring in the study area on the basis of available habitat is assessed in **Table 4** (Section 2.3.1).
Threatened Species – Fauna (Terrestrial Species only)	Yes	Twelve species: **Species or species habitat may occur within area according to EPBC modeling.** Swift Parrot *Lathamus discolor* (**E**) Australian Painted Snipe *Rostratula australis* (**V**) Littlejohn's Tree Frog *Litoria littlejohni* (**V**) Large-eared Pied Bat *Chalinolobus dwyeri* (**V**) Spotted-tailed Quoll *Dasyurus maculatus* (**E**) Brush-tailed Rock-wallaby *Petrogale penicillata* (**V**) Long-nosed Potoroo *Potorous tridactylus tridactylus* (**V**) **Species or species habitat likely to occur within area according to EPBC modeling.** Regent Honeyeater *Xanthomyza Phrygia* (**E**) Green and Golden Bell Frog *Litoria aurea* (**V**) Stuttering Frog *Mixophyes balbus* (**V**) Southern Barred Frog *Mixophyes iterates* (**E**) **Roosting known to occur within area according to EPBC modeling.** Grey-headed Flying-fox *Pteropus poliocephalus* (**V**) The likelihood of any of these species occurring in the study area on the basis of available habitat is assessed in **Table 5** (Section 2.3.1).

Continued…..

Table 3. continued

Protected Matter	Potentially Relevant?	Details
Matters of National Environmental Significance		
Migratory Species (Terrestrial Species Only)	Yes	Twenty-three species : **Species or species habitat likely to occur within area according to EPBC modeling.** White-bellied Sea Eagle *Haliaeetus leucogaster* (**Mi**) Regent Honeyeater *Xanthomyza Phrygia* (**Mi, E**) **Species or species habitat may occur within area according to EPBC modeling.** White-throated Needletail *Hirundapus caudacutus* (**Mi**) Rainbow Bee-eater *Merops ornatus* (**Mi**) **Breeding likely to occur within area according to EPBC modeling.** Satin Flycatcher *Myiagra cyanoleuca* (**Mi**) **Breeding may occur within area according to EPBC modeling.** Black-faced Monarch *Monarcha melanopsis* (**Mi**) Rufous Fantail *Rhipidura rufifrons* (**Mi**) Wetlands Species **Species or species habitat may occur within are according to EPBC modeling.** Latham's Snipe *Gallinago hardwickii* (**Mi**) Painted Snipe *Rostratula benghalensis s. lat.* (**Mi**) **Species or species habitat likely to occur within are according to EPBC modeling.** Ruddy Turnstone *Arenaria interpres* (**Mi**) Curlew Sandpiper *Calidris Sandpiper* (**Mi**) Lesser Sand Plover *Charadrius mongolus* (**Mi**) Broad-billed Sandpiper *Limicola falcinellus* (**Mi**) Bar-tailed Godwit *Limosa lapponica* (**Mi**) Black-tailed Godwit *Limosa limosa* (**Mi**) Eastern Curlew *Numenius madagascariensis* (**Mi**) Whimbrel *Numenius phaeopus* (**Mi**) Pacific Golden Plover *Pluvialis fulva* (**Mi**) Common Greenshank *Tringa nebularia* (**Mi**) Marsh Sandpiper *Tringa stagnatilis* (**Mi**) Terek Sandpiper *Xenus cinereus* (**Mi**) **Breeding likely to occur within area according to EPBC modeling.** Great Egret *Ardea alba* (**Mi**) Cattle Egret *Ardea ibis* (**Mi**) The likelihood of any of these non-wetland species occurring in the study area on the basis of available habitat is assessed in **Table 5** (Section 2.3.1).

Continued…..

Table 3. continued

Protected Matter	Potentially Relevant?	Details
Other Matters Protected by the EPBC Act		
Commonwealth Lands	Yes	Six - Commonwealth Lands identified within the study locality do not occur in the vicinity of the study area.
Commonwealth Heritage Places	No	-
Places on the Register of the National Estate	Yes (Natural places only)	One: Hunter Estuary Wetlands NSW
Listed Marine Species	No	-
Whales and Other Cetaceans	No	-
Critical Habitats	Yes	None
Commonwealth Reserves	Yes	None
Extra Information		
State and Territory Reserves	Yes	Three: Hexham Swamp Nature Reserve, NSW Kooragang Nature Reserve, NSW Pambalong Nature Reserve, NSW
Other Commonwealth Reserves	Yes	None
Regional Forest Agreements	Yes	One: Lower North East NSW RFA, New South Wales

Notes:
V Species listed as Vulnerable under the Commonwealth *EPBC Act*.
E Species listed as Endangered under the Commonwealth *EPBC Act*.
Mi Species listed as Migratory under the Commonwealth *EPBC Act*.

2.3 Habitat Assessment of the Study Area

Investigations for the habitat assessment comprised a site inspection, noting floral and faunal habitat types and features. Using this habitat assessment, and the known habitat preferences of the listed threatened flora and fauna species, a determination of the likelihood of occurrence of subject species was made. The factors investigated and assessed for the study area included:

Flora: - Type and Structure of Vegetation;
- Dominant Species;
- Subjective assessment of Floristic Diversity;
- Disturbance Regime, both past and ongoing
- Extent of Weed Invasion;
- Potential occurrence of Local Threatened and Significant Flora Species

Fauna: - Presence and Frequency of Large Mature Trees, Dead Trees and Hollow-bearing Trees;
- Height of Upper Strata
- Density of Shrub and Ground Cover;
- Presence of Fallen Timber and Rock Outcrops;
- Presence of Wet Areas or Waterbodies;
- Assessment of Previous and Present Land Use and Disturbance Regimes;
- Extent of Connectivity, Movement Corridors and Refugia;
- Presence of Critical Habitat Elements for Local Threatened Species;
- Searches for evidence of the presence of Threatened Species; and
- Fauna species diversity (all fauna observed or signs of fauna were recorded).

From these site assessments it was possible to:

- identify those parts of the study area that contain potentially significant habitats for threatened species and local biodiversity;
- determine if any areas of the subject site require detailed field survey;
- identify potential constraints from an ecological perspective within the study area; and

- generate a list of local and regional threatened species regarded as subject species.

Table 4. Summary of habitat features within the study area

Habitat Feature	Habitat Description
1) Overall Type and Structure of Vegetation	Cleared and levelled land.
2) Dominant Species	Exotic pasture grasses and herbaceous weeds. Also *Juncus* and *Cyperus*
3) Density of Shrub and Ground Cover	No shrub layer. 90% ground cover.
4) Geology	Sandy loam
5) Aspect and slope	The subject site lies on predominantly flat ground with drains collecting any runoff on the southern and western boundaries.
6) Presence of; Large Mature Trees (>50cms DBH), Dead Trees Hollow-bearing Trees Fallen Timber Rock Outcrops Wet Areas or Waterbodies	 No trees on the subject site (there is a row of small trees adjacent to the southern boundary) None None A couple of small logs. None Drains along the southern and western boundary. The drain along the southern boundary is approx. 1m wide and was dry at the time of the survey. The drain along the western boundary is wider, approx. 6m. This drain has a sandy floor and banks and contains vegetation including grass and reeds (e.g. Bullrush and Common Rush). Standing water was present at the time of survey. This drain also includes low concrete culverts under Kennington road. There are patchy wet areas across the site where there is more clay in the soil and therefore less drainage.
7) Extent of Weed Invasion	Moderate to high, due to the level of clearing.
8) Assessment of previous and present Land Use and Disturbance Regimes	The land has been completely cleared and levelled recently (likely within 12 months). The previous land use is unknown.
9) Extent of connectivity, movement corridors and refugia	The subject site does not form part of a movement corridor and represents poor quality habitat for refuge.

2.4 Determination of Local Threatened Flora and Fauna as Subject Species

Through an analysis of the known habitat requirements of local threatened flora and fauna species, in relation to the habitats present within the study area, a list of subject species has been compiled. Discussion of the potential impacts on these species as a result of the proposal is provided later in this report.

2.4.1 Threatened Flora

There is limited potential for locally-occurring threatened flora species to occur due to the high level of clearing. An assessment of the habitats on the site to support threatened flora species (*TSC Act* 1995) is presented in **Table 5** below.

Some of these threatened flora species therefore may need to be addressed via a 7-part test, if it is considered that there is still some possibility that they may occur following targeted field surveys.

Table 4. Assessment of the Potential for Local Threatened Flora Species to occur within the Study Area

Scientific Name	Latest Record	Records Within		Preferred Habitat and Comments*	Habitat available on site?	Potential to occur within study area	Subject Species
		10 km	2 km				
Callistemon linearifolius	2005	3	0	Moist Open forest on sandy to clayey soils on sandstone.	N	Unlikely	N
Cryptostylis hunteriana	-	-	-	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland.	Y	Unlikely – due to clearing	N
Eucalyptus camfieldii	2001	1	0	Ridgetops in heath on sandy soils over sandstone often of restricted drainage, loamy soils with coffee rock, low nutrients.	N	Unlikely	N
Eucalyptus Parramattensis subsp. decadens	2006	12	0	Generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant. In the Tomago Sandbeds area, the species is usually associated with the 'Tomago Swamp Woodland' as defined by NSW NPWS (2000b).	Y	Unlikely - due to clearing	N
Grevillea parviflora subsp. parviflora	-	-	-	Sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of aspects from flat, low-lying areas to upper slopes and ridge crests Often occurs in open, slightly disturbed sites such as along tracks.	N	Unlikely.	N
Persicaria elatior	-	-	-	This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	N	unlikely	N

Rulingia prostrata	2000	2	0	Scribbly Gum (Eucalyptus haemastoma)/ Swamp Mahogany (E. robusta) ecotonal forest at Tomago.	N	Unlikely	N

Table 4 continued

Scientific Name	Latest Record	Records Within		Preferred Habitat and Comments*	Habitat available on site?	Potential to occur within study area	Subject Species
		10 km	2.5 km				
Tetratheca juncea	2004	2	0	Usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heathland and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. While the species has a preference for cooler southerly aspects, it has been found on slopes with a variety of aspects. It generally prefers well-drained sites and occurs on ridges, although it has also been found on upper slopes, mid-slopes and occasionally in gullies.	N	unlikely	N
Zannichellia palustris	2006	4	0	Grows in fresh or slightly saline stationary or slowly flowing water.	N	unlikely	N
ROTAP Species							
Grevillea granulifera	1998	1	0	Granitic rocky areas	N	unlikely	
Macrozamia flexuosa	2004	3	0	Scattered in sclerophyll forests on siliceous soils.	N	unlikely	

*Note: ROTAP only species do not require assessment under legislation, hence are not eligible to be subject species.
Compiled from; Harden (1991, 1993, 2002); PlantNet; Robinson (2003)

2.4.2 Threatened Fauna

An assessment of the habitats on the site to support threatened fauna species (*TSC Act* 1995) is presented in **Table 5** below. Note that apart from those also listed as threatened, any migratory species likely to occur will be discussed in the EPBC Act assessment in **Section 4.3** of this report.

Table 5. Assessment of the Potential for Local Threatened Fauna Species to occur within the Study Area

Common Name	Most Recent Record	Closest Records		Preferred Habitat and Comments*	Habitat available on site			Potential to utilise study area	Subject Species
		10 km	2.5 km		Breeding	Roosting	Foraging		
Magpie Goose	2004	36	1	Tropical wetlands, floodplains, dams, irrigated crops. Grazes in shallow water, usually in large flocks. Also grazes in pasture and crops. Create a large floating nest on the water amongst emerging rushes or grasses. Only vagrants occur in the south.	N	N	N	Unlikely	N
Australasian Bittern	2002	12	0	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha spp*.) and spikerushes (*Eleoacharis spp.*). Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. Feeding platforms may be constructed over deeper water from reeds trampled by the bird; platforms are often littered with prey remains. Breeding occurs in summer from October to January; nests are built in secluded places in densely-vegetated wetlands on a platform of reeds.	N	N	N	Unlikely	N
Black Bittern	1999	1	0	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night. During the day, roosts in trees or on the ground amongst dense reeds. Generally solitary, but occurs in pairs during the breeding season, from December to March. Like other bitterns, but unlike most herons, nesting is solitary. Nests, built in spring are located on a branch overhanging water and consist of a bed of sticks and reeds on a base of larger sticks.	N	N	N	Unlikely	N
Black-necked Stork	2005	145	0	Inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water on a variety of prey including fish, frogs, eels, turtles, crabs and snakes. Breeds in late summer in the north, and early summer further south. A large nest, up to 2 m in diameter, is made in a live or dead tree, in or near a freshwater swamp.	N	N	N	Unlikely	N
Comb-crested Jacana	1990	6	0	Inhabits permanent wetlands with a good surface cover of floating vegetation, especially water-lilies. Pairs and family groups forage across floating vegetation. They feed primarily on insects and other invertebrates, as well as some seeds and other vegetation. Breeds in spring and summer in NSW, in a nest of floating vegetation.	N	N	N	Unlikely	N

Table 5. continued

Common Name	Most Recent Record	Closest Records		Preferred Habitat and Comments*	Habitat available on site			Potential to utilise study area	Subject Species
		10 km	2.5 km		Breeding	Roosting	Foraging		
Australian Painted Snipe	-	-	-	Permanent and temporary shallow inland and coastal wetlands (can be freshwater or brackish), particularly where there is a cover of vegetation. Individuals have been known to use artificial wetlands (such as sewage ponds, dams and water-logged grasslands.	N	N	N	Unlikely	N
Bush Stone-curlew	1999	7	0	Lightly-timbered open-forest or woodland often associated with Casuarina, eucalypts or Acacia; also dry open grassland and cropland with nearby cover.	N	N	N	Unlikely	N
Gang-gang Cockatoo	2004	3	0	Tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter it occurs in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. Requires hollow trees for nesting.	N	N	N	Unlikely	N
Glossy Black-Cockatoo	2004	4	1	Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black She-oak (Allocasuarina littoralis), Forest She-oak (A. torulosa) or Drooping She-oak (A. verticillata) occur. In the Riverina area, inhabits open woodlands dominated by Belah (Casuarina cristata). Feeds almost exclusively on the seeds of several species of she-oak (Casuarina and Allocasuarina species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites.	N	N	N	Unlikely	N
Blue-billed Duck	1987	4	0	The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached. Blue-billed Ducks will feed by day far from the shore, particularly if dense cover is available in the central parts of the wetland. They feed on the bottom of swamps eating seeds, buds, stems, leaves, fruit and small aquatic insects such as the larvae of midges, caddisflies and dragonflies. Blue-billed Ducks are partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer. Blue-billed Ducks usually nest solitarily in Cumbungi over deep water between September and February. They will also nest in trampled vegetation in Lignum, sedges or Spike-rushes, where a bowl-shaped nest is constructed.	N	N	N	Unlikely	N

Continued…

Table 5. continued

Common Name	Most Recent Record	Closest Records		Preferred Habitat and Comments*	Habitat available on site			Potential to utilise study area	Subject Species
		10 km	2.5 km		Breeding	Roosting	Foraging		
Freckled Duck	1986	20	0	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Generally rest in dense cover during the day, usually in deep water. Feed at dawn and dusk and at night on algae, seeds and vegetative parts of aquatic grasses and sedges and small invertebrates. Nesting usually occurs between October and December but can take place at other times when conditions are favourable. Nests are usually located in dense vegetation at or near water level.	N	N	N	Unlikely	N
Osprey	2005	7	0	Highly specialised fish catcher inhabiting coastal areas. Nests in trees, rocky outcrops, on the ground or in artificial towers (eg. electricity towers).	N	N	N	Unlikely	N
Black-breasted Buzzard	1990	1	0	Open woodlands and savannas. Rare visitor to the local region.	N	N	N	Unlikely	N
Square-tailed Kite	1993	2	0	Specialised canopy predator, feeding on small birds, eggs and insects. Primarily hunts over open forest, woodlands and mallee communities that are rich in passerines, as well as over adjacent heaths and other low scrubby habitats and in wooded towns. Appears to prefer a structurally diverse landscape.	N	N	N	Unlikely	N
White-bellied Sea-eagle	-	-	-	Inhabit areas near large bodies of water	N	N	N	Unlikely	N
Black-chinned Honeyeater	2004	3	0	Dry eucalypt savannah woodland and forest with an annual rainfall range of 400-700mm, particularly with box-ironbark associations and River Red Gums. Considered to be locally nomadic requiring remnants of greater than 200ha in area. Forages within foliage and bark of eucalypt trees on spiders, insects, lerp and nectar.	N	N	N	Unlikely	N
Regent Honeyeater	-	-	-	Box-ironbark eucalypt associations, though uses other woodland types and wet lowland coastal forest in times of food shortage. The wandering nature of this species makes it difficult to assess. Known to frequent areas with densely blossoming winter-flowering trees (eg. Spotted Gum, Red Iron bark, Forest Red Gum and Swamp Mahogany) on an opportunistic basis along the coast and ranges of NSW.	N	N	N	Unlikely	N
Swift Parrot	2003	5	0	The migratory nature of this species makes them difficult to assess. Known to frequent sclerophyll forest and woodlands with winter flowering trees (eg. Spotted Gum, Red Iron bark, *Eucalyptus crebra* and *E. siderophloia*, Forest Red Gum and Swamp Mahogany) on an opportunistic basis along the coast and ranges of NSW	N	N	N	Unlikely	N

Continued….

Table 5. continued

Common Name	Most Recent Record	Closest Records		Preferred Habitat and Comments*	Habitat available on site			Potential to utilise study area	Subject Species
		10 km	2.5 km		Breeding	Roosting	Foraging		
Turquoise Parrot	2004	4	0	Open eucalypt woodland or forest with a grassy or sparsely shrubby understorey. Favours grasslands on the edge of these habitat types, particularly timbered grassland on mountain slopes and ridges. Feeds on seeds of native and introduced grasses and other herbs. Requires suitable hollows in tree limbs, logs or fence posts for breeding. Usually seen in pairs or small, possibly family groups and have also been reported in flocks of up to thirty individuals.	N	N	N	Unlikely	N
Grey-crowned Babbler	2006	7	0	Open eucalypt woodlands with a grassy groundcover and sparse, tall shrub layer. May also be observed along streams in cleared areas and grassy road verges. Conspicuous large communal nests/roosts are constructed out of twigs. Raucous groups of 2-13 individuals foraging for insects in all substrates.	N	N	N	Unlikely	N
Barking Owl	1998	1	0	Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as Acacia and Casuarina species, or the dense clumps of canopy leaves in large Eucalypts. Feeds on a variety of prey, with invertebrates predominant for most of the year, and birds and mammals such as smaller gliders, possums, rodents and rabbits becoming important during breeding. Live alone or in pairs. Territories range from 30 to 200 hectares and birds are present all year. Three eggs are laid in nests in hollows of large, old eucalypts.	N	N	N	Unlikely	N
Powerful Owl	2006	11	0	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine *Syncarpia glomulifera*, Black She-oak *Allocasuarina littoralis*, Blackwood *Acacia melanoxylon*, Rough-barked Apple *Angorphora floribunda*, Cherry Ballart *Exocarpus cupressiformis* and a number of eucalypt species. The main prey items are medium-sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider. There may be marked regional differences in the prey taken by Powerful Owls. For example in southern NSW, Ringtail Possum make up the bulk of prey in the lowland or coastal habitat. At higher elevations, such as the tableland forests, the Greater Glider may	N	N	N	Unlikely	N

Continued….

Table 5. continued

Common Name	Most Recent Record	Closest Records		Preferred Habitat and Comments*	Habitat available on site			Potential to utilise study area	Subject Species
		10 km	2.5 km		Breeding	Roosting	Foraging		
Powerful Owl *continued….*				constitute almost all of the prey for a pair of Powerful Owls. As most prey species require hollows and a shrub layer, these are important habitat components for the owl. Pairs of Powerful Owls are believed to have high fidelity to a small number of hollow-bearing nest trees and will defend a large home range of 400-1450 ha. Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old. During the breeding season, the male Powerful Owl roosts in a "grove" of up to 20-30 trees, situated within 100-200 metres of the nest tree where the female shelters.					
Masked Owl	2004	6	1	Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	N	N	N	Unlikely	N
Grass Owl	-	-	-	Open areas with a dense cover of tall grass. Often in swampy areas. Also heaths, cane grass, sugar cane and mangrove margins.	N	N	Y	Low	N
Wompoo Fruit-Dove	1996	1	0	Lowland rainforest that provides fleshy fruit resources. Rare incidental visitor to the local region.	N	N	N	Unlikely	N
Superb Fruit-dove	1973	1	0	Forest or rainforest with fleshy fruit resources. Rare incidental visitor to the local region.	N	N	N	Unlikely	N
White-throated Needletail	-	-	-	High open spaces of sky above all habitat types.	N	N	Y	Moderate –fly over	N
Rainbow Bee-eater	-	-	-	Migrate throughout mainland from northern Australia in September to April. Occurring in woodland, open forest, semi-arid scrub, grasslands and timbered plains, avoiding dense forest. Pursue flying insects. Nest in ground tunnels.	N	N	N	Unlikely	N
Black-faced Monarch	-	-	-	Rainforests, mangroves and adjacent eucalypt woodlands	N	N	N	Unlikely	N
Rufous Fantail	-	-	-	Rainforest, wet eucalypt forest, paperbark and mangrove swamps, also riverside vegetation. Will use more open habitats when migrating.	N	N	N	Unlikely	N
Large-eared Pied Bat	2004	1	0	Range of well-wooded habitats, including dry sclerophyll forests and woodlands of coastal and semi-arid areas. Occasionally in sub-alpine woodlands and at the edge of rainforest and semi-arid areas. Reliant on suitable roosting habitat including caves and mine tunnels (though may use other structures, eg. abandoned Fairy Martin nests).	N	N	N	Unlikely	N

Table 5. continued

Common Name	Most Recent Record	Closest Records		Preferred Habitat and Comments*	Habitat available on site			Potential to utilise study area	Subject Species
		10 km	2.5 km		Breeding	Roosting	Foraging		
Eastern False Pipistrelle	2000	2	0	Tall forest, woodland or heath/ grassland edges. Roosts in hollow trunk of the largest trees and sometimes buildings.	N	N	Y	Low	N
Little Bentwing-bat	2005	27	1	Forages in a range of habitats, including forest, woodland, heath, coastal swamps and rainforest. A nightly foraging range of 20km from roost sites has been reported. Reliant on suitable roosting habitat in caves and mine tunnels, though has been recorded roosting in hollowed out tree bases and dense foliage.	N	N	Y	Moderate	Y
Eastern Bentwing-bat	2005	22	0	Forages within a variety of habitat types including moist and dry eucalypt forest, woodland, rainforest, heath and open environments, including urban areas. Reliant on suitable roosting/breeding habitat in caves and mine tunnels, though will also roost in stormwater channels, road culverts and other comparable structures (including buildings). Estimated nightly foraging range of 20 kilometres.	N	N	Y	Moderate	Y
Eastern Freetail-bat	2004	12	1	The habitat preference of this species is unclear. It has been predominantly recorded in dry eucalypt forest and woodland, but has been recorded in moist and edge environments. The wing morphology indicates that this species is adapted to the more open habitats. This species primarily roosts in tree hollows, although the roofs of buildings are also used.	N	N	Y	Moderate	Y
Large-footed Myotis	2004	9	0	Habitats adjacent to large bodies of water for hunting aquatic insects. Usually forages over or adjacent to water-bodies and associated terrestrial habitats. Roosts in caves, mines, tunnels, bridges, culverts and tree hollows.	N	N	N	Unlikely	N
Yellow-bellied Sheathtail-bat	2003	3	0	Wide range of habitats, including open forest. Forages above the canopy in wooded areas and lower down in more open areas or along creeklines. Reliant on suitable trees with hollows for roosting.	N	N	Y	Moderate	Y
Greater Broad-nosed Bat	2005	9	1	Forages for insects over a range of natural and altered habitats, including tall forest, woodland or heath/grassland edges, often along the tree line boundary. Prefers tree hollows in large, often isolated, mature trees for roosting. Usually associated with tall moist open forest.	N	N	Y	Moderate	Y
Grey-headed Flying-fox	2006	21	1	Regularly occurs along the eastern coastal plain through NSW. Roosts in camps, usually in dense riparian habitats. At dusk disperses in search of the preferred food source, mainly Eucalypt blossom and rainforest fruits. Long distances are covered (30+km) in search of food.	N	N	N	Moderate – fly over only	N

Continued….

Table 5. continued

Common Name	Most Recent Record	Closest Records		Preferred Habitat and Comments*	Habitat available on site			Potential to utilise study area	Subject Species
		10 km	2.5 km		Breeding	Roosting	Foraging		
Koala	2006	1305	68	Forest and woodland habitats that contain suitable regional eucalypt feed trees. In the locality, the Forest Red Gum, Grey Gum and Scribbly Gum are listed food trees in SEPP 44.	N	N	N	Unlikely	N
Squirrel Glider	2005	20	1	Usually inhabits dry open sclerophyll forest and woodlands, but has also been observed in moist regenerating forest and moist gullies. Forages on Acacia gum, Eucalypt sap, nectar, honeydew, manna invertebrates and pollen, utilising areas with an abundance of flowering eucalypts and tall shrubs (eg. Banksias). Acacia species are the preferred sap feeding trees. This species requires an abundance of suitably sized hollow-bearing trees.	N	N	N	Unlikely	N
Brush-tailed Phascogale	1992	5	0	Nest in hollow trees. Use dry sclerophyll forests and woodlands, with a preference for sparse ground cover.	N	N	N	Unlikely	N
Spotted-tailed Quoll	-	-	-	Inhabits a variety of habitat types from moist and wet sclerophyll through to dry forests and woodlands on the edge of open grasslands. Requires large hollow logs on the ground for den.	N	N	N	Unlikely	N
Brush-tailed Rock-wallaby	-	-	-	In more recent years this Rock-wallaby appears to have become restricted to rock outcrops containing suitable caves and tunnels or very dense undergrowth to provide shelter.	N	N	N	Unlikely	N
Long-nosed Potoroo	-	-	-	Coastal heath and dry and wet sclerophyll forests - relatively thick ground cover is essential and it prefers areas with light, sandy soils.	N	N	N	Unlikely	N
Stuttering Frog	-	-	-	Terrestrial inhabitants of rainforest, Antarctic Beech or wet sclerophyll forest along permanent streams.	N	N	N	Unlikely	N
Southern (Giant) Barred Frog	-	-	-	Giant Barred Frogs forage and live amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m. They breed around shallow, flowing rocky streams from late spring to summer. Females lay eggs onto moist creek banks or rocks above water level, from where tadpoles drop into the water when hatched. Tadpoles grow to a length of 80 mm and take up to 14 months before changing into frogs. When not breeding the frogs disperse hundreds of metres away from streams. They feed primarily on large insects and spiders.	N	N	N	Unlikely	N
Wallum Froglet	2003	1	0	Sedge, vegetated swamps or wet heath	N	N	N	Unlikely	N

Continued….

Table 5 continued

Common Name	Most Recent Record	Closest Records		Preferred Habitat and Comments*	Habitat available on site			Potential to utilise study area	Subject Species
		10 km	2.5 km		Breeding	Roosting	Foraging		
Littlejohn's Tree Frog	-	-	-	It occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops. It hunts either in shrubs or on the ground. Breeding is triggered by heavy rain and can occur from late winter to autumn, but is most likely to occur in spring when conditions are favourable. Eggs are laid in loose gelatinous masses attached to small submerged twigs. Eggs and tadpoles are mostly found in slow flowing pools that receive extended exposure to sunlight, but will also use temporary isolated pools.	N	N	N	Unlikely	N
Green and Golden Bell Frog	2006	708	0	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (Typha spp.) or spikerushes (Eleocharis spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (Gambusia holbrooki), have a grassy area nearby and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney region occur in highly disturbed areas. The species is active by day and usually breeds in summer when conditions are warm and wet. Males call while floating in water and females produce a raft of eggs that initially float before settling to the bottom, often amongst vegetation. Tadpoles feed on algae and other plant-matter; adults eat mainly insects, but also other frogs. Preyed upon by various wading birds and snakes.	N	N	N	Unlikely	N

*****Compiled from: Churchill, 1998; Cogger ,1975; Higgins, 1999; Higgins et al., 2001; Slater et al., 1998; Morcombe, 2000;DEC, 2006 ; Strahan, 1995.
√ likely to occur and therefore a potential subject species.

Tables 4 and 5 detail information regarding the habitat requirements of the threatened flora and fauna species that have previously been recorded in the locality or have distributional ranges that incorporate the study area and have been recorded in similar habitat types. The information provided determines the potential for each species to occur within the habitats of the actual subject site and immediately surrounding lands potentially affected by the proposal. This information was used to guide field survey work and to assist the preparation of the 7-part test of significance of impact on threatened species. In this regard no threatened flora species but five (5) threatened insectivorous bat species, (all listed as vulnerable in the NSW TSC Act), are considered to potentially use the subject site for foraging purposes. These comprise the **Little Bent-wing Bat**, **Eastern Bent-wing Bat**, **Eastern Freetail Bat**, **Greater Broad-nosed Bat** and **Yellow-bellied Sheathtail Bat**.

3.0 SECOND STAGE ECOLOGICAL INVESTIGATION – FIELD SURVEYS

3.1 Floral Investigations

3.1.1 Methodology

Flora field surveys were undertaken within the entire study area on 29th of May 2007.

Due to the limited size of the site, its cleared nature and the limited quantity of natural vegetation present, the following survey methodology was adopted.

- A general traverse on foot throughout the entire study area to assess the range of floristic variation, vegetation structure, extent of modification, disturbance, weed invasion and condition of the vegetation generally. The vegetated edge areas of the site were examined most thoroughly;
- A targeted search for threatened flora species within the study area. A random meander is regarded as the most efficient method for detection of most threatened flora species (Cropper 1993).

Small samples of any plant species that could not be identified in the field were obtained for further examination and identification, particularly any species that may be threatened or significant.

3.1.2 Flora Survey Results

Vegetation Communities

Only one highly modified / artificial vegetation community type occurs within the study area: **Cleared weedy grassland.** No shrub or tree layer remains on the site and the ground cover consists mainly of introduced grasses and herbaceous weeds. Two common native ground covers, *Cyperus polystachyos* and *Juncus usitatus* were widespread and common across the site.

There is a row of native trees (*Casuarina glauca* and *Melaleuca quinquenervia*) adjacent to the southern boundary. Under these trees are introduced weedy shrubs, including Cassia, Lantana, Wild Tabacco and Blackberry.

Floral Diversity

Flora diversity in the study area was found to be low, with only 23 species from 12 families identified. This included 13 dicotyledons and 10 monocotyledons. Of the total species recorded, 18 species of introduced and/ or planted flora were identified, representing 78% of the total species. This percentage is expected to be higher, as little effort was contributed to identifying exotic weeds.

A list of all flora species recorded and identified from within the study area is included as **Appendix 1.**

Condition of the Vegetation and Presence of Weeds

The vegetation is in very poor condition with such a high level of clearing and weed invasion.

Two of the species recorded in the study area are declared Noxious in the Port Stephens Control Area. These, together with their relevant control classes, are:

- Blackberry (*Rubus fruticosus*) – Class 4
- Lantana (*Lantana camara*) – Class 5

Explanations of the relevant control categories area as follows:

Class 4: The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority. A control plan for Blackberry prepared by Port Stephens Council can be found on the Port Stephens Council Website. The plant may not be sold, propagated or knowingly distributed.

Class 5: The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with. The plants must not be purchased, sold or moved without permit.

Classes 1, 2 and 5 are notifiable plants. To report new outbreaks of notifiable noxious weeds, contact: Weeds Hotline 1800 680 244 or email: weeds@dpi.nsw.gov.au (NSW Department of Primary Industries).

None of the noxious weeds were present at high abundance within the study area. A small occurrence of Lantana and Blackberry was present amongst the narrow strip of vegetation along the Southern boundary. Land Owners are expected to act on the requirements in the Noxious Weeds Act in regard to any listed Noxious Weeds on the Property.

Threatened or Significant Flora Species

No threatened flora species were recorded within the study area during the field survey. Due to the disturbed / cleared nature of the site it is possible to say that these species do not presently occur on the subject site.

Endangered Ecological Communities and Locally Significant Vegetation Communities

No endangered or locally significant communities were considered to occur in the study area.

None of the vegetation communities listed as potentially nationally significant, state significant or regionally significant in the *Port Stephens Council Comprehensive State of the Environment Report* (Port Stephens Council 2004), occur within the study area.

Overall Significance of the Vegetation

The overall significance of the vegetation on the site is considered to be poor, with little natural vegetation present and a low regeneration potential with such a high presence of introduced weeds.

3.2 Faunal Investigations

3.2.1 Methodology

This has involved fauna habitat assessment and targeted searches for the subject threatened fauna species, within any suitable habitat in the proposed development area. All fauna species observed, or identified from evidence, were recorded during field inspections on 29th May 2007.

Given the disturbed nature and lack of natural vegetation over the subject site, survey techniques were limited to the following:

Habitat assessment
Spotlighting (frogs)
Call playback (Grass Owl)
Ultrasonic bat call analysis

All opportunistic sightings of fauna species and evidence of species presence through the identification of tracks, trails and faecal pellets were recorded during all site activities.

Ultrasonic Bat Call Detection

Two Anabat II detectors (Titley Electronics, Ballina, NSW) was used to collect ultrasonic calls of the bat species using the site. Bats emit ultrasonic calls as a method of navigating and searching for food. These calls are often at a higher frequency than calls audible to the human ear. In order to make the calls audible, bat detectors convert the call to a lower frequency. The detectors were connected to a ZCAIM with a CFC card reader and were used to sample the first hour after dusk on the 29th of May 2007. The detectors were placed on the ground at a 45^0 angle. All recorded calls were later analysed with a computer package Anabat V.6.3g, to identify the species recorded. Ultrasonic call detectors have proved useful for recording species that are difficult to capture. However, owing to variations in call strength and frequency within and between species and the difficulty in identifying short or poor quality calls, the identity of species recorded by bat detector cannot always be guaranteed. Some bats are difficult to detect due to their quiet calls (e.g. *Nyctophilus* sp., *Kerivoula papuensis*) and bats with extremely similar calls are sometimes difficult to differentiate (e.g. *Miniopterus schreibersii* and *Vespadelus darlingtoni*). Therefore, bat detectors cannot always provide positive species identification.

Nocturnal Call Playback

The playback of pre-recorded calls of the Grass Owl were carried out on the 29th of May 2007. Following an initial listening period of 15 minutes, each species call was played (amplified by the use of a loud hailer) for a total of 5 minutes, followed by a 5 minute listening period, with the last listening period followed by 5 minutes of spotlighting.

Spotlighting

Spotlighting was undertaken for all small, medium and large-sized mammals and nocturnal birds, reptiles and frogs within the study area. Spotlighting was conducted on foot by two observers on 29th of May, 2007.

Weather Conditions

Weather conditions were considered moderate for a bat and frog survey as the weather was cooling by late May. On the 29th of May 2007 there was moderate wind, no rain, 3/8 cloud and 3/4 moon.

3.2.2 Results

A total of eight (8) definite and a further two (2) probable fauna species were recorded during the field surveys, comprising three (3) bird, three (3) definite and two (2) probable mammal and two (2) frog species.

Two common birds, the Australian Raven and Black-shouldered Kite typically capable of utilising the open habitats of the site were recorded during the field surveys. The Superb Blue Wren was recorded in the shrubbery adjacent to the southern boundary of the site.

Faecal pellets of the Red-necked Wallaby and Grey Kangaroo were observed on site. Individuals would visit to forage on grasses, however there is no suitable sheltering habitat.

Bat activity was low. Definite calls (3 passes) of the Greater Broad-nosed Bat *Scoteanax rueppellii* were recorded on the site. Probable calls of *Mormopterus sp.2* (1 pass) and Gould's Wattled Bat *Chalinolobus gouldii* (1 pass) were also recorded, but not clear enough for a definite identification.

Two frog species, the Common Eastern Toadlet *Crinia signifera* (10+ individuals) and the Broad-palmed Frog *Litoria latopalmata* (1 sub adult) were recorded in the drain along the western boundary.

A list of the fauna recorded within the study area during this survey is presented in Appendix 2.

Additional birds, terrestrial small mammals and reptiles expected to use open grassland habitats may also occur at times (e.g. the introduced Black Rat *Rattus rattus* and House Mouse *Mus musculus*).

4.0 ASSESSMENT OF THE ECOLOGICAL IMPACTS OF THE PROPOSAL

4.1 Overview of Potential Impacts Associated with the Current Proposal

The potential impacts on local native flora and fauna as a result of the current proposal are considered to be minimal in the study area, due to the highly disturbed and modified nature of the site. With no shrub or tree layer and minimal native vegetation remaining in the ground cover potential habitat for most of the threatened species no longer exists. Prior to any clearing the natural vegetation in the study area would have provided suitable habitat for a wide variety of flora and fauna species including some of those that are threatened.

No threatened flora species were detected on the site, nor is it considered likely that any would occur.

Potential foraging habitat is available for the five insectivorous bat species that will forage in open areas, including the Greater Broad-nosed Bat, Eastern Freetail Bat, Yellow-bellied Sheathtail Bat and the Eastern and Little Bentwing bats. Positive ultrasonic calls of at least one foraging Greater Broad-nosed Bat were recorded during the field survey. None of these bat species would roost or breed in the study area. These bats are also known to forage in a wide range of habitats and have relatively large home-range sizes. Although it is considered unlikely that a significant impact would occur on any of the predicted species, a 7-part test under the provisions of Section 5A of the *Environmental Planning & Assessment Act 1979,* (*EP&A Act*), has been addressed below.

4.2 Threatened Species Assessment (Section 5A of the EP&A Act 1979)

The *Threatened Species Conservation Act*, (TSC Act), was gazetted in late 1995 and aims to conserve threatened species, populations and ecological communities of animals and plants. Specific objectives of the *Act* are to: -

a) conserve biological diversity and promote ecologically sustainable development;

b) prevent the extinction and promote the recovery of threatened species, populations and ecological communities that are endangered;

c) protect critical habitat of those threatened species, populations and ecological communities;

d) eliminate or manage certain processes that threaten the survival or evolutionary development of those threatened species, populations and ecological communities;

e) ensure that the impact of threatening actions are properly assessed; and

f) encourage the conservation of threatened species, populations and ecological communities by the adoption of measures involving co-operative management.

Section 5A of the *Environmental Planning & Assessment Act 1979*, (EP&A Act), aims to improve the standard of consideration and protection afforded to threatened species, populations and communities, and their habitats in the planning process. The outcome of any threatened species assessment should be that developments and activities are undertaken in an environmentally sensitive manner, and that appropriate measures are undertaken to minimise adverse effects on threatened species or their habitats.

Under the *Threatened Species Conservation Amendment Act 2002*, Section 5A of the *EP&A Act* has been amended. This has also affected the *TSC Act 1995* and the *Fisheries Management Act 1994*. An essential outcome of the amendments is that as of late 2005, the previous "eight-part test" has been replaced with a set of revised factors now known as the "seven-part test".

The basic intent of the revised factors remains the same, the main change in emphasis being more towards impacts and losses at the local rather than the regional level. Additionally, recovery planning and threat abatement planning is explicitly considered in one of the factors. As with the previous eight-part test, the seven-part test should not be treated as a "pass or fail" test, but rather as a tool to assist in determining whether further assessment (such as a Species Impact Statement) might need to be undertaken.

Determining authorities have an obligation under the *EP&A Act* to consider whether a proposal is likely to significantly affect threatened species, populations or ecological communities, or their habitats. In this regard, the determining authority must take into account the seven-part test.

Seven-part tests for threatened fauna species are presented below.

4.2.1 Threatened Flora

No threatened flora species were detected within the study area, and none are considered likely to occur, therefore no further assessment on threatened flora is required.

4.2.2 Endangered Ecological Communities

No Endangered Ecological Communities are considered to occur within the study area. Therefore, no further assessment of EECs is required.

4.2.3 Threatened Fauna

Only one threatened fauna species, the Greater Broad-nosed Bat, has been recorded on the subject site, but potential foraging habitat for a further four threatened bat species, all listed as vulnerable on the TSC Act, is considered to be present within the area to be affected by the current proposal and surrounding land.

Species to be assessed are as follows:

Greater Broad-nosed Bat	*Scoteanax rueppellii*
East Coast Free-tail Bat	*Mormopterus norfolkensis*
Large-eared Pied Bat	*Chalinolobus dwyeri*
Eastern Bent-wing Bat	*Miniopterus schreibersii oceanensis*
Little Bent-wing Bat	*Miniopterus australis*

Seven-part Test of Significance

(a) ***in the case of a threatened species, whether the action proposed is likely to have an adverse affect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.***

The habitat on site is only suitable for foraging purposes for all five bat species. The Bent-wing Bats roost in caves, tunnels, mines and culverts. The Eastern Freetail Bat, Greater Broad-nosed Bat and Yellow-bellied Sheathtail Bat are tree hollow roosting species.

These species have relatively large foraging ranges and will seek prey in a wide range of habitat types. Due to the lack of vegetative structure and complexity the available insectivorous prey is likely to be reduced, and therefore the value of the subject site is considered to be low. The Greater Broad-nosed Bat recorded on the site, may have been foraging or simply using the area to traverse from one foraging area to another. If foraging, it is most likely that the Greater Broad-nosed Bat would find prey nearer to the row of trees adjacent to the southern boundary.

It is considered unlikely that the life cycle of these species would be disrupted such that any viable local population will be placed at risk of extinction.

(b) ***in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species likely to be placed at risk of extinction.***

Not Applicable

(c) ***in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

- **(i)** ***is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or***
- **(ii)** ***is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.***

Not Applicable

(d) ***in relation to the habitat of a threatened species, population or ecological community:***

- **(i)** ***the extent to which habitat is likely to be removed or modified as a result of the action proposed, and***
- **(ii)** ***whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and***
- **(iii)** ***the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.***

(i) the bats will still be able to forage over the site post construction, however there may be a slight reduction in available prey, due the loss of ground cover as a result of construction.

(ii) No habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposal. Although the construction of a fence would restrict movement by larger terrestrial fauna across the site.

(iii) The small amount of sub-optimal potential foraging habitat to be removed as a result of the proposal is considered highly unlikely to impact the long-term survival of any local population of a threatened species.

(e) ***whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).***

No areas of designated critical habitat so far identified under the provisions of the *Threatened Species Conservation Act* 1995 apply to the study area.

(f) ***whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan***

No draft recovery plans have been written for the five subject species. None of the current threat abatement plans are relevant to this proposal and site.

(g) ***whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.***

None of the Key Threatening Processes are relevant to the subject site and these five bat species. Therefore the proposal is not expected to significantly increase the incidence of the designated threatening processes listed on Schedule 3 of the *TSC Act*.

Conclusions from the seven-part test for fauna: It is considered that the impact of the proposal on these five bat species, including the Greater Broad-nosed Bat that was recorded using the site, is likely to be negligible. This is due to the current condition (very poor) of the site and immediately surrounding area.

4.3 Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act was gazetted in 2000 and replaced several earlier Commonwealth statutes. This Act focuses Commonwealth interests on matters of national environmental significance including integrated biodiversity conservation and the management of important protected areas. The Act also establishes a streamlined environmental assessment and approvals process.

The matters of national environmental significance (NES) as identified in the Act which require assessment and approval to be addressed by the Commonwealth include:

- World Heritage properties
- National Heritage places
- Ramsar wetlands
- Nationally threatened species and ecological communities (Part 13, Division 1, Subdivision A of the EPBC Act)
- Migratory species
- Commonwealth Marine areas
- Nuclear actions (including uranium mining)

The assessment and approval process applies to any action that has, will have or is likely to have a significant impact on a matter of NES. An 'action' is defined as a project, development, undertaking or an activity or series of activities.

The only matters of NES that could be relevant in the case of the proposed action are nationally threatened species and migratory species. The relevant criteria given in the administrative guidelines for the Act to determine whether the action will or is likely to have a significant impact on a nationally threatened species are as follows:

Critically endangered and endangered species

Criteria

An action has, will have, or is likely to have a significant impact on a critically endangered or endangered species if it does, will, or is likely to:

- lead to a long-term decrease in the size of a population, or
- reduce the area of occupancy of the species, or

- fragment an existing population into two or more populations, or
- adversely affect habitat critical to the survival of a species, or
- disrupt the breeding cycle of a population, or
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*, or
- interfere with the recovery of the species.

** Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a critically endangered or endangered species by direct competition, modification of habitat, or predation.*

Vulnerable species

Criteria

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

- lead to a long-term decrease in the size of an important population of a species, or
- reduce the area of occupancy of an important population, or
- fragment an existing important population into two or more populations, or
- adversely affect habitat critical to the survival of a species, or
- disrupt the breeding cycle of an important population[#], or
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- result in invasive species that are harmful a vulnerable species becoming established in the vulnerable species' habitat*, or
- interferes substantially with the recovery of the species.

[#]An important population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

- *key source populations either for breeding or dispersal,*
- *populations that are necessary for maintaining genetic diversity, and/or*
- *populations that are near the limit of the species range.*

**Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a vulnerable species by direct competition, modification of habitat, or predation.*

Threatened Flora

None of the nationally-listed flora species under the EPBC Act were found within the study area, and none are expected to occur. None of the threatened ecological communities listed under the EPBC Act occur within the study area.

Threatened and Migratory Fauna

None of the nationally-listed fauna species under the EPBC Act were found within the study area, and none are expected to occur

No other Matters of NES or other matters protected by the EPBC Act are directly relevant to the study area. Therefore the specific assessment process under the provisions of the *EPBC Act* 1999 is not required for the proposed Asphalt Plant, since it does not constitute an action that is likely to have an impact on any Matter of National Environmental Significance.

4.4 Port Stephens Council Comprehensive Koala Plan of Management (CKPoM)

The Port Stephens Council CKPoM has been prepared in accordance with the framework of SEPP 44 – Koala Habitat Protection and has been approved by Council and the Director General of the

Department of Planning. Therefore the CKPoM now supersedes the requirements of SEPP 44 and compliance with the CKPoM only is now required.

Guidelines for Koala habitat assessments are given in Appendix 6 of the CKPoM and the results the assessments carried out at the study site are provided below.

The following steps are given in the CKPoM as the minimum acceptable approach for a Koala habitat assessment in the Port Stephens LGA.

1. Preliminary Assessment

The subject site is not mapped as Koala habitat, a habitat link or a habitat buffer in the CKPoM.

On inspection of the site, it is clear that it does not contain any koala habitat or act as a suitable link or buffer. Therefore no further action (i.e. vegetation mapping, koala habitat identification and CKPoM assessment of the proposal) is required.

5.0 CONCLUSIONS

An assessment of the potential effects on flora and fauna of the proposed asphalt plant at Kennington Road, Tomago has been made based on a combination of literature review, field habitat assessment and targeted field surveys. The subject site has been cleared and levelled and is currently devoid of trees and shrubs. There is a ground cover consisting of mainly introduced grasses and herbaceous weeds.

The information resulting from the investigation has been used to address the requirements of Section 5A of the *Environmental Planning and Assessment Act 1979* and the *Environment Protection and Biodiversity Conservation Act 1999.*

No threatened flora species or Endangered Ecological Communities were identified on site. It is considered unlikely that any of the threatened species previously recorded in the locality would occur in the study area.

Calls of the Greater Broad-nosed Bat (listed as Vulnerable on the TSC Act) were recorded on the site. It is also possible that four other Vulnerable insectivorous bats may forage in the study area, including the Eastern Freetail Bat, Yellow-bellied Sheathtail Bat, Eastern Bent-wing Bat and Little Bent-wing Bat. It was concluded that the potential impacts caused by the proposal would likely be negligible to these five bat species, as they are wide-ranging, foraging in a variety of habitat and there is no roosting habitat on or immediately adjacent to the subject site. Furthermore the habitat currently provided by the site in sub-optimal.

None of the species listed in the EPBC Act are considered likely to use the subject site. No Koala habitat is present in the study area therefore the Port Stephens Council Comprehensive Koala Plan of Management does not apply to the site.

6.0 RECOMMENDATIONS

The proposed development is considered unlikely to result in adverse effects on the overall biodiversity of the area due to the disturbed nature of the subject site and the relatively small area of land involved. However, in order to ameliorate the impacts from the proposed construction works and improve the quality of the existing vegetation to be retained outside of the development area, the following recommendations are provided:

- Remove any Lantana, Blackberry and other environmental weeds throughout the property.

- Locally indigenous tree and shrub species should be used preferentially in any landscaped areas associated with the proposal.

7.0 REFERENCES

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Appendix 1. Flora Species Recorded in the Study Area

The following is a list of all flora species recorded within the study area. Please note that this list may be not fully comprehensive, and should be regarded as an indication of the flora present. A period of some years is often needed to identify all species present in an area, particularly for cryptic or seasonally detectable species (such as orchids and small grass-like herbs).

Notes:

* indicates an exotic or introduced native species

Nomenclature follows Harden (1990, 1992, 1993, 2002), Harden & Murray (2000) and subsequent recent revisions.

CLASS MAGNOLIOPSIDA (Flowering Plants)

Subclass Magnoliidae (Dicotyledons)

ASTERACEAE	
*Ambrosia tenuifolia**	Lacy Ragweed
Conyza sp.*	Fleabane
*Senecio madagascariensis**	Fire Weed
*Taraxacum officinale**	Dandelion
CASUARINACEAE	
Casuarina glauca (off-site)	Swamp Oak
FABACEAE - Subfamily Caesalpinoideae	
*Senna pendula** (off-site)	Cassia
FABACEAE - Subfamily Faboideae	
Vicia sativa subsp. *nigra**	Narrow-leaved Vetch
MYRTACEAE	
Melaleuca quinquenervia (off-site)	Broad-leaved Paperbark
POLYGONACEAE	
Persicaria decipiens	Slender Knotweed
ROSACEAE	
Rubus fruticosus species aggregate* (off-site)	Blackberry
SOLANACEAE	
*Solanum mauritianum** (off-site)	Wild Tobacco Tree
VERBENACEAE	
*Lantana camara** (off-site)	Lantana
*Verbena bonariensis**	Purpletop

Subclass Liliidae (Monocotyledons)

CYPERACEAE	
Cyperus polystachyos	-
JUNCACEAE	
Juncus usitatus	Common Rush
POACEAE	
*Chloris gayana**	Rhodes Grass
*Cynodon dactylon**	Couch
*Eragrostis tenuifolia**	Elastic Grass
*Melinis repens**	Red Natal Grass

*Paspalum urvillei**	Tall Paspalum / Vasey Grass
*Pennisetum clandestinum**	Kikuyu
*Setaria gracilis**	Slender Pigeon Grass
*Triticum aestivum**	Common Wheat/Bread Wheat

TYPHACEAE

Typha orientalis	Bullrush/Cumbungi

Appendix 2. Fauna recorded within the Study Area

Notes:

AMG reference for site

Map Grid 56 Easting 379000 Northing 6369000 Accuracy 500m

* indicates introduced species (not native to the area)
Bold indicates a threatened species
V - Vulnerable, E – Endangered, M- Migratory

Observation types:

O	observed	W	Heard	H	Hair, feathers or skin
F	tracks/scratchings	P	scat	E	Nest/roost
T	Trapped or netted	Y	Bone or teeth	Z	In raptor/owl pellet
K	Dead	X	In scat	R	Road kill
M	Miscellaneous	U	Ultrasonic call	d	Definite identification
p	Probable identification				

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Number of individuals	Observation type	NPWS code
	Mammals					
Family: *MACROPODIDAE*						
Macropus giganteus	Eastern Grey Kangaroo				P	1265
Macropus rufogriseus	Red-necked Wallaby				P	1261
Family: *MOLOSSIDAE*						
Mormopterus sp. 2 (Adams et al)	A Freetail-bat				Up	1049
Family: *VESPERTILIONIDAE*						
Chalinolobus gouldii	Gould's Wattled Bat				Up	1349
Scoteanax rueppellii	**Greater Broad-nosed Bat**	**V**			**Ud**	**1361**
	Frogs					
Family: *MYOBATRACHIDAE*						
Crinia signifera	Common Eastern Froglet			10+	W	3134
Family: *HYLIDAE*						
Litoria latopalmata	Broad-palmed Frog			1	O	3191
	Birds					
Family: *ACCIPITRIDAE*						
Elanus axillaris	Black-shouldered Kite			1	O	0232
Family: *MALURIDAE*						
Malurus cyaneus	Superb Fairy-wren				O/W	0529
Family: *CORVIDAE*						
Corvus coronoides	Australian Raven				O	0930

Appendix 3. Project Personnel and Relevant Licenses

REPORT COMPONENT	STUDY TEAM MEMBERS	QUALIFICATIONS
Flora identification	Stefan Rose	B.Sc (Biol. Sci), M.Env.Stud., MAIBiol, MECA
Fauna and Flora Field Surveys, Analysis of Bat Detector Tapes	Narawan Williams	TAFE Cert II (Conserv. & Land Mgt. Nat. Area Rest.)
Literature Review, Report Writing, Flora and Fauna Field Survey and Assessment.	Amy Rowles	B.Sc (Hons)

Relevant licences held by Ecotone Ecological Consultants

TYPE	FOR	LICENCE NO	NAME	DATE VALID TO	ORGANISATION	LOCATION
Animal Research Authority	Vertebrate Fauna Surveys	AW94/082	Brian Wilson	15 Nov 2007	Animal care and ethics committee of the Director-General of NSW Agriculture	NSW
Certificate of Approval	Vertebrate Fauna Surveys	DG's ACEC 94/082	Brian Wilson	15 Nov 2008		
Licence to	Access NPWS Wildlife Atlas Data Base	CON93002	Brian Wilson	30 June 2007	NSW Department of Environment and Conservation	
Scientific Licence	Harm/ trap/ release: protected fauna; pick/ hold: native flora	S10555	Brian Wilson Stefan Rose Jenny Lewis Amy Williams Narawan Williams Anne Williams	30 June 2007		
	As above plus bat banding	S10556	Ray Williams	31 Aug 2007		